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COMPLICATED PREGNANCY IN THE EXPERIENCE OF EMS TEAMS

RISK OF CARDIOVASCULAR COMPLICATIONS OF SARS-COV-2

POLYTRAUMA WITH PELVIC FRACTURE

ORAL CORROSIVE POISONING

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ORIGINAL ARTICLE

PRIORITIES AND OVERARCHING GOALS IN THE DIAGNOSIS AND EMERGENCY TREATMENT OF PATIENTS WITH SUSPECTED ECTOPIC PREGNANCY – RETROSPECTIVE STUDY

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ABSTRACT

Aim: Analysis of priorities in the emergency treatment of patients with ectopic pregnancy who are in a life-threatening condition. Observation of differences in the course of treatment depending on belonging to the age group.

Material and methods: The study included 68 patients of the Gynaecological and Obstetric Specialist Hospital. E. Szczeklik in Tarnów, Małopolskie Voivodeship, who were diagnosed with ectopic pregnancy. The patients were divided into two groups according to age, counting 34 people in both cases.The study was retrospective and concerned patients hospitalized in the period 27.01.2016–01.08.2022.

Results: The length of hospital stay due to ectopic pregnancy is not significantly longer in patients under 30 years of age compared to patients over 30 years of age. No significant relationship was observed between the patient's age and the stage of pregnancy in which health collapse occurs and the need for medical intervention in connection with ectopic pregnancy occurs. Ectopic pregnancies are most often localized in the right fallopian tube. No significant differences between age groups were shown in laboratory tests of hCG, WBC, RGB, HGB, HCT, PLT levels. The most common treatment in both groups was surgical resection of the ruptured fallopian tube. No statistically significant differences were found between age groups and treatment.

Conclusions: Ectopic pregnancy is a dangerous clinical situation for pregnant women regardless of their age. The intensity of haemorrhage as a result of rupture at the site of implantation of the embryo, assessed on the basis of laboratory tests, is comparable in both patients before and after 30 years of age.

KEY WORDS

ectopic pregnancy, emergency treatment, dyspnoea

INTRODUCTION

Abdominal pregnancy (Latin - graviditas extrauterine) is otherwise known as ectopic pregnancy. It is a clinical situation in which the blastocyst is implanted outside the physiological site of the endometrium. It is assumed that this situation is statistically rare, as it occurs in a total of 1–2% of all pregnancies developing abnormally. When an ectopic pregnancy occurs statistically as much as 96% it is located within the fallopian tubes, and in the remaining sites it covers 1. 3–4% of cases. This applies to the abdomen, uterine and caesarean scars, cervix and other areas of the ovary [1, 2]. Among the most common symptoms requiring urgent diagnosis is sudden severe abdominal pain with accompanying bleeding from the genital tract, as a pathological symptom of concern requiring immediate medical consultation. It is estimated that the risk of death of a pregnant patient is about 4% taking into account all deaths associated with the pathology of pregnancy [3, 4]. Based on the observations described in the literature, the occurrence of ectopic pregnancy increases the risk of ectopic pregnancy, especially within the same fallopian tube. Deaths associated with the development of ectopic pregnancy occur in about 4% of cases and are mostly due to shock caused by massive bleeding from the birth canal [4]. The diagnostic problem of ectopic pregnancies compared to ovarian pregnancies is a different rate of increase of human chorionic gonadotropin (hCG). In abdominal pregnancies, hCG increases at a rate comparable to normal pregnancy, while the rate of increase in hCG levels in fallopian pregnancy is unnaturally higher with respect to the week of pregnancy [5]. Life-threatening clinical situations among patients suspected of having an ectopic pregnancy correlate with a rapidly deteriorating general condition and therefore need to be treated interventional. One method of surgical intervention is

a laparotomy involving removal of the pregnancy follicle and, if necessary, resection involving removal of the entire fallopian tube. This should be especially the case with cardiovascular and respiratory instability caused by massive bleeding into the abdomen. Stable cases of non-sustaining ectopic pregnancy can be treated pharmacologically with Methotrexate [6].

DIAGNOSTIC POSSIBILITIES USING ULTRASOUND

Appropriate criteria are used for the diagnosis of ectopic pregnancy, of which the presence of an ectopic vesicle with a yolk sac is important. In addition, an embryo with or without heart contracture can be seen, with the primary heart beginning contracture on the 22nd day of fetal life [7,8]. Other predictive values include the presence of a ring in the appendages, a complex mass in the appendages separated from the ovary, temporal cyst and the presence of a pseudo-bladder in the endometrium [9]. The presence of a moderate to significant amount of fluid in ultrasound is also of key importance [10]. An important element in the diagnosis of ectopic pregnancy is the distinction between the fallopian mass and the occurrence of ovarian cysts. It is helpful to differentiate the lower echogenicity of the corpus luteum wall compared to the wall of the fallopian ring associated with ectopic pregnancy and to the echogenicity of the endometrium [9, 10]. However, caution should be exercised in the interpretation of the ultrasound result, since the physiological ultrasound image of the pelvis does not exclude the development of an ectopic pregnancy. There are cases where pathological masses and fluid are not visible in recto-uterine pouch, and yet ectopic pregnancy has developed, which has been verified by an abnormal increase in hCG levels [10, 11]. An important method in the early diagnosis of ectopic pregnancy is considered to be ultrasound examination in the option of dopler imaging. In the described case, the development of ectopic pregnancy was identified using the above-mentioned method, which was not possible in the diagnosis undertaken by standard ultrasound imaging [12].

THE AIM

Research hypotheses:

1. Is there a difference in the length of hospitalization of patients up to 30 years of age (group 1) and over 30 years of age (group 2)?
2. Is there a difference in the extent of the week in which the health breakdown occurs and the need for medical intervention divided into group 1 and group 2?
3. Is ectopic pregnancy more often located in one of the fallopian tubes?
4. Are ectopic pregnant patients over 30 years of age (group 1) at the time of hospitalization due to worrying symptoms more significant deviations from the norm in the qualitative and quantitative assessment of peripheral blood counts and hCG levels than in patients under 30 years of age (group 2)?
5. Is there a difference in rescue treatment depending on age group 1 or 2?

MATERIAL AND METHODS

The study included 68 patients of the Gynaecological and Obstetric Specialist Hospital E. Szczeklik in Tarnów, Małopolskie Voivodeship, who were diagnosed with ectopic pregnancy. The patients were divided into two groups according to age, counting 34 people in both cases. The first of them included women under 30 years of age, while the second women over 30 years of age. The study was retrospective and concerned patients hospitalized in the period 27.01.2016 – 01.08.2022. The analyzed information was obtained from medical records of hospital treatment. The variables analysed included age, length of hospitalisation, week of gestation, location site, hCG, WBC level, RBC level, HGB level, HCT level, PLT level, and type of treatment administered. The statistical analysis was carried out using the PQStat program.

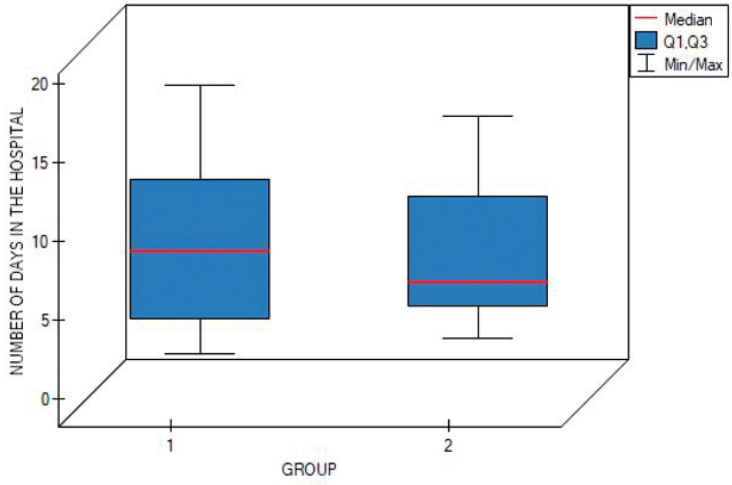
RESULTS

There are the following questions:

1. Is there a difference in the length of hospitalization of patients from the age groups up to 30 years old and over 30 years old?
   The results present figure 1.
2. Does the week in which the health breakdown occurs and the need for intervention depend on the patient's age?
   The results present figure 2.
3. Is an ectopic pregnancy more likely to be located in one of the fallopian tubes?
   The answer results figure 3.
4. Do patients with ectopic pregnancy over 30 years of age at the time of hospitalization due to disturbing symptoms have more significant deviations from the norm in the qualitative and quantitative assessment of peripheral blood counts and hCG levels than in patients under 30 years of age?
   The results present table 1.
5. Is there a difference in the undertaken rescue treatment depending on the age of the patient?
   The results present figure 4.

DISCUSSION

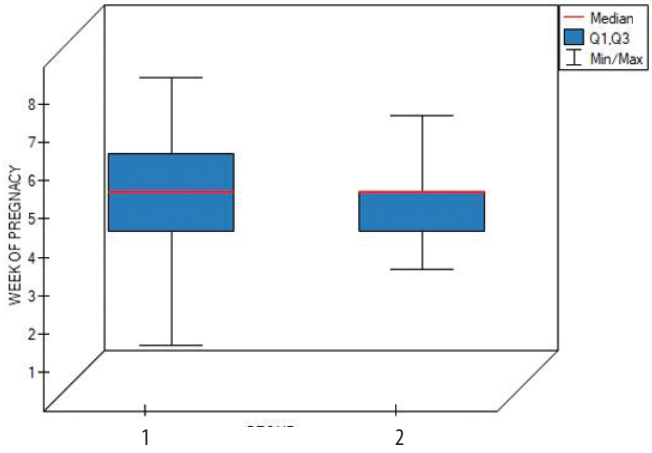
In the diagnosis of abdominal pain in women of childbearing age reporting to the Hospital Emergency Department (ED), it is worth considering the possibility of ectopic pregnancy. For this purpose, hCG level determination and abdominal ultrasound should be performed. As it turns out in the work of Hawrylyshyn K. et al., 40.2% of the study group, i.e. 221 patients, did not have an ultrasound examination during their stay in the emergency department. After leaving the ED, it turned out that 33% of the study group, i.e. 7.2% of the entire group of patients not subjected to ultrasound examination, were in ectopic pregnancy [13]. An important observation among patients who have a history of



Summary		
Group	1	2
Sample size	34	34
Median	7,5	5,5
Lower quartile	3,25	4
Upper quartile	12	11

Two sided p–value (asymptotic) **p= 0,348463**

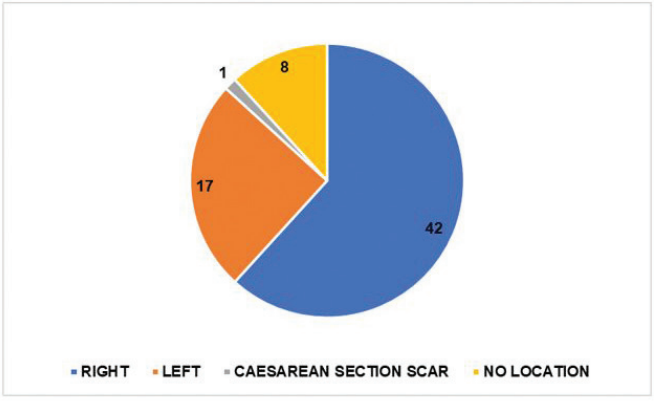
Fig. 1. The length of hospitalization of patients from the age groups up to 30 years old and over 30 years old.



Summary		
Group	1	2
Sample size	31	32
Median	5	5
Lower quartile	4	4
Upper quartile	6	5

Two sided p–value (asymptotic) **p= 0,620824**

Fig. 2. Week in which there is a breakdown of health and the need for intervention.



DATA	LOCATION			
GROUP	CAESAREAN SECTION SCAR	LEFT	RIGHT	TOTAL
1	0 (0%)	9 (31,03%)	20 (68,97%)	29
2	1 (3,22%)	8 (25,81%)	22 (70,97%)	31
TOTAL	1	17	42	

p–value=0,58

Fig. 3. Location of ectopic pregnancies.

Tab. 1. Values of morphological and biochemical parameters of blood laboratory tests.

hCG	GROUP		HGB	GROUP	
	1	2		1	2
MEDIAN	1342	921,2	MEDIAN	7,9	7,81
Two sided p-value (asymptotic)	0,146228		Two sided p-value (asymptotic)	0,910036	
WBC	**GROUP**		**HCT**	**GROUP**	
	1	2		1	2
MEDIAN	9,385	10,4	MEDIAN	0,37625	0,375
Two sided p-value (asymptotic)	0,205253		Two sided p-value (asymptotic)	0,572455	
RBC	**GROUP**		**PLT**	**GROUP**	
	1	2		1	2
MEDIAN	4,395	4,28	ARITHMETIC MEAN	260,44	282,3
Two sided p-value (asymptotic)	0,292057		p-value (Fisher-Snedecor)	0,214238	

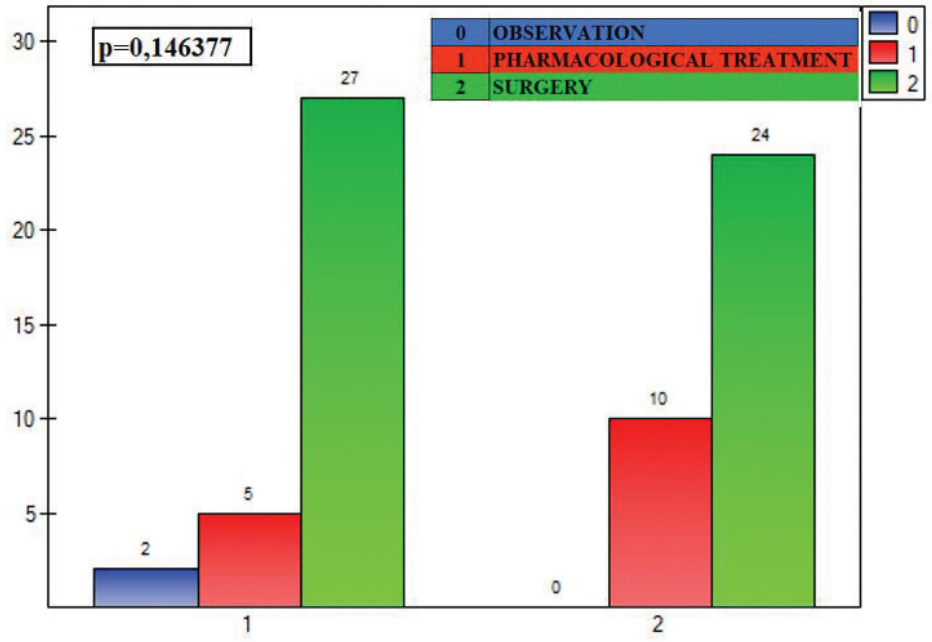


Fig. 4. Type of treatment used.

cesarean section in their medical history is the intensification of diagnostics towards the development of ectopic pregnancy in the scar after caesarean section. This is important because the development of pregnancy in this place may affect the inability to develop future pregnancies. This is related to damage to the uterine cavity at the site of an earlier cesarean section [14]. With regard to the literature, it can be concluded that the occurrence of ectopic pregnancy in the scar after caesarean section does not occur significantly often against the background of general statistics. However, there are also such situations, as Adams A. et al. mentions in one of his articles. Researchers emphasize that a significant factor in ectopic pregnancy may be too early pregnancy after a previous caesarean section. The clinical picture of patients with ruptured ectopic pregnancy in this case is not the same, and its course depends on the time of diagnosis and intervention. Also in this case, the initial abdominal pain and bleeding can lead to the development of hypovolemic shock. An important and useful diagnostic aspect in the location of a ruptured pregnancy of this type turned out to be the use of ultrasound examination with an additional Doppler option [14]. As a consensus of the above considerations, it should be stated that every patient with a history of disturbing symptoms indicating a potential risk of ectopic pregnancy should have a mandatory ultrasound examination correlating with monitoring the level of hCG and taking into account the clinical picture of the patient [15]. The significant impact of the use of ultrasound screening during admission to the emergency room is described in their article Poxon A. et. al. qualifying patients into 3 groups. The first is the highest priority group in which the time of surgical intervention should not exceed 2 hours from admission, because

patients are qualified as hemodynamically unstable. The other two groups concern hemodynamically stable patients, in whom a ruptured ectopic pregnancy does not cause a breakdown of vital signs. Such patients should be provided in the operating theatre within 2 to 8 hours. The observations made by the authors of this study conducted in a large academic center resulted in the classification of only 6 out of 73 hemodynamically unstable patients included in the study group. The remaining cases, i.e. 67 patients, were in the hemodynamically stable group. It turns out that excessive surgical haste in the case of hemodynamically stable patients was observed in 65.9% of stable cases, which was a statistically significant difference compared to the group of patients who should actually undergo surgery without time delays. Poor qualification to therapeutic groups and the associated time delays were caused by improper assessment of patients' condition and erroneous redirection within gynaecology specialists. The system of qualification of patients due to their hemodynamic stability requires improvement within this specialty [16].

CONCLUSIONS

1. The length of hospital stay due to ectopic pregnancy is not significantly longer in patients under 30 years of age compared to patients over 30 years of age.
2. No significant relationship was observed between the patient's age and the stage of pregnancy in which health collapse occurs and the need for medical intervention in connection with ectopic pregnancy occurs.
3. Ectopic pregnancies are most often localized in the right fallopian tube.
4. No significant differences between age groups were shown in laboratory tests of hCG, WBC, RGB, HGB, HCT, PLT levels.
5. The most common treatment in both groups was surgical resection of the ruptured fallopian tube. No statistically significant differences were found between age groups and treatment.

Ectopic pregnancy is a dangerous clinical situation for pregnant women regardless of their age. The intensity of haemorrhage as a result of rupture at the site of implantation of the embryo, assessed on the basis of laboratory tests, is comparable in both patients before and after 30 years of age. The treatment used in the vast majority consists of performing surgery regardless of age. Observations show that the most common place of localization of ectopic pregnancy is one of the fallopian tubes. Statistically, it was shown among the study group that this occurs more often in the right ovary, however, due to the limitations of the study, no relationship was found between location and other variables that could suggest an unambiguous cause of this condition. Attention was also drawn to the importance of ultrasound examination in diagnosing ectopic pregnancy using these criteria.

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ORIGINAL ARTICLE

COMPLICATED PREGNANCY IN THE EXPERIENCE OF EMERGENCY MEDICAL SERVICES TEAMS - HYPERTENSION

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ABSTRACT

Aim: To present the characteristics of Emergency Medical Services (EMS) team interventions in cases of women with a hypertensive disorder of pregnancy (HDP).

Material and methods: The study was based on a retrospective analysis of interventions by basic and specialist EMS teams in cases of pregnant women with a hypertensive disorder carried out between 1 January 2018 and 30 June 2021.

Results: Most of the women studied were pregnant for the first time (52.3%), in their III trimester (76.6%). The most commonly reported symptom was swelling (12.0%). The majority of interventions were carried out by a basic (only paramedics), two-person (55.0%) EMS team and were assigned urgency code 2 (65.8%). Emergency medical procedures most commonly provided by EMS teams to pregnant patients were pulse oximetry (95.5%) and blood pressure measurement (73.3%). Further management involved providing assistance to the pregnant patient and transferring her to hospital (94.7%). Basic EMS teams (only paramedics) were more likely than specialist EMS teams (with physician) to be dispatched to women with HDP who were in their second pregnancy (23.7%) and had no history of giving birth (53.5%). Most interventions by basic EMS teams (only paramedics) were assigned urgency code 2 (70.0%) and were carried out by a two-person EMS team (81.1%). The associations identified were statistically significant ($p<0.05$).

Conclusions: Further studies on out-of-hospital obstetric emergencies are necessary in order to gain a better understanding of the subject and ensure that EMS teams provide the best possible care to pregnant patients.

KEY WORDS

Emergency Medical Service, pregnancy, hypertension

INTRODUCTION

Cardiovascular disease is the leading cause of death among women and men worldwide. Certain cardiovascular risk factors are present at a younger age. However, cardiovascular disease develops on average 10-15 years later in women than in men. The early cardiovascular risk factors include hypertensive disorders of pregnancy, such as pregnancy-induced hypertension and pre-eclampsia [1].

Hypertensive disorders in pregnancy are divided into chronic hypertension (i.e. hypertension that is present before pregnancy or is diagnosed before 20 weeks of pregnancy and persists beyond six weeks postpartum), gestational hypertension, i.e. pregnancy-induced hypertension (i.e. hypertension which presents after 20 weeks of pregnancy and resolves within six weeks after delivery), and pre-eclampsia [2]. Hypertension during pregnancy is associated with a risk of complications such as pre-eclampsia, eclampsia, disseminated intravascular coagulation and HELLP syndrome (which is characterised by haemolysis, elevated liver enzymes as well as low platelet count), which are associated with a higher risk of death for the pregnant, labouring or postpartum patient and the foetus [2, 3]. It has also been found that after pregnancy women with HDP have a higher risk of classical cardiovascular risk factors, such as chronic hypertension, diabetes and reduced kidney function [1]. Therefore, hypertensive disorders in pregnancy are one of the major global health problems. They occur in up to 10 per cent of pregnancies and are a major challenge for healthcare and the public health sector [3-5].

It should be noted that complications can occur in all pregnancies, not only in those with risk factors. Hypertensive disorders in pregnancy and their possible complications constitute a threat to the life and health of the pregnant patient and the foetus [6]. EMS teams are a significant component of the Polish Emergency Medical Services system which is responsible for responding to health or life threatening emergencies and performing emergency medical procedures both on site and during transport to hospital, including in the case of pregnant women [7].

THE AIM

The aim of the study was to present the characteristics of interventions by Emergency Medical Services teams in cases of pregnant women with a hypertensive disorder.

MATERIAL AND METHODS

The study was based on a retrospective analysis of interventions by basic (only paramedics) and specialist (with physician) EMS teams concerning women with a

hypertensive disorder of pregnancy. The study covered the period between 1 January 2018 and 30 June 2021 and was carried out based on data from the database of Poland's National Monitoring Centre of Emergency Medical Services, which included Emergency Medical Services team dispatch records and emergency medical procedure records. An analysis of the documentation was carried out in order to obtain the following information: date and location of call, details of the pregnant patient, patient's clinical parameters, main diagnoses based on the International Statistical Classification of Diseases and Related Health Problems (ICD-10), emergency medical procedures performed as well as other characteristics of the intervention. The study included all cases that were classified by EMS team members under the following ICD-10 codes: O10, O11, O12, O13, O14, O15, O16, I10, I15. The exclusion criteria were as follows: cancellation of call, refusal of medical assistance, absence of the pregnant patient on site and data gaps in medical records. The study protocol was submitted to the Bioethics Committee at the Medical University of Warsaw, which confirmed that this study did not require consent due to its retrospective nature.

The data obtained from the analysis of the documentation were analysed statistically using the STATISTICA software, version 13.2 (Tibco Software Inc., Palo Alto, CA, United States). Quantitative data were reported using means (M) and standard deviations (SD), whereas qualitative data were described using numbers (n) and percentages (%). The normality of distribution of quantitative variables was tested using the Kolmogorov–Smirnov test and the Lilliefors test. The Chi2 test was used to analyse statistically significant differences between qualitative variables, and the non-parametric Mann–Whitney U-test was used to analyse differences between two independent groups. A level of significance of $p < 0.05$ was used in the study.

RESULTS

The mean age of the pregnant patients studied was 30.5 years. Most patients were pregnant for the first time (52.3%), in their third trimester (76.6%), and had not given birth before (53.3%). The most common symptom reported by the patients was swelling (12.0%) – (Table 1).

The statistical analysis carried out showed a statistically significant positive correlation between the age of the patients with HDP and the number of pregnancies and labours and found a statistically significant negative correlation between the age of the patients and gestational week ($p<0.05$) (Fig. 1).

Table 2 shows the characteristics of EMS team interventions concerning women with a hypertensive disorder of pregnancy. The largest number of interventions took place in 2018 (31.4%), in the winter (29.2%), on Tuesdays (16.3%). EMS teams were more often dispatched to urban areas (65.4%), in the Silesia Province, and most emergency calls were made from home (82.9%). Most interventions were carried out by a basic (only paramedics), two-person (55.0%) EMS team, between 6.59 PM and 7.00 AM (51.2%), and were assigned urgency code 2 (65.8%).

Emergency medical procedures most commonly provided by EMS teams to women with a hypertensive disorder of pregnancy were pulse oximetry (95.5%) and blood pressure measurement (73.3%). Further management involved providing assistance to the pregnant patient and transferring her to hospital (94.7%). Details concerning the emergency medical procedures performed, selected physical examination findings and further management are shown in Table 3.

The statistical analysis carried out showed that basic (only paramedics) EMS teams were more likely than specialist (with physician) EMS teams to be dispatched to women with HDP who were in their second pregnancy (23.7%) and had no history of giving birth (53.5%). Most interventions by basic EMS teams (only paramedics) were assigned urgency code 2 (70.0%) and were carried out by a two-person EMS team (81.1%). Most interventions in rural areas were carried out by a two-person EMS team (60.5%). The associations identified were statistically significant ($p<0.05$) and detailed data are shown in Table 4.

Table 1. Characteristics of the patients studied.

Age – M (SD)	30.5 (6.4)
Number of pregnancies – n (%)	
1st	337 (52.3)
2nd	137 (21.3)
3rd or subsequent	170 (26.4)
Number of labours – n (%)	
0	343 (53.3)
1-2	223 (34.6)
3 or more	78 (12.1)
Gestational week – n (%)	
1st trimester	47 (7.3)
2nd trimester	104 (16.1)
3rd trimester	493 (76.6)
Selected clinical symptoms – n (%)	
Swelling	77 (12.0)
Abdominal tenderness on palpation	57 (8.9)
Convulsions	46 (7.1)
Vomiting	43 (6.7)
Fainting	40 (6.2)
Diarrhoea	14 (2.2)

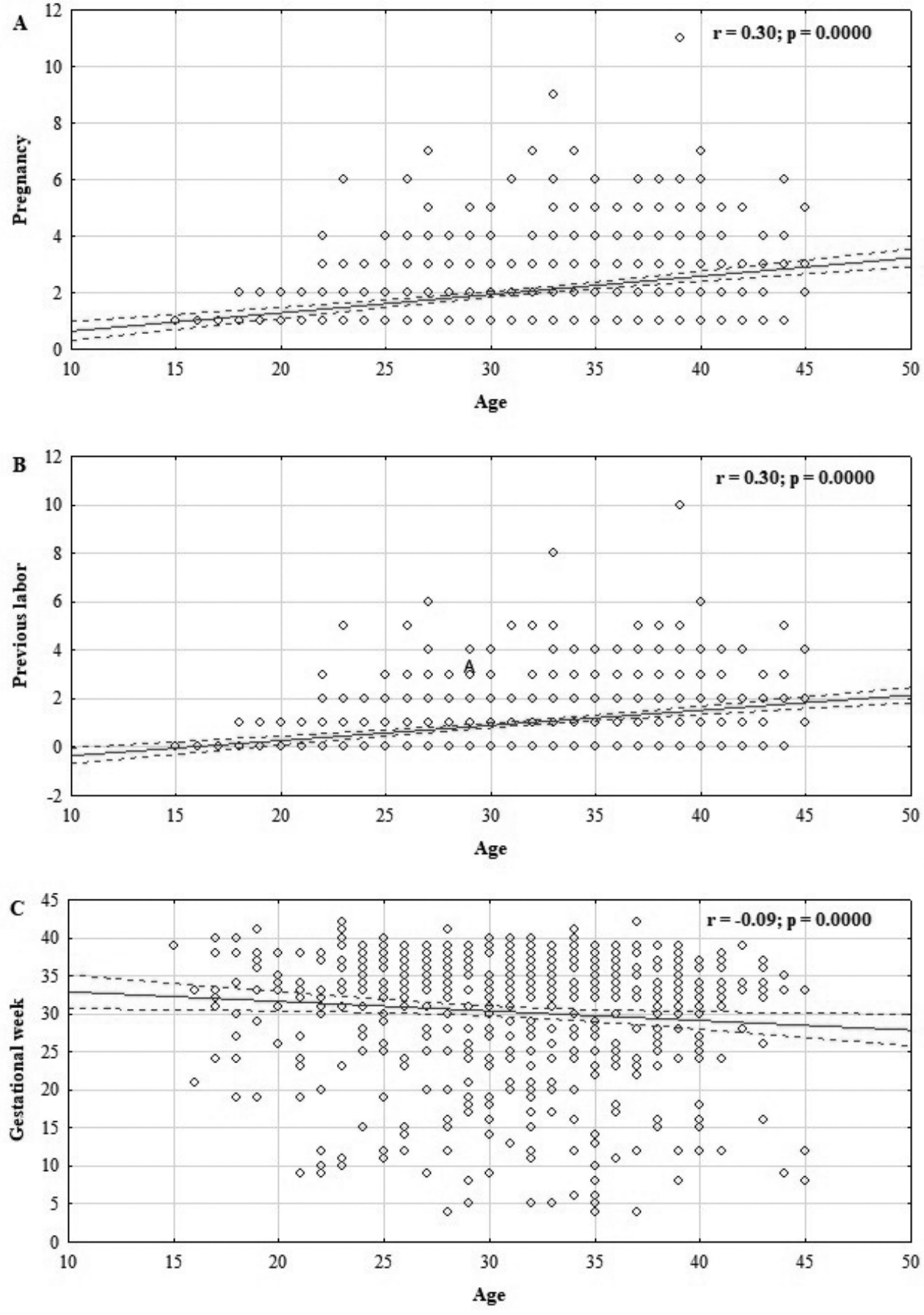

Fig. 1. Analysis of correlation between age and the number of pregnancies (A) and labours (B) and gestational week (C).

Table 2. Characteristics of EMS team interventions.

Year – n (%)	
2018	202 (31.4)
2019	179 (27.8)
2020	168 (26.1)
2021	95 (14.8)
Time of year – n (%)	**343 (53.3)**
Spring	176 (27.3)
Summer	133 (20.7)
Fall	147 (22.8)
Winter	188 (29.2)
Day of the week – n (%)	**104 (16.1)**
Monday	100 (15.5)
Tuesday	105 (16.3)
Wednesday	92 (14.3)
Thursday	82 (12.7)
Friday	93 (14.4)
Saturday	84 (13.0)
Sunday	88 (13.7)
Location of call – n (%)	**14 (2.2)**
Urban area	421 (65.4)
Rural area	223 (34.6)
Location of incident – n (%)	
Home	534 (82.9)
Public place	110 (17.1)
Province – n (%)	
Silesia Province	92 (14.3)
Mazovia Province	90 (14.0)
Lower Silesia Province	58 (9.0)
Małopolska Province	48 (7.5)
Pomerania Province	46 (7.1)
Kujawy-Pomerania Province	46 (7.1)
West Pomerania Province	38 (5.9)
Warmia-Masuria Province	34 (5.3)
Łódź Province	34 (5.3)
Wielkopolska Province	30 (4.7)
Lublin Province	30 (4.7)
Podkarpacie Province	28 (4.3)
Opole Province	25 (3.9)
Podlasie Province	16 (2.5)
Lubuskie Province	15 (2.3)
Świętokrzyskie Province	14 (2.2)
EMS team type – n (%)	
Basic (only paramedics)	417 (64.8)
Specialist (with physician)	227 (35.2)
EMS team composition – n (%)	
Two-person	354 (55.0)
Three-person	290 (45.0)
Urgency code – n (%)	
Code 1	220 (34.2)
Code 2	424 (65.8)
Time of call – n (%)	
7.00 AM - 6.59 PM	314 (48.8)
7.00 PM - 6.59 AM	330 (51.2)

DISCUSSION

A study by Togal et al. carried out in Turkey and a study by Oliveira carried out in Portugal found that hypertensive disorders of pregnancy were a major cause of obstetric admissions to intensive care units, which indicates that hypertensive disorders in pregnancy are an emergency that poses a threat to the life and health of women in the perinatal period [8, 9]. In their study, Togal et al. found that the nine patients admitted to ICU for obstetric reasons who did not survive had pre-eclampsia or eclampsia [8]. Freitas et al. carried out a study on the situation of pregnant women requiring emergency mobile care services in Brazil. The authors found that most of the pregnant women studied were aged between 18 and 35 years, multigravidas and in the third trimester of pregnancy. Our findings are similar to those from the aforementioned study by Freitas et al. [10].

It should be stressed that there are numerous factors predisposing to hypertensive disorders in pregnancy, including among others hypertension/pre-eclampsia in a previous pregnancy, significant family history (history of hypertension / pre-eclampsia in the patient's mother), chronic kidney disease, chronic hypertension, diabetes, being a primigravida, advanced maternal age and obesity [11-13]. The findings from our study showed that the number of pregnancies and labours increased with the age of the patients with HDP, whereas the mean duration of pregnancy / number of gestational weeks decreased with the age of the patients.

Numerous studies have been carried out into the multifaceted aspects of EMS team interventions [10, 14-16, 18]. Timler et al. analysed EMS team interventions in cases of patients aged over 65. They found that the number of EMS team interventions in the population studied was highest in the winter, between 6.00 AM and 10.00 PM [14]. Another study found that the larg-

est number of EMS team interventions concerning paediatric patients took place in the afternoon and in the spring [15]. A study by Andrzejewski et al. demonstrated that EMS teams were busiest between noon and 6.00 PM and were most often dispatched to urban areas [16]. Our present study found that the largest number of EMS team interventions in cases of pregnant women with a hypertensive disorder took place in the winter, at night, in urban areas, in the Silesia Province. It is important to stress that exposure to polluted air has been found to be associated with an increased risk of pregnancy-induced hypertension, as was indicated in a study by Pedersen et al. [17]. The findings from our study showed that most interventions in cases of women with HDP were carried out by a basic (only paramedics), two-person EMS team and were assigned urgency code 2 and that basic EMS teams (only paramedics) were more likely than specialist EMS teams (with physician) to be dispatched to women in their second pregnancy, with no history of giving birth or with 1 or 2 deliveries. Similarly, Andrzejewski et al. (2015) and Guła et al. (2014) found in their studies that basic EMS teams intervened more often compared with specialist EMS teams [16,18].

A study by Freitas et al. (2020) found that most of the pregnant patients studied who required emergency mobile care services in Brazil had a normal heart rate, normal oxygen saturation levels and normal respiratory frequency and had a GCS score of 13-15. However, one-fifth of the women studied had abnormal blood pressure [10]. Our findings are similar to those presented above. The antihypertensive treatment provided by EMS teams to patients with severe pre-eclampsia or eclampsia mainly consists of the intravenous administration of urapidil or, in the case of patients with co-existing pulmonary oedema / circulatory insufficiency, the intravenous administration of urapidil and furosemide, whereas the drug of choice used to treat and prevent convulsions is intravenous magnesium sulphate [19]. The findings from our study revealed that the drugs most commonly administered by EMS team members to pregnant women with a hypertensive disorder were magnesium sulphate and captopril (which is not indicated in pregnancy). In pregnant women, a BP ≥160/≥110 mmHg on several consecutive readings in a period of 15-30 minutes is an emergency requiring admission to hospital as well as the initiation of antihypertensive treatment within 60 minutes [2]. In our present study, the mean systolic blood pressure in the patients studied was 162 mmHg, and further management mainly consisted of providing assistance to the patient on site and transferring her to hospital. Similar patient management by EMS teams has been reported in the case of patients over 65 [14] and paediatric patients [15].

CONCLUSIONS

The mean age of the patients with a hypertensive disorder of pregnancy attended by EMS teams was 30 years. The majority of the patients were in their first pregnancy and in their third trimester.

Table 3. Characteristics of the emergency medical procedures performed by EMS teams, selected physical examination findings and further management of the pregnant patient.

Emergency medical procedures – n (%)	
Pulse oximetry	615 (95.5)
Blood pressure measurement	472 (73.3)
Blood glucose measurement	443 (68.8)
Monitoring	407 (63.2)
Intravenous cannulation	403 (62.6)
Physical examination	387 (60.1)
Neurological examination	174 (27.0)
Taking of medical history	171 (26.6)
Temperature measurement	170 (26.4)
ECG	139 (21.6)
Administration of intravenous medication	112 (17.4)
Administration of other medication	44 (6.8)
Gynaecological examination	20 (3.1)
Medication administered – n (%)	
NaCl 0.9%	74 (11.5)
$MgSO_4$	82 (12.7)
Captopril	45 (7.0)
Other	72 (11.2)
Selected physical examination findings	
Respiratory rate (breaths per minute) – M (SD)	16.9 (7.9)
Saturation (%) – M (SD)	97.7 (1.6)
Heart rate (beats per minute) – M (SD)	99.3 (18.5)
Systolic blood pressure (mmHg) – M (SD)	161.9 (24.7)
Diastolic blood pressure (mmHg) – M (SD)	96.3 (15.3)
Mean arterial pressure (MAP) (mmHg) – M (SD)	129.2 (18.5)
GCS score – M (SD)	14.9 (0.5)
RTS score – M (SD)	12.0 (0.2)
Blood glucose – M (SD)	108.2 (22.9)
Further management – n (%)	
Assistance was provided and the patient was transferred to hospital	610 (94.7)
The patient was left in place	34 (5.3)

EMS teams were more often dispatched in the winter, in urban areas, in the Silesia Province. Most interventions were carried out at night, by a basic (only paramedics), two-person EMS team, and were assigned urgency code 2.

Further studies on out-of-hospital obstetric emergencies are necessary in order to gain a better understanding of the subject and ensure that EMS teams provide the best possible care to pregnant patients.

Table 4. Analysis of associations between EMS team type and location of call and selected variables.

Variables	EMS team type		p-value	Location of call		p-value
	Basic (only paramedics)	Specialist (with physician)		Urban area	Rural area	
Age – M (SD)	30.6 (6.94)	30.5 (6.51)	0.9229	30.6 (6.4)	30.4 (6.6)	0.8545
Number of pregnancies – n (%)						
1st	218 (52.3)	119 (52.4)		215 (51.1)	122 (54.7)	
2nd	99 (23.7)	38 (16.7)	0.0496	89 (21.1)	48 (21.5)	0.5290
3rd or subsequent	100 (24.0)	70 (30.8)		117 (27.8)	53 (23.8)	
Number of labours – n (%)						
0	223 (53.5)	120 (52.9)		219 (52.0)	124 (55.6)	
1-2	153 (36.7)	70 (30.8)	0.0380	147 (34.9)	76 (34.1)	0.5242
3 or more	41 (9.8)	37 (16.3)		55 (13.1)	23 (10.3)	
Trimester – n (%)						
1st	37 (8.9)	10 (4.4)		30 (7.1)	17 (7.6)	
2nd	65 (15.6)	39 (17.2)	0.1103	74 (17.6)	30 (13.5)	0.3994
3rd	315 (75.5)	178 (78.4)		317 (75.3)	176 (78.9)	
Time of call – n (%)						
7.00 AM - 6.59 PM	199 (47.7)	115 (50.7)	0.4759	213 (50.6)	101 (45.3)	0.2003
7.00 PM - 6.59 AM	218 (52.3)	112 (49.3)		208 (49.4)	122 (54.7)	
Location of call – n (%)						
Urban area	266 (63.2)	151 (67.7)	0.2523	-	-	
Rural area	155 (36.8)	72 (32.3)		-	-	
Urgency code – n (%)						
Code 1	125 (23.0)	95 (41.9)	0.0024	143 (34.0)	77 (34.5)	0.8862
Code 2	292 (70.0)	132 (58.1)		278 (66.0)	146 (65.5)	
EMS team composition – n (%)						
Two-person	338 (81.1)	16 (7.1)	0.0000	219 (52.0)	135 (60.5)	0.0387
Three-person	79 (18.9)	211 (92.9)		202 (48.0)	88 (39.5)	
Further management – n (%)						
Assistance was provided and the patient was transferred to hospital	397 (95.2)	213 (93.8)	0.4572	398 (94.5)	212 (95.1)	0.7746
The patient was left in place	20 (4.8)	14 (6.2)		23 (5.5)	11 (4.9)	

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CONFLICT OF INTEREST

The Authors declare no conflict of intertest.

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ORIGINAL ARTICLE

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COMPARISON OF AIRTRAQ® LARYNGOSCOPE WITH SMARTPHONE CAMERA ADAPTER *VS.* MACINTOSH LARYNGOSCOPE FOR ENDOTRACHEAL INTUBATION PERFORMED BY OPERATORS WITHOUT CLINICAL EXPERIENCE – A RANDOMISED, CONTROL MANIKIN STUDY

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ABSTRACT

Aim: Difficult or failed tracheal intubation is a well-known cause of morbidity and mortality associated with anesthesia and emergency medicine. The aim of the presented study was to evaluate the laryngoscopes AirTraq, AirTraq with phone camera adapter and Macintosh in simulated conditions when used by people without clinical experience.

Material and methods: A total of 32 students of medical direction were qualified for the study. The tested laryngoscopes were evaluated in terms of the effectiveness and time of endotracheal intubation procedure. In each scenario, participants had up to three attempts to intubate with each laryngoscope. The AirTraq was previously unknown to the study participants. In total, 288 endotracheal intubation attempts were evaluated.

Results: The overall number of successful intubations with the AirTraq was 96 (100%), for the AirTraq with smartphone adapter 96 (100%) and with the Macintosh classic laryngoscope 88 (91%). The median time of endotracheal intubation was 28,3 seconds for the Macintosh laryngoscope, 16,4 seconds for AirTraq and 17,6 second for the AirTraq with smartphone adapter. Intubation performed with the AirTraq was shorter by 11.9 seconds in comparison with Macintosh laryngoscope and intubation performed with the use of camera-guided AirTraq was shorter by 10,7 seconds in comparison with Macintosh.

Conclusions: The study shows that AirTraq and AirTraq with smartphone adapter are the most useful devices, combining high efficiency with a statistically significant reduction in time between successive attempts compared with Macintosh classic laryngoscope.

KEY WORDS

endotracheal intubation, optical AirTraq laryngoscope, smartphone adapter, Macintosh classic laryngoscope, novice operators

INTRODUCTION

Endotracheal intubation (EI) performed in direct laryngoscopy (DL) is one of several available options for airway management strategy in emergency medicine. Alternatives to EI include supraglottic devices (SGD) devices including as most popular the i-gel, LMA and laryngeal tube. Compared with SGD, successful EI enables better protection of airways against possible complications related to stomach regurgitation, while at the same time offering ventilatory characteristics that are worldwide considered as the gold standard of instrumental airway management strategy [1].

The basic device used for EI is a classic laryngoscope with a Macintosh blade (MCL). Nowadays, other devices such as video laryngoscopes (VL) are increasingly used in emergency medicine. The Airtraq optical laryngoscope (ATL) is a device that can be used both as an optical laryngoscope and as a smartphone-assisted video laryngoscope.

The ATL is classified as a laryngoscope equipped with hyperangulated blade shape. During EI procedure, the operator is watching patient's airways through the ocular placed at the proximal end of the laryngoscope. The system of mirrors inside the device enables observation of the entrance to the larynx (Fig. 1). The basic version of the ATL has a channel for the endotracheal tube (ET) on the right side of the device. In order to use the classic ATL as a video guided laryngoscope, operator uses a specially dedicated smarthphone camera adapter, which in this modified technique serves as a VL camera (Fig. 2).

Intubation using a laryngoscope with Macintosh blade is a difficult technique to master and requires fifty attempts to achieve a >90% efficiency [2]. However, due to the appearance of modern laryngoscopes such as

ATL, it seems that operators with no clinical experience can also perform successful intubation.

THE AIM

Our objective was to assess and compare the time and effectiveness of EI attempts performed by students without clinical experience using optical modified ATL and MCL on manikin model.

MATERIAL AND METHODS

TRIAL DESIGN

This was a prospective randomised controlled study with three groups conducted with enrolled students from June 2022 to December 2022. Thirty two students of Medical Direction took part in the study. In total, 288 EI attempts were evaluated.

STUDY SETTINGS

The study received a positive opinion of the Bioethics Committee of the Medical University of Lodz. Decision number: RNN/175/20/KE. A total of 32 students of 4th year of Medical Direction at Medical University of Lodz were qualified for the study.

ALLOCATION AND RANDOMISATION

A total of 32 students were assessed for eligibility to be included in the trial.

Students were randomly allocated to the three groups of evaluated devices. After each EI attempt allocation within groups was performed. All student who were randomised received the assigned intervention. Due to the limitation of the manuscript length we skipped randomisation figure.

TRIAL INTERVENTIONS

All student participated in a 30-min training course before starting the study. At the end of the main training, study participants had 10 min to familiarize themselves individually with all laryngoscopes under normal airway conditions on Laerdal Airway Management Trainer placed on the table in a neutral position. In the study, each participant performed EI using three laryngoscopes in a single airway scenario. Participants were randomized to start with one of three devices. In each scenario, participants had up to three attempts to intubate with each laryngoscope. The ATL was previously unknown to the study participants.

OUTCOMES

The intubation time was recorded by a stopwatch and was counted from the moment the student selected the appropriate ET size and clearly communicated readiness to open the airway while holding the assessed device in his hand. The total time of insertion of the ET into the trachea was assessed. Successful intubation was verified by performing effective bag-valve-mask (BVM) ventilations. BVM with a volume of 1500 ml was used during ventilations.

Correct placement of ET and effective ventilation was considered as the final stage of airway management. Timeout (90 seconds), esophageal intubation, laryngoscope or ET withdrawal were counted as failed attempts.

STATISTICAL ANALYSIS

Statistical analysis of collected data was performed using STATISTICA ver. 13.6 (Statsoft, Poland). Between-group comparisons of continuous variables were performed using the parametric Student's t-test for independent variables. The significance level of 0.05 was assumed in the study. This means that the results for which $p < 0.05$ were statistically significant.

Fig. 1. AirTraq optical laryngoscope, canal version (own source).

Fig. 2. Smartphone camera adapter for the AirTraq optical laryngoscope (own source).

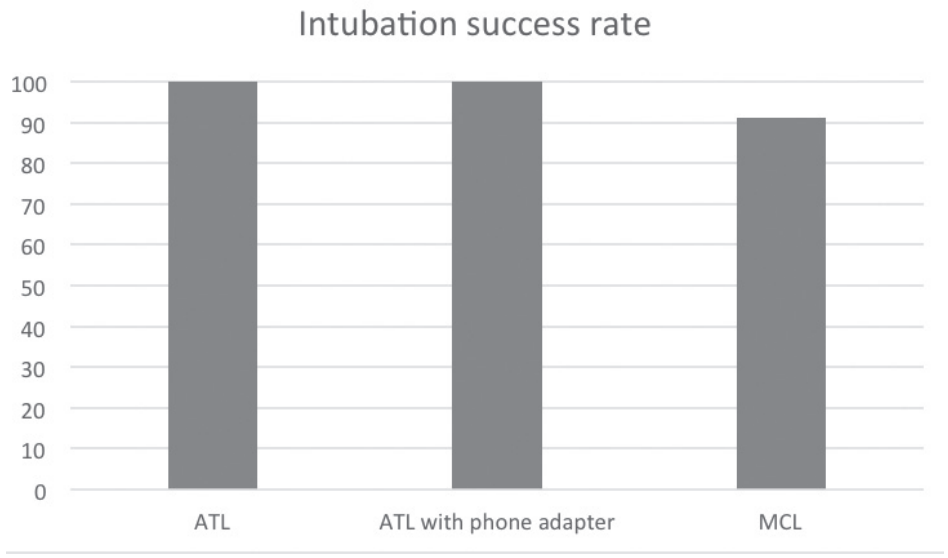

Fig. 3. Overall intubation efficiency in all groups.

Table 1. Descriptive statistics for intubation time using three types of laryngoscopes.

	Laryngoscopes			Student's t-test comparison		
Device	MCL	ATL	ATL with adapter	MCL *vs.* ATL	MCL *vs.* ATL with adapter	ATL *vs.* ATL with adapter
Time (sec)	28,3 ±19,6*	16,4 ±7,7	17,6 ±8,9	p<0,05	p<0,05	p>0,05

*Average values±SD

Table 2. Descriptive statistics for intubation time in three attempts for all laryngoscopes.

	Laryngoscopes		
Time (sec)	MCL	ATL	ATL with adapter
1st Attempt	29,4 ±23,4*	19,2 ±9	21 ±11
2nd Attempt	28,8 ±16,4	16 ±7,6	16 ±7,7
3rd Attempt	26,8 ±19,1	13,8 ±5,2	15,6 ±6,6

*Average values±SD

RESULTS

DEMOGRAPHIC CHARACTERISTICS

The baseline characteristics of participants were comparable. Among the 32 participants qualified for the study, there were 10 men and 22 women. All study participants had no previous clinical experience in intubation.

PRIMARY OUTCOME

The primary outcome was intubation success rate, which with the use of ATL was higher than with the MCL but without statistical significance. The overall number of successful intubations with the ATL was 96 (100%), for the ATL with smartphone adapter 96 (100%) and with the MCL 88 (91%).

The first intubation attempt success rate for the ATL was 100% (n=32/32), for the ATL with smartphone adapter 100% (n=32/32) and 84% (n=27/32) for the MCL. In second intubation attempt success rate for the ATL was 100% (n=32/32), for the ATL with smartphone adapter 100% (n=32/32) and 90% (n=29/32) for the MCL. In third intubation attempt success rate for the ATL was 100% (n=32/32), for the ATL with smartphone adapter 100% (n=32/32) and 97% (n=31/32) for the MCL. Because of lack of significance in success rate in subsequent EI attempts only overall comparison of intubation efficiency in three groups is presented in Figure 3.

SECONDARY OUTCOME

The secondary outcome was time of intubation performance. The median time of EI was 28,3 seconds for the MCL, 16,4 seconds for ATL and 17,6 second for the ATL with smartphone adapter. Intubation performed with the ATL was shorter by 11.9 seconds in comparison with MCL and EI performed with the use of camera-guided ATL was shorter by 10,7 seconds in comparison with MCL. Comparing the average manikin intubation times, a statistically significant difference was found between the ATL and the MCL in a favor of the ATL, both with and without the phone camera adapter. However, there was no statistical significance between the use of a smartphone adapter ATL and EI using standard ATL. The average intubation times in total undertaken attempts are shown in Table 1.

In comparison of the average intubation times in individual trials for each tested devices, the greatest progress in the learning curve was observed for the both ATL laryngoscopes.

For the MCL no significant reduction in intubation time was observed in subsequent trials.

The results are shown in Table 2.

DISCUSSION

Data presented in numerous publications show that the difficulties in obtaining intubation skills result primarily from the limitations of the conventional approach to performing this procedure using a classic laryngoscope. The use of the MCL is considered to be the traditional EI method where the placement of the EI in the trachea is done under operators' eye control. This skill is difficult to master [3-5] and maintain at an acceptable level [6], especially among occasional operators and if opportunities for regular practice are limited. In order to increase the efficiency of intubation and reduce the risk of complications, alternative models of laryngoscopes such as ATL with modifications may prove to be more effective than a classic laryngoscopes in performance of effective intubation by novice or less experienced operators.

The ATL is designed to facilitate EI, especially in difficult situations that may occur in emergency medicine. The available studies comparing ATL and a classic laryngoscope for intubation performed by inexperienced operators, such as students, showed reduction of time needed for EI and higher efficiency in the case of use the ATL [7-9]. Comparing the classic laryngoscope with the ATL in terms of the learning curve and skill retention, better results were also shown in the case of the ATL [10]. The data obtained in our study showed improved intubation time and higher efficiency when ATL was used.

Park et al. demonstrated that ATL is a superior device for novice medical students to acquire tracheal intubation skills, with a higher success rate, less duration of intubation, better glottis exposure and less optimization maneuvers required. Time needed for successful intubation was shorter by 32,2 seconds when ATL was used [11].

The use of a smartphone adapter for the ATL allows to use the ATL as a VL. There is a small number of publications in the available literature on experiences with the ATL equipped with a smartphone adapter. In a study comparing the ATL with phone adapter to other VL such as the KingVision VL, VividTrac VL and a standard MCL, obtained results confirmed video-modified ATL is superior to the MCL in terms of intubation time and effectiveness. Additionally, the results are similar to other VLs [12]. In a study evaluating the usefulness of video-modified ATL it was shown that such improvement allows to increase the efficiency of intubation and to overcome the limitations of the standard ATL without VL modification [13]. In our study, the effectiveness of the ATL both with and without the smartphone adapter was 100%, but the use of the phone adapter did not accelerated EI performance. In the Ajimi et al. study, where authors compared the use of a smartphone adapter with standard ATL for intubation using double-lumen tubes, a shorter time to successful intubation was obtained for classic ATL [14]. These results are different from those obtained in our study.

The main reason for introducing the smartphone adapter for the ATL was to allow the classic ATL to be used as a VL without the additional need for a dedicated camera. Currently, there are no available studies in the literature similar to ours, evaluating the use of the ATL with or without smartphone adapter for EI performed by clinically inexperienced operators. However, there are studies in evaluating the use of similar in design to the video-modified ATL devices, comparing EI procedure performed by operators with small or no experience in airway management.

The Pentax AWS VL which is similar in construction to modified ATL, provided better conditions for EI than even the Glidescope VL when EI was performed by inexperienced operators [15]. Another similar in design and use to the video-modified ATL is the KingVision VL. In a study by Pujri et al. intubation time and effectiveness of the KingVision VL were evaluated in comparison to a classic MCL performed by inexperienced operators [16]. The intubation time and the percentage of oesophageal intubations were reduced when the KingVision VL was used. Such results are consistent with our observations, although intubation success rate was 100% in our study and only 75% in the Pujri study.

Teaching of EI can be successfully conducted using the ATL. In the study of Zao et al., the authors showed that the ATL is more effective in teaching intubation than the classic MCL [17]. Zao achieved significantly higher intubation efficiency and shorter time of proper visualization of the laryngeal entrance. In a study by Di Marco et al. with the participation of anesthesia residents in patients undergoing general anesthesia, a better learning curve was demonstrated for the ATL compared to the classic laryngoscope [18]. Sarocoglu et al. compared the teaching of intubation using the ATL, the Laryngeal Mask Airway CTrach and classic MCL [19]. Again, the ATL provided the shortest intubation time and the best efficiency in teaching intubation. Kaki et al. compared the teaching of intubation using the ATL and the C-Mac and Glidescope VL [20]. Authors showed that in this case too, the ATL provided the fastest intubation time, even compared to VLs.

LIMITATIONS OF THE STUDY

The study we conducted has several limitations. The study is a pilot study where only three types of laryngoscopes were compared. Because different devices could provide different findings, caution should be used when extending our results to other contexts. An important factor is also the issue of the lack of experience in airway management of study participants. The study was limited to the students, thus the results cannot be directly transferred to physicians and other medical personnel

with different experiences in airway management. Great limitation of the study is lack of information according to subjective opinions on the degree of intubation difficulty for a particular laryngoscope. We missed this parameter in a study preparation protocol. Taking all above into account our study results should be interpreted in wide context of instrumental airway management.

CONCLUSIONS

In conclusion, the EI time performed by medical direction students using the ATL and video-modified ATL was significantly shorter when compared with MCL, in the first and in the total number of intubation attempts. There were no statistically significant differences in the effectiveness of intubation between individual laryngoscopes.

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ORIGINAL ARTICLE

ALTERED MENTAL STATUS IS AN INDEPENDENT FROM AGE, GENDER, AND LOW OXYGEN SATURATION RISK FACTOR FOR LONG TERM MORTALITY IN PATIENTS WITH COVID-19 DISEASE

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ABSTRACT

Aim: The aim of the study was to determine the clinical characteristics and long term survival in patients with SARS-CoV-2 infection presenting with AMS.

Material and methods: Retrospective analysis of the medical records was performed. The patients were divided into a group 1 with AMS and a group 2 without AMS. Demographics, the presence of concomitant diseases, systolic and diastolic blood pressure, heart rate and peripheral oxygen saturation (SpO2) were compared between the group that presented with AMS and the group that did not present with AMS. Survival analysis was performed with multiple regression models. The study was approved by Bioethical Commission.

Results: The study group consisted of 174 patients aged 65±14 years. There were 88 (51%) women and 86 (49%) men. AMS at hospital admission was recognized in 14 (8%) patients. The patients with AMS were significantly older. Follow-up data were available for 163 patients. The median follow-up time was 467 (20-484) days. The 30 day mortality was 24% and the long term mortality was 30%.

Conclusions: AMS occurs in about 8% of patients with COVID-19 admitted to the hospital. AMS is an independent from age, gender, and low oxygen saturation risk factor for long term mortality in patients with COVID-19 disease. Quarantine have the importance of early diagnosis of SARS-CoV-2 infection and patient monitoring in preventing deaths. The long term mortality in comparison to 30-day mortality doubled in patients with AMS and only slightly increased in patients without AMS.

KEY WORDS

COVID-19, altered mental state,quarantine, mortality

INTRODUCTION

Coronavirus disease 2019 (COVID-19) may present as a variety of symptoms. The most common are respiratory symptoms: cough, dyspnoea, fever. Often accompanied them neurological disorders: headaches, loss of smell, taste, muscle pain and weakness. Disorders of consciousness or alter mental states (AMS) are an acute, dangerous neurological complication of COVID 19, associated with a severe course of the disease (especially in older people). AMS may result from damage to brain tissue by the virus, but may equally well occur in the course of respiratory failure, hypoxia, thrombosis, dehydration, electrolyte disturbances, sepsis -caused COVID-19 infection.

The disturbances of the consciousness could be described as qualitative (the content) disturbances of consciousness relate to changes in the cortex and include disturbances of orientation, perception, memory, executive function and quantitative (the level, arousal) disorders of consciousness concern the ascending reticular formation in the medulla oblongata and involve reactivity to environmental stimuli (for ex: lethargy, drowsy, somnolens, hyperactivity). However, in clinical practice usually a common term of altered mental status is used.

Disturbance of consciousness is a risk factor for death. Awareness that AMS carry a high risk of mortality should motivate timely interventions that may improve the patient's outcome.

THE AIM

The aim of the study was to determine the clinical characteristics and long term survival in patients with SARS-CoV-2 infection presenting with AMS.

MATERIAL AND METHODS

The study was approved by Bioethical Commission (N° of agreement 275/2020).

Retrospective analysis of the medical records was performed.

The patients were divided into 2 groups: the group of patients who presented with AMS and the group of patients who did not present with AMS.

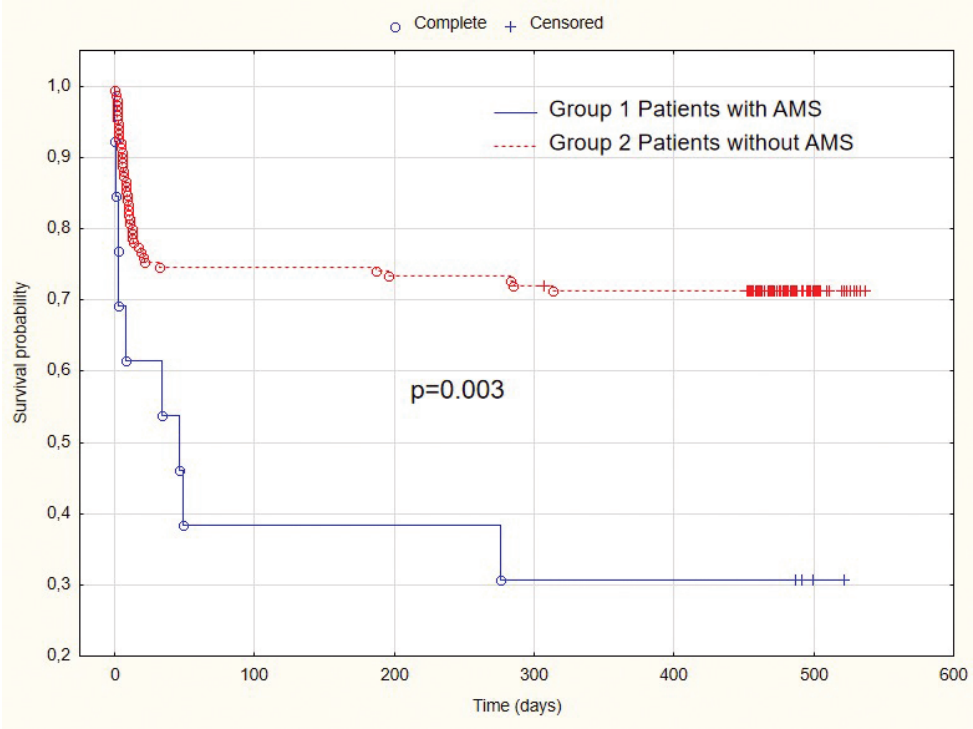

Table 1. Clinical characteristics and vitals in patients admitted to hospital with COVID-19 diseased with (Group 1) and without (Group 2) altered mental status.

	Group 1 N=14	Group 2 N=160	p
Age, years, means±SD	76±12	64±13	0.002
Age above 65 years, n (%)	12 (86)	78 (49)	0.0138
Male gender, n (%)	6 (36)	81 (51)	0.28
Quarantine , n (%)	1 (7)	72 (45)	0.019
Diabetes, n (%)	4 (29)	35 (22)	0.81
Arterial hypertension, n (%)	7 (50)	72 (45)	0.72
Atrial fibrillation, n (%)	1 (7)	12 (8)	0.63
Dementia, n (%)	1 (7)	2 (1)	0.58
Renal failure, n (%)	0 (0)	9 (6)	0.78
CHF, n (%)	0 (0)	11(7)	0.66
Stroke, n (%)	3 (21)	5 (3)	0.014
IHD, n (%)	4 (29)	15 (9)	0.078
SBP [mmHg], median (IQR)	120 (110-140)	130 (120-140)	0.18
DBP [mmHg], median (IQR)	70 (70-85)	80 (70-85)	0.22
HR, [bpm], median (IQR)	80 (88-125)	90 (80-100)	0.66
SpO2, [%], median (IQR)	86 (75-90)	90 (83.5-94)	0.061
30-day mortality, n (%)	5 (38) n=13	37 (25) n=150	0.28
Long term mortality n (%)	10 (71) N=13	43 (29) N=150	0.003

CHF – congestive hart failure, DPB - diasystolic blood pressure, HR - heart rapid, IHD - ischemic heat diesese, SBP - systolic blood pressure

The following additional variables were noted: age, gender, concomitant diseases, presenting symptoms, vitals at admission, quarantine.

Demographics, the presence of concomitant diseases, systolic and diastolic blood pressure, heart rate and peripheral oxygen saturation (SpO_2) were compared between the group that presented with AMS and the group that did not present with AMS.

STATISTICAL ANALYSIS

The continuous date were presented as means and their standard deviations and compared with Student's T test. The discrete variables were presented as numbers and percentages and compared with chi2 test. P less than 0.05 was considered as significant.

Survival analysis was performed with multiple regression models. The patients' survival status was assessed on August 1st 2022. Survival data was obtained from the Ministry of Digitization

The Kaplan-Meier curves for survival of patients with and without AMS were constructed and the rank test was performed to assess the statistical significance between the curves.

RESULTS

The study group consisted of 174 patients aged 65±14 years. There were 88 (51%) women and 86 (49%) men.

AMS at hospital admission was recognized in 14 (8%) patients.

The patients with AMS were significantly older, but the gender distribution do not differ from the other patients.

Follow-up data were available for 163 patients. The median follow-up time was 467 (20-484) days. The 30 day mortality was 24% and the long term mortality was 30%.

Mortality between day 31 and the end of long-term follow-up was 33% in the group with AMS and 6% in the group without AMS (p<0.001)

In the table 1 the comparison between patients with and without AMS was presented.

Male gender, AMS and older age increased the risk of mortality, higher SpO2 is related with higher chances for survival.

DISCUSSION

The first finding of the study was that the patients with AMS constitute about 8% of the studied population. AMS is a common presentation of the COVID-19. Depending on whether the study population includes all patients with SARS-COV-2 infection from the general population or includes only patients hospitalised for the above reason, the percentage of patients with impaired consciousness ranges between 3% in the general population to as high as 38,2% among patients admitted to hospital [1, 2, 4-6]. AMS could be cause by neurological, metabolic and cardiovascular factors (Antoniello) . AMS may be the first manifestation of the COVID-19 [1, 4, 6]. In the study presented here, among patients without AMS at the time of hospital presentation, the proportion observed during quarantine was higher than in patients with AMS. This result may indicate the importance of clinical observation to avoid delayed referral to hospital. The lower number of patients remaining in quarantine and admitted to the ED with disorders of consciousness can also be explained by the likely rapid progression of the disease and, consequently, the admission of patients to hospital in the first hours of illness.

The second finding was that AMS is a predictor of increased mortality in patients with COVID-19. it is less known whether this is an independent factor or if it is a factor that can be explained by other concomitant factors. Hypoxia is an important cause of consciousness disturbances. Antoniello et al reported the presence of hypoxia in 62% of patients with AMS. Hypoxia was regarded as one of the metabolic causes of AMS which could be recognized in up to 92% of the patients with AMS. In COVID-19 disease the hypoxia could be caused by lung involvement, pulmonary thromboembolism, heart failure. Therefore, the hypoxia could be considered as a combined endpoint of the different pathological processes which could present the severity of the disease. Furthermore, hypoxia may result in AMS. However, in the presented study AMS in the multivariate analysis was still the independent, statistically significant factor for long term mortality [1, 2]. AMS in COVID-19 was considered by Antoniello et al as a metabolic encephalopathy/delirium [3]. The metabolic disturbances are more likely to occur in older population, Indeed older age and male gender were found to be risk factors for death in many studies. However, AMS remained the predictor of death in the multivariate analysis [1, 2].

LIMITATIONS

The main limitation of the study is its retrospective character. The study group is also small. However, the patients were included into the study in consecutive manner. Furthermore, the patients are from a same region what enables presentation of the disease outcome. The other limitation were lack of data regarding the meta-

Table 2. Multivarate survival regression analysis.

Variable	HR	-95% CI	+95% CI	p
Male gender	2.43	1.33	4.45	0.004
Age (1 year)	1.07	1.04	1.10	<0.001
AMS (YES)	2.34	1.04	5.29	0.040
Sp02 (1%)	0.94	0.91	0.96	<0.001

AMS - altered mental status

bolic factors like the plasma concentrations of sodium potassium, glucose, and calcium.

The last finding was that the long term mortality remained on the same level as 30 day mortality in the patients without AMS. However, in the patients with AMS it double during the long term observation.

This finding indicates the presence of the long term consequences of SARS-COV-2 infection which are in line with the concept of the long COVID. The damage of the autonomic nervous system may be a risk factor for death. The 30-day mortality was higher in patients with COVID, however, the difference did not obtained statistical significance. The studied population could be to small to reveal slight differences. However, it is clear that the important factor related to death is no related to age, cancer or concomittnat disease because these factors influenced the survival also during the first 30 days.

CONCLUSIONS

1. AMS occurs in about 8% of patients with COVID-19 admitted to the hospital.
2. AMS is an independent from age, gender, and low oxygen saturation risk factor for long term mortality in patients with COVID-19 disease.
3. Quarantined patients are less likely to be admitted to hospital with AMS, indicating the importance of early diagnosis of SARS-CoV-2 infection and patient monitoring in preventing deaths.
4. The long term mortality in comparison to 30-day mortality doubled in patients with AMS whether only slightly increased in patients without AMS.

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ORIGINAL ARTICLE

RISK ASSESSMENT OF CARDIOVASCULAR COMPLICATIONS IN PATIENTS TREATED FOR SARS-COV-2 IN THE OBSERVATION IN INFECTIOUS DISEASE DEPARTMENT

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ABSTRACT

Aim: Assessment of the risk of pulmonary embolism and myocardial dysfunction based on the measured levels of d-dimer and troponin-T in patients treated in the hospital for COVID-19.

Material and methods: The study included a 3-year retrospective analysis of medical records of patients treated at the Independent Public Healthcare Institution. The authors compared the 12 months preceding the epidemic treating this group of patients (without COVID-19) as a control (comparative), and the 24 months of the epidemic in Poland (patients with COVID-19 infection).

Results: Statistically significant differences in d-dimer concentrations before and during the pandemic were found (2.150 ± 3.892 vs. 4.990 ± 15.244 vs. 5.032 ± 13.426 µg/ml; $P = 0.046$). However, there were no statistically significant differences before and during the pandemic in troponin T concentrations (0.027 ± 0.049 vs. 0.032 ± 0.082 vs. 0.034 ± 0.121 ng/mL; $P = 0.718$). Comparing the periods of the pandemic and the time before the pandemic, the length of the hospitalization period was statistically significantly extended (8 ± 4 vs. 10 ± 7 vs. 12 ± 7 days; $P<0.001$).

Conclusions: Diagnostics consisting in monitoring the level of d-dimer in patients with COVID-19 allows to reduce the risk of complications, including hospital death. Determining the level of d-dimer and troponin-T allows for the implementation of appropriate treatment in patients with COVID-19. Testing the level of d-dimer is important in making clinical decisions against the risk of flordembolism in adult COVID-19 patients.

KEY WORDS

COVID-19, d-dimer, troponin-T, pulmonary embolism, myocarditis

INTRODUCTION

A frequent complication of SARS-CoV-2 infection, both in the course of the disease and in the late effect, is the risk of developing venous thromboembolism (VTE), which in turn leads to pulmonary embolism (PE), which is a common cause of death in the group of cardiovascular diseases [1].

The spread of the pandemic. Establishments that have problems treating other diseases and carrying out a procedure that has problems with venous thrombotic diseases, disease embolism, in which the coronavirus is a proven risk factor [2, 3].

In the initial stage of the COVID-19 pandemic, many patients with acute respiratory failure were a serious burden for healthcare entities in Poland. As a result, the number of cardiovascular benefits decreased, although even before the pandemic, the statistics showed a large number of patients and deaths due to cardiological causes. Some sources pointed to an epidemic of heart failure (HF). Patients burdened with other diseases underwent COVID-19 more difficult, therefore they had to undergo specialist procedures such as extracorporeal membrane oxygenation (ECMO), but for many the prognosis was unfavorable [4-7].

The factor whose level is prophylactically determined during SARS-CoV-2 infection in order to determine the thrombotic risk is d-dimer. Later diagnostic is based, for example, on the results according to the Wells scale, used to assess the clinical probability of pulmonary embolism [8-10].

The level of d-dimer is one measure used in patients to detect thrombosis. Studies have shown an increase in d-dimer and fibrinogen levels in the early stages of COVID-19 disease, and a 3-4-fold increase in d-dimer levels is associated with poor prognosis. In addition, underlying diseases such as diabetes, cancer, stroke and pregnancy may increase the levels of d-dimer in COVID-19 patients [11].

Troponin-T is a highly sensitive marker of myocardial damage, so it is an independent predictor of cardiovas-

cular disease. The impact of COVID-19 infection on the level of troponin-T is important in the development of myocarditis, it can be the cause of heart damage, impaired contractility, and the occurrence of atrial fibrillation (AF) [12].

The correlation of COVID-19 with the level of troponin-T and d-dimer prompted the authors of the study to analyze the patients of the infectious diseases ward treated for COVID-19 with the level of these indicators determined.

THE AIM

Assessment of the risk of pulmonary embolism and myocardial dysfunction based on the measured levels of d-dimer and troponin-T in patients treated in the hospital for COVID-19.

MATERIAL AND METHODS

The study included a 3-year retrospective analysis of medical records of patients treated at the Independent Public Healthcare Institution (IPHI) in northern part of the Lubelskie Voivodeship in the period from March 2019 to the end of February 2021. The analysis concerned patients treated in the observation-infectious ward and begins with March, because at the beginning of March 2020, the first case of COVID-19 was reported in Poland [13].

The authors compared the 12 months preceding the epidemic treating this group of patients (without COVID-19) as a control (comparative), and the 24 months of the epidemic in Poland (patients with COVID-19 infection). The analysis was carried out in the observation and infectious disease ward of the district hospital, where patients go to the admission room (AR) of the ward on their own on the basis of a referral from a primary care clinic (PCC) or night and holiday medical care (NHMC), or without a referral in a health and life threatening condition provided by the emergency medical team (EMT).

On 05/05/2021, the consent of the Director of IPHI was obtained for the provision of medical documentation. The personal data of patients and staff have not been archived for the purposes of the analysis, the described cases are fully anonymous, the analysis complies with the principles of the Helsinki Declaration and did not require the consent of the bioethics committee.

For the purposes of the analysis, the following formulations were used:

- period I (Pre - Pan) - patients of the ward in the year preceding the SARS-CoV-2 pandemic
- period II (Pan I) - patients of the ward in the first year of the SARS-CoV-2 pandemic in Poland
- period III (Pan II) - patients of the ward in the second year of the SARS-CoV-2 pandemic in Poland

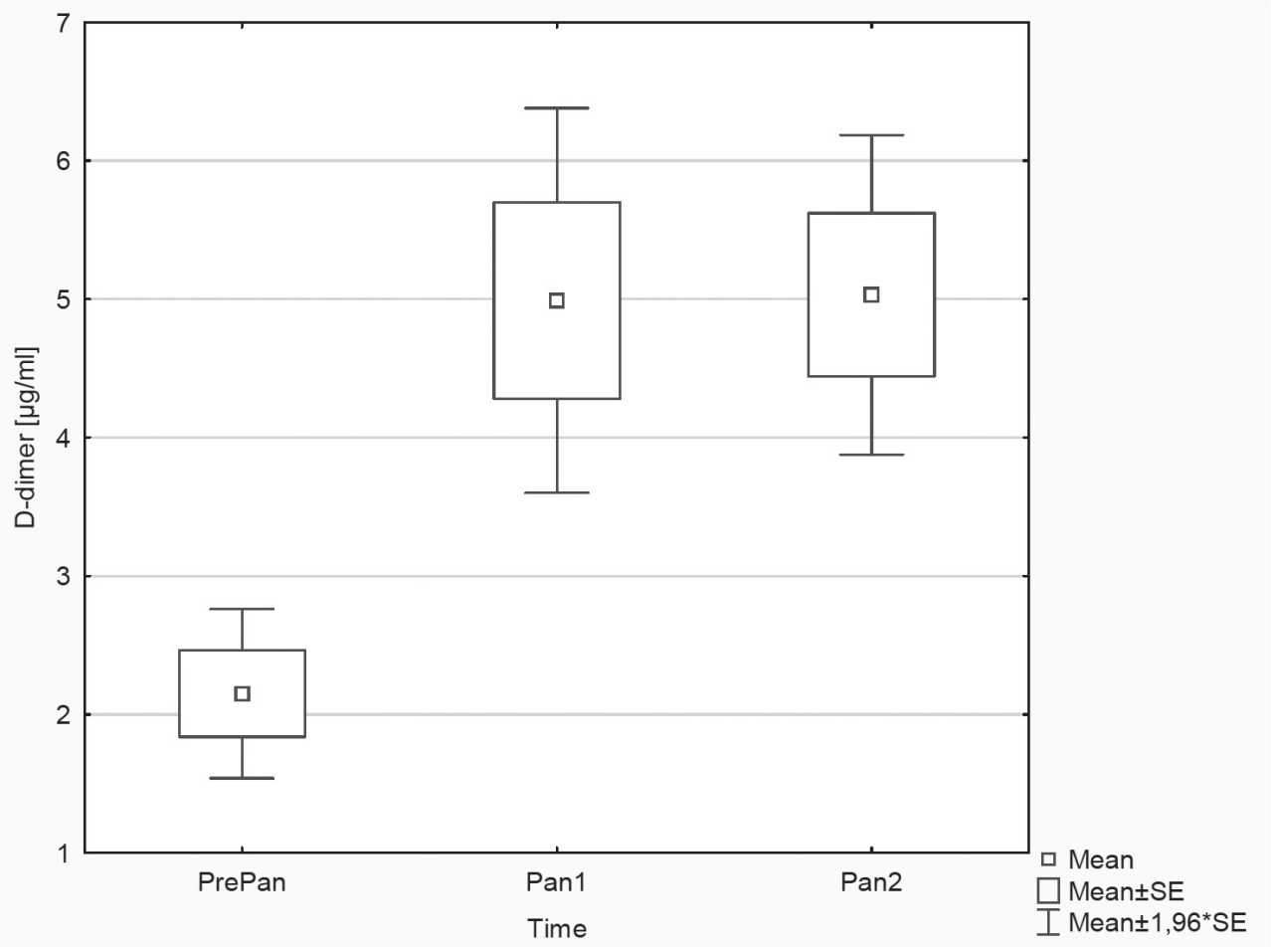

Fig. 1. Comparative analysis of D-dimer concentration [µg/ml] before and during the pandemic.

The observation and infectious disease ward provides services in the field of diagnostics and treatment of infectious, parasitic and zoonotic diseases for adults, including:

- diagnosis and treatment of viral hepatitis,
- diagnosis and treatment of neuroinfections,
- diagnosis and treatment of feverish conditions,
- diagnosis and treatment of diseases transmitted by ticks,
- offers diagnostics: imaging, endoscopy, liver biopsy, specialist laboratory, bacteriological and other diagnostics,
- diagnosis and treatment of acute and chronic diarrhea, diagnosis and treatment of acute gastrointestinal infections in children from 3 years of age.

Since the announcement of the pandemic in Poland, the ward has temporarily become a one-name facility treating patients only with COVID-19 infection.

INCLUSION CRITERIA

In period I - patients treated for various diseases and ailments with levels of d-dimer and troponin-T during hospitalization. During the period of II and III, patients with COVID-19 infection with determined levels of d-dimer and troponin-T during hospitalization. When the level of the aforementioned indicators was determined several times, e.g. in the first and subsequent days of hospitalization, or in subsequent hours during one day, the highest value was selected. A comparative analysis of subsequent values was not carried out because some patients had the levels of troponin-T, d-dimer measured once, some twice and some more. The highest value was selected for the analysis.

DIAGNOSTIC GUIDELINES

According to the guidelines, the type and models of diagnostic devices used in the laboratory of the IPHI, the norms for the levels of the analyzed indicators are as follows:

- d-dimer - 0.00-0.50 µg / ml
- troponin-T- 0.00-0.014 ng / ml [14].

STATISTICAL ANALYSIS

Results concerning quantitative variables were presented as average values ± standard deviation. A one-way analysis of variance (ANOVA) test were used in the comparative characteristics of period of the pandemic. Qualitative variables (age, sex) were presented as quantity (n) and percentage values of the whole group (%), while proportions in groups were assessed with a Chi-squared test. Statistica 13 software (StatSoft Inc., Tulsa, OK) was used in the statistical analysis. $P < 0.05$ was adopted as the significance level.

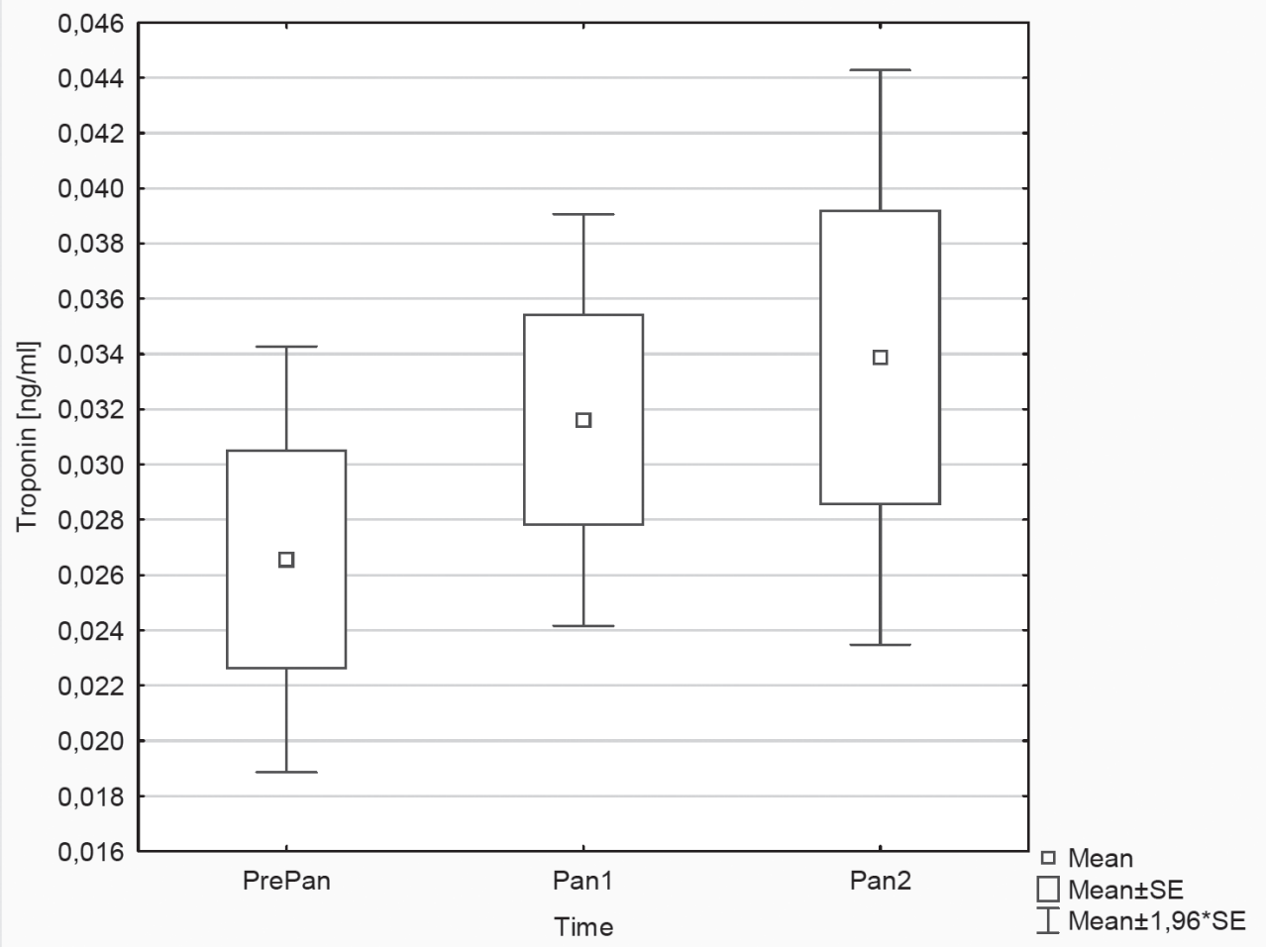

Fig. 2. Comparative analysis of troponin T [ng/ml] before and during the pandemic.

RESULTS

In the 3-year analysis in the observation and infectious disease department, the patients treated were:

Period I (PrePan) - 872 people, 340 men, 509 women, 23 minors
Period II (Pan1) - 1194 people, 634 men, 551 women, 9 minors
Period III (Pan2) - 763 people, 358 men, 405 women, 0 minors

Statistically significant differences in d-dimer concentrations before and during the pandemic were found (2.150 ± 3.892 *vs.* 4.990 ± 15.244 *vs.* 5.032 ± 13.426 µg/ml; P = 0.046; Fig. 1). However, there were no statistically significant differences before and during the pandemic in troponin T concentrations (0.027 ± 0.049 *vs.* 0.032 ± 0.082 *vs.* 0.034 ± 0.121 ng/mL; P = 0.718; Fig. 2). Comparing the periods of the pandemic and the time before the pandemic, the length of the hospitalization period was statistically significantly extended (8 ± 4 *vs.* 10 ± 7 *vs.* 12 ± 7 days; P<0.001) (Table 1).

An analysis of patients with exceeded indicator levels was performed, the results are presented in Table 2.

DISCUSSION

The d-dimer level is used to assist clinicians in diagnosing pulmonary embolism in adults. This correlation was known even before COVID-19. d-dimer has not been validated in this regard in adolescents. The own study also did not concern minors [15].

As Zhou showed in study in 2020, that increased levels of d-dimer and hematological disorders as lymphopenia in the course of SARS-CoV-2 infection, may be associated with a higher risk of death upon admission to hospital. In the own study, in the group of people treated for COVID-19, death occurred in 67 cases in the Pan1 period, and 81 in the Pan2 period [16].

COVID-19 is classified as a respiratory disease, but many studies in the literature show that the disease causes cardiovascular complications [17]. Among the complications, Du et al. mentions heart failure in 25% of patients in their study group [18]. Guan et al. Analyzing the literature and data available for treated patients, he listed the risk factors for death: advanced age, coexisting chronic diseases, but also the risk associated with high levels of d-dimers [19].

D-dimer level can be used to estimate the onset of respiratory and circulatory failure. One method developed is the Modified Early Warning Score (MEWS). The scale is recommended by the Polish Society of Epidemiologists (PSE) for patient assessment in the case of SARS-CoV-2 virus infection. In own study, the authors did not have access to data on whether the patients in the observed group were assessed using the MEWS [20].

Loran et al [21] described the frequency of pulmonary embolism in patients classified as COVID-19 infection, concluding that higher levels of d-dimer predict severe disease.

Table 1. Univariate comparison of period of the pandemic.

	PrePan	Pan1	Pan2	All Groups	P
N	156	462	520	1138	
d-dimer [µg/ml]	2,150 ± 3,892	4,990 ± 15,244	5,032 ± 13,426	4,620 ± 13,399	0,046
Troponin T [ng/ml]	0,027 ± 0,049	0,032 ± 0,082	0,034 ± 0,121	0,032 ± 0,099	0,718
Length of hospitalization (days)	8 ± 4	10 ± 7	12 ± 7	10 ± 7	<0,001
Age (years)	67 ± 16	68 ± 9	69 ± 16	68 ± 14	0,457
Sex, male, n(%)	71 (46)	257 (56)	238 (46	566 (50)	0,004

Table 2. List of patients with elevated d-dimer and troponin T levels in each period.

	PrePan	Pan1	Pan2	All Groups
N	156	462	520	1138
D-dimer [µg/ml]	57 (36,5%)	225 (48,7%)	337 (64,8%)	619
Male	25	123	138	
Female	32	102	199	
Troponin T [ng/ml]	12 (7,6%)	45 (9,7%)	7 (1,3%)	64
Male	5	22	4	
Female	7	23	3	
Both indicators	63 (40,3%)	162 (35,0%)	133 (25,5%)	358
Male	27	96	76	
Female	36	66	57	

Piccioni et al. [22] showed a correlation between COVID-19 infection with troponin-T and I levels and their importance in the risk of developing myocarditis. Patients with COVID-19 infection with cardiovascular risk factors (hypertension, diabetes, advanced age) are at increased risk of cardiac complications. In our own study, the troponin-t level was exceeded in 79 patients (50.6%) in the PrePan period, 207 (44.8%) in the Pan1 period, 281 (54.0%) in the Pan2 period, respectively, which suggests that the infection with COVID-19 does not significantly exceed the level of troponins individually in the studied population.

The link between cardiovascular disease and myocardial damage with deaths in COVID-19 patients was also looked for by Guo in 2020 [23]. A single-centre analysis of patients with elevated troponin T levels vs. those without elevated levels showed that 27% of patients in the first group developed myocardial injury. Correlation of myocardial damage with COVID-19 has been confirmed.

Other causes of cardiovascular complications in the course of SARS-CoV-2 are cited by Huang. The authors of the study published in 2019 claim that the virus has a direct effect on heart muscle damage, through the angiotensin-converting enzyme (ACE-2), thanks to which the virus enters the cells of the infected person. In our own study, there were no procedures for the determination of the ACE-2 enzyme [24].

In addition to research from China, Lodigiani [25] dealt with similar topics from Italy. A study published in 2019 looked at confirmed COVID-19 patients with a thromboembolic complication: VTE, PE, heart failure (HF), acute coronary syndrome (ACS), disseminated intravascular coagulation (DIC), including a large percentage confirmed in imaging diagnostics.

LIMITATIONS

The study had several limitations. Patients had different frequency and number of d-dimer levels, therefore the authors considered the highest level, considering this level as the highest thromboembolic risk. The ward where the analysis was carried out had no procedures for determining the level of other indicators and enzymes mentioned by the authors, so it was impossible to compare your results with other researchers, as well as confirmation of embolism in an imaging diagnostic in own study.

CONCLUSIONS

Diagnostics consisting in monitoring the level of d-dimer in patients with COVID-19 allows to reduce the risk of complications, including hospital death. Determining the level of d-dimer and troponin-T allows for the implementation of appropriate treatment in patients with COVID-19. Testing the level of d-dimer is important in making clinical decisions against the risk of flordembolism in adult COVID-19 patients. In the study group, no significant increase in the level of indicators was observed in connection with COVID-19 infection, which may be related to the short average hospitalization time. It may be important to repeat the determination of indicators in an outpatient setting after a longer period of time (e.g. 30-60 days). In the practice of Emergency Department and EMT, it may be justified to perform POCT tests determining the level of D-dimer and troponin among patients with COVID complications.

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CONFLICT OF INTEREST
The Authors declare no conflict of intertest.

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ORIGINAL ARTICLE

CONFIRMATION OF SUDDEN CARDIAC ARREST IN DIFFERENT SITUATIONS OF PATIENT MANAGEMENT - ANALYSIS OF THE TEAMS' ACTIONS DURING THE POLISH UNIVERSITIES' CHAMPIONSHIPS IN EMERGENCY MEDICINE

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ABSTRACT

Aim: The aim of this study was to analyze the confirmation of sudden cardiac arrest by team members during the tasks performed during the three editions of the "Polish Universities' Championship in Emergency Medicine".

Material and methods: The study was based on an analysis of the evaluation sheets from the "Polish Universities' Championship in Emergency Medicine" organized in 2015, 2017 and 2019 by the Faculty of Health Sciences of the University of Bielsko-Biala. The championships were attended by three-person teams of students, which could not include persons with medical training as well as those working in the Emergency Medical Service System.

Results: The study showed that during task performance 87.20% of teams correctly confirmed SCA before starting CPR. Correct performance of this procedure was not significantly influenced by the circumstances of SCA, the year of the task, the age of the patient, or the heart rhythm causing the SCA.

Conclusions: The knowledge and skills of the participating in the championships team members, regarding confirmation of sudden cardiac arrest, appear to be at a satisfactory level. In order to minimize the risk that future medical personnel, will make while working with the patient mistakes that occur during the performance of tasks, more attention should be paid to the level of education in this important aspect.

KEY WORDS

cardiac arrest, emergency medicine, cardiopulmonary resuscitation

INTRODUCTION

Medical personnel starting work in emergency medical service (EMS) teams should have a high level of knowledge and skills on how to help patients in various life-threatening conditions. This level of preparation for the profession should be guaranteed by appropriate medical education. It is particularly important that this education also extensively covers the medical procedures performed during cardiopulmonary resuscitation (CPR) [1-4]. However, before such procedures as chest compressions, artificial ventilation and defibrillation can be undertaken it is necessary to properly confirm sudden cardiac arrest (SCA) [5-6]. Qualified medical personnel, such as members of the EMS, should confirm SCA in the patient by, among other things, assessing the pulse. Such action should be taken regardless of whether SCA occurs in the patient before or after the arrival of the EMS team at the scene, as well as whether the cardiac arrest is accompanied by a rhythm with visible (ventricular tachycardia (VT) or pulseless electrical activity (PEA)) or without visible QRS complexes (ventricular fibrillation (VF) or asystole) [7-8].

In addition to the championships for medical personnel, which have been held for many years [9], in Poland, the "Polish Universities' Championship in Emergency Medicine" has been held since 2010. Such events are a valuable tool in improving knowledge and skills in performing emergency medicine procedures [10]. Those participating in this championship can test their preparation for their future profession. The results obtained by the teams can also provide valuable guidance to individual Universities on how to improve the training of medical personnel in their institutions.

THE AIM

The purpose of this study was to analyze the confirmation of cardiac arrest by team members during the tasks performed during the three editions of the "Polish Universities' Championship in Emergency Medicine". The authors of the study paid particular attention to how this

procedure was performed when SCA occurred before the arrival of the team, when CPR was taken over from a bystander, and when SCA occurred in the presence of the team.

MATERIAL AND METHODS

The research was carried out based on the analysis of evaluation sheets from three editions of the "Polish Universities' Championship in Emergency Medicine" organized in 2015, 2017 and 2019 by the Faculty of Health Sciences of the University of Bielsko-Biala. This event can be organized by the University, whose team of students took 1st place in the previous edition of the championship. A total of 61 teams representing Universities from all over the country participated in the editions reviewed.

According to the regulations, three-person teams consisting of students majoring in medical rescue, nursing and medicine were eligible to participate in the championships. Teams could not include people who already have a medical training and work in the EMS System. The championship also included teams consisting of students of the organizer and invited guest teams of universities from abroad, which were not considered in the general classification and were excluded from the study.

A total of 19 tasks were carried out during the analyzed editions of the championships. Of these, 10 tasks involved situations with an adult or child patient with SCA. The authors and judges of these tasks were European Resuscitation Council (ERC) instructors of Advanced Life Support (ALS) and European Pediatric Advanced Life Suport (EPALS) courses. The tasks were based on conducting simulated actions in the following scenarios:

- Task 1 - A call to two adult patients with SCA caused by an opioid overdose. Upon arrival at the scene, the teams found a situation in which two police officers were performing CPR on each patient (the teams should have confirmed SCA on each of the patient before continuing CPR);
- Task 2 - A call to an unconscious adult patient. At the scene, members of the teams found a situation in which a bystander was performing CPR on the patient (teams should have confirmed SCA in the patient before continuing CPR);
- Task 3 - A call to two adult patients poisoned by an organophosphorus compound. At the scene, one patient with SCA in whom CPR had not been undertaken before the arrival of the teams (the teams should have confirmed the patient's SCA before starting CPR);
- Task 4 - A call to an electrocuted child. At the scene, the teams found a patient aged 6 years, in whom the family had not started CPR (the teams should have confirmed SCA in the patient before starting CPR);
- Task 5 - Call to an adult patient choked with a foreign body. The patient was occurrence SCA in the presence of the teams. After some time, there was a return of spontaneous circulation (ROSC) and then a recurrence of SCA (the teams should have confirmed SCA twice - at the time of the onset of SCA and when there was a recurrence of SCA after obtaining ROSC);
- Task 6 - A call to a child aged 7 years bitten by a snake. The patient was occurrence SCA in the presence of the teams (teams should have confirmed SCA in the patient before starting CPR);
- Task 7 - A call to an unconscious child with a heart defect. At the scene, the teams found a patient aged 9 years, in whom the family had not started CPR. After some time after the team started CPR, there was ROSC and then a recurrence of SCA (the teams should have confirmed SCA twice - at the time of the onset of SCA and when there was a recurrence of SCA after obtaining ROSC);
- Task 8 - Call to an adult patient with a tachycardia. The patient was occurrence SCA in the presence of the teams (the teams should have confirmed SCA in the patient before starting CPR);
- Task 9 - A call to a child aged 6 years with a tachycardia. The patient was occurrence SCA in the presence of the teams (the teams should have confirmed SCA in the patient before starting CPR);
- Task 10 - A call to an adult patient with acute coronary syndrome. The patient was occurrence SCA in the presence of the teams (the teams should have confirmed SCA in the patient before starting CPR).

Judges evaluating the tasks noted, among other things, whether teams confirmed SCA before starting CPR. The scenarios of the tasks analyzed were performed on Laerdal's MegaCode Kelly and MegaCode Kid manikins.

The study was conducted in accordance with the Declaration of Helsinki and approved by Ethics Committee of the University of Bielsko-Biala (Decisions no. 2023/4/19/E/23).

In performing statistical analysis of the results obtained, a significance level of $p = 0.05$. After checking the assumptions of normality of distribution, a parametric analysis of variance ANOVA was applied, comparing the means of the dependent variable in each group. For independent variables, a parametric T-test was used. Calculations were made in the R statistical environment version 3.6.0, PSPP software and MS Office 2019.

RESULTS

After statistical processing, the results of the study are presented in tables 1-5.

Table 1 shows the characteristics of the tasks evaluated according to the circumstances in which the SCA occurred, the year in which the task took place, the age of the patient, the rhythm causing the SCA, and the correctness of confirming the SCA before starting CPR.

Table 2 compares the correct confirmation of SCA depending on the circumstances under which the patient occurrence SCA.

Table 1. Characteristics of the analyzed tasks.

Circumstances of SCA occurrence	Percentage
SCA before arrival of the team - CPR undertaken by a bystander	23.10%
SCA before arrival of the team - CPR not undertaken by a bystander	23.10%
SCA in the presence of the team	53.80%
Year	**Percentage**
2015	53.80%
2017	30.80%
2019	15.40%
The age of the patient	**Percentage**
Adult	61.50%
Child	38.50%
The rhythm causing the SCA	**Percentage**
VF	66.70%
VT/PEA	33.30%
Confirming the SCA before starting CPR	**Percentage**
Correct confirmation	87.20%
No correct confirmation	12.80%

Table 2. Comparison of correct confirmation of SCA according to the circumstances, in which SCA occurred in the patient.

	Circumstances of SCA occurrence	F	df1	df2	p	M	SD
Correct confirmation of SCA	SCA before arrival of the team - CPR undertaken by a bystander	0,09	2	10	0,918	85,00	5,00
	SCA before arrival of the team - CPR not undertaken by a bystander					87,33	11,02
	SCA in the presence of the team					87,14	7,71

F - test statistic; df - degrees of freedom; p - statistical significance; M - mean; SD - standard deviation

Table 3. Comparison of correct confirmation of SCA according to the year in which each task took place.

	Year	F	df1	df2	p	M	SD
Correct confirmation of SCA	2015	0,49	2	10	0,629	85,71	8,38
	2017					89,75	7,76
	2019					84,00	0,00

F - test statistic; df - degrees of freedom; p - statistical significance; M - mean; SD - standard deviation

Table 4. Comparison of correct confirmation of SCA according to whether the teams proceeded with an adult patient or a child.

	The age of the patient	t	df	p	M	SD
Correct confirmation of SCA	Adult	0,11	11	0,916	86,88	7,64
	Child				86,40	7,93

F - test statistic; df - degrees of freedom; p - statistical significance; M - mean; SD – standard deviation

Table 5. Comparison of correct confirmation of SCA depending on at which rhythm, in a patient with monitored electrical activity of the heart, it occurred.

	The rhythm causing the SCA	t	df	p	M	SD
Correct confirmation of SCA	VF	-1,46	4	0,219	83,50	6,56
	VT or PEA				93,00	9,90

F - test statistic; df - degrees of freedom; p - statistical significance; M - mean; SD - standard deviation

The study showed that the percentage of correct confirmation of SCA by teams did not differ significantly regardless of the circumstances under which the patient experienced a sudden cardiac arrest.

Table 3 shows the results of correct SCA confirmation depending on which year each task took place.

The study showed that the percentage of correct confirmation of SCA by teams before the start of CPR did not differ significantly between years.

Table 4 shows the results of correct SCA confirmation depending on whether the teams proceeded with an adult patient or a child.

The study showed that the percentage of correct confirmation of SCA by teams did not differ significantly depending on whether the teams proceeded with an adult patient or with a child.

Table 5 shows the results of correct confirmation of SCA depending on at which rhythm, in a patient with monitored electrical activity of the heart, it occurred.

The study showed that the percentage of correct confirmation of SCA by teams did not differ significantly between tasks in which the monitored patient had a rhythm with QRS complexes (VT or PEA) or without QRS complexes (VF).

DISCUSSION

The EMS members should precede the begining of CPR on the patient with confirmation of SCA [11-13]. If the cardiac arrest occurred in the patient before the arrival of the EMS team, the team members should confirm SCA regardless of whether a bystander did or did not initiate CPR. Such a procedure allows to take the decision to continue CPR or to discontinue it in a situation where a bystander performing CPR on a patient with preserved circulation [7, 14]. Haley et al. [15] in their study describes an analysis of the medical records of a group of more than six hundred patients in whom a bystanders performed CPR before the arrival of the EMS team. This study showed that in 11.5% of cases, a bystanders performed CPR on patients with preserved circulation, which in 1.4% of them was the most likely cause of complications in their condition. Our own research showed that teams participating in the championship confirmed SCA in 85.00% of cases in tasks where a bystanders had previously undertaken CPR and in 87.33% of cases when CPR had not been previously undertaken. In tasks where SCA occurred in the presence of the team members, 87.14% of teams confirmed SCA before CPR was started. This type of management allows for immediate implementation of advanced resuscitation procedures and increased chances of patient survival [5, 6]. Our own study showed no significant differences in the correct confirmation of SCA across tasks, regardless of the circumstances under which the patient's cardiac arrest occurred.

The goal of subsequent scientific studies and the resuscitation guidelines created based on them is primarily to increase the chances of survival of patients with SCA [16, 17]. Knowledge of these guidelines by members of the EMS teams should influence the correct management of this group of patients [5, 6]. One study [9] analyzed the actions carried out by EMS members in Poland participating in the championship in emergency medicine. Analysis of the evaluation sheets from these championships showed that the percentage of most actions performed by teams during CPR improved significantly in subsequent years. Our own research showed no significant differences in the correct confirmation of SCA between the years in which the championship was held.

The initiation of CPR in a patient by EMS members should be preceded by confirmation of SCA in both adult and pediatric patients [7, 8]. According to ERC guidelines, the standard confirmation of SCA in adults should be by simultaneous assessment of breathing and pulse on the carotid artery [7]. As a standard in pediatric patients over 1 year of age, after confirming the absence of normal breathing, 5 artificial ventilations should be performed and the pulse should be checked on the carotid or femoral artery. In patients younger than 1 year of age, after confirming the absence of normal breathing, 5 artificial ventilations should be performed and the pulse should be checked on the brachial or femoral artery [8]. Our study showed no significant differences in the percentage of correct confirmation of SCA between tasks where the management involved an adult or pediatric patient. In the case of the adult patient, the correct confirmation of SCA was performed by 86.88% of the teams and in the case of the pediatric patient by 86.40% of the teams. The different way of confirming SCA is due to differences in the causes that most often lead to SCA in each age group [18, 19]. The proper handling by most teams in this regard, noted during the study, was most likely due to the fact that their members had adequate knowledge in this regard.

During CPR performed by EMS members, the patient's pulse should be assessed when rhythms with QRS complexes, which could potentially give a pulse, are visible on the monitor. When rhythms that cannot give a pulse (VF or asystole) are noted, in order not to generate unnecessary pauses in CPR, this procedure should be omitted. However, when SCA is suspected in a monitored patient with preserved circulation, the pulse should be assessed regardless of the rhythm seen on the defibrillator monitor [7, 14]. Our study showed that the initiation of CPR was not preceded by confirmation of SCA in 7.00% of teams with VT and PEA rhythms and in 16.50% of teams with VF rhythm. The lack of SCA confirmation when VF was observed was most likely due to a misconception among team members that SCA confirmation was not necessary with this heart rhythm.

LIMITATIONS

The authors are aware that a limitation of the study is the fact that it was conducted under simulated conditions on a group of students. In the future, it is planned to conduct similar studies on the work of emergency medical team personnel.

CONCLUSIONS

During the simulated tasks, the vast majority of teams correctly confirmed SCA before starting CPR. Correct handling in this regard was not significantly influenced by the circumstances under which the patient was occurrence SCA, the year in which the task was performed, the age of the patient and the heart rhythm accompanying the cardiac arrest. The authors of the study suggest that during the training of medical personnel, more attention should be paid to training in this important aspect, so as to minimize the risk that medical personnel will make mistakes in this regard during work with patients.

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LEVEL OF KNOWLEDGE ABOUT PREHOSPITAL MANAGEMENT OF A PATIENT WITH CHEST PAIN AMONG NURSING AND MIDWIFERY STUDENTS

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ABSTRACT

Aim: To assess the level of knowledge about chest pain and the management procedure in patients with chest pain among nursing and midwifery students.
Material and methods: The study was conducted in 276 nursing and midwifery students at the Medical University of Lodz, Poland.
Results: First-year first-cycle program students constituted the largest group among the respondents (114 people), whereas the smallest group included third-year first-cycle program students. Classes attended in the course of university studies were the most common source of knowledge about chest pain in the surveyed group (62.7%, 173 subjects), whereas 6.9% of the respondents (19 individuals) reported having no knowledge about chest pain. Depending on their age, the surveyed students most often assessed their level of knowledge about prehospital management of a patient with chest pain as satisfactory - 45.3% (125 respondents), and least frequently as very good - 4% (11 respondents). As regards the characteristic symptoms of myocardial infarction pain, the students most often indicated the correct answer, i.e. retrosternal pain (81.8%, 226 respondents), while 18.2% (50) of the students did not know the right answer.
Conclusions: Cardiovascular diseases are the main cause of death in Poland, therefore, especially students of every medical field at the beginning of the education cycle should acquire knowledge and skills in the field of pre-hospital management of a patient with chest pain.

KEY WORDS

acute coronary syndrome, nursing, midwifery, chest pain

INTRODUCTION

Chest pain may be a sign of diseases that are health and life-threatening, therefore it must not be ignored. The patient should see a doctor if the complaint persists. In the case of severe pain and other accompanying symptoms, medical assistance should be sought immediately. There are various causes of chest pain.

Acute coronary syndromes (ACS) is caused by a sudden reduction in blood supply to the heart muscle due to decreased patency rate of the coronary artery, most often resulting from a thrombus formed on a damaged atherosclerotic plaque, usually in its inner surface. Depending on the clinical picture and troponin levels, three forms of acute coronary syndrome (ACS) are distinguished, i.e. ST Elevation Myocardial Infarction (STEMI), non-ST Elevation Myocardial Infarction (NSTEMI) and unstable angina pectoris (UAP) [1, 2].

Also, depending on the type of myocardial infarction, an appropriate management strategy is applied, based on the current guidelines issued by the European Society of Cardiology and the Polish Society of Cardiology, as well as the individual assessment of the patient [2, 3].

The symptom that will initiate both diagnostic and therapeutic management in patients with suspected acute coronary syndrome is severe chest pain, with typical radiation, shortness of breath and excessive sweating [3, 4]. Another alarming sign is pain lasting 20 minutes, with little or no response to the treatment applied, mainly nitrates [5]. Acute coronary syndrome should be suspected in all patients with pain or discomfort in the chest. This is especially true for those with risk factors for coronary artery disease who have suffered cardiovascular incidents.

Factors that affect the time that elapses from the onset of coronary pain to the commencement of treatment, mainly reperfusion therapy, are a delay in calling for medical assistance and the organization of the emergency medical system. Additionally, patients quite frequently attempt self-treatment. Sometimes they associate their symptoms with other coexisting chronic conditions. They often lack awareness of the benefits provided by early treatment. Studies indicate that individuals who are more likely to delay calling for medical assistance are elderly people and diabetics [6, 7].

In the prehospital period, in the case of a patient with suspected acute coronary syndrome, it is crucial to reduce the time in which they reach the hemodynamics laboratory. The speed and accuracy of the decisions made allows to efficiently establish the correct diagnosis and apply appropriate management procedures, thereby improving the prognosis for the patient.

THE AIM

The aim of this study was to assess the level of knowledge about chest pain and the management procedure in patients with chest pain among nursing and midwifery students.

MATERIAL AND METHODS

The survey was conducted among nursing and midwifery students of first-cycle and second-cycle programs at the Medical University of Lodz. The study group included 253 women and 23 men.

The criteria for participation in the survey were being a student of nursing or midwifery and giving voluntary consent. The survey was conducted anonymously with the use of the Microsoft Forms application in October and November 2022.

The tool used was a questionnaire including 20 closed-ended questions, developed by the authors for the purpose of this specific study. Initial questions concerned the respondents' gender, age, place of residence and their year of studies in nursing or midwifery. Subsequent questions referred to the source of information about chest pain. In the next part of the survey, the questions concerned knowledge about chest pain and assessment of the level of training in the procedure of prehospital management of a patient with chest pain. Among others, they referred to the characteristics of myocardial infarction pain and the features that distinguish it from coronary pain. Additionally, the questions related to the consequences of worsening chest pain and possible management of complications of prolonged myocardial infarction pain.

STATISTICAL ANALYSIS

Variables were analyzed using the one-way analysis of variance (ANOVA), Kruskal - Wallis test, chi-square test, and the Pearson and Spearman correlation coefficients. Quantitative variables were presented as mean ± standard deviation. A value of $p<0.05$ was considered to be statistically significant. The results obtained were subjected to statistical analysis using Statistica 12 EN.

RESULTS

Women accounted for 91.7% (253 individuals) of the study group, while men accounted for 8.3% (23 individuals). The largest group, 35.9% (99 individuals) of the students came from cities with more than 500,000 inhabitants, whereas the smallest group, 11.2% (31 individuals) came from cities with 100,000-500,000 inhabitants. 33% (91 people) came from rural areas, and 19.9% (55 people) lived in cities up to 100,000 inhabitants.

The average age of first-year undergraduate students is 19 years old. Second-year students were on average 20.06 years old, and third-year students 21.2 years old. The average age in second-cycle studies is 23.1 years.

First-year first-cycle program students constituted the largest group among the respondents (114 individuals), while the smallest group was third-year first-cycle program students. The present study showed a statistically significant correlation between the students' education level and their age ($p<0.001$).

The most common source of knowledge about chest pain in the surveyed group were classes attended in the course of university studies - 62.7% (173 people); 6.9% of the respondents (19 people) declared having no knowledge about chest pain. The first-year first-cycle program students most often reported classes attended outside the University as a source of knowledge about pain.

The first-year first-cycle program respondents, who constituted the largest group, most often assessed their level of previously received training in prehospital procedure as satisfactory (35.5%, 98 students), while only 8.7% (24 students) assessed it as very good. The present study showed a statistically significant relationship between the age of the respondents and the assessment of the level of training received so far ($p<0.001$).

Students commencing their university studies most often assessed their level of knowledge about prehospital management of a patient with chest pain as satisfactory - 45.3% (125 respondents), least often as very good - 4% (11 respondents).

As for the characteristics of myocardial infarction pain, the respondents most often chose the correct answer - retrosternal pain radiating to the left shoulder and the lower jaw - 81.8% (226 respondents), while the wrong answer was given by 18.2% (50 respondents). There was no statistically significant relationship between knowledge of the characteristics of myocardial infarction pain and the age of the respondents. The characteristics of myocardial infarction pain were correctly indicated at a similar level by both men and women. The surveyed group reported lectures as the most common source of knowledge about the characteristics of myocardial infarction pain.

In the study group, a vast majority believed that the administration of nitroglycerin affects the severity of chest pain - 79.7% (220 individuals). Those were mainly first-year first-cycle program students. Only 56 respondents thought that nitroglycerin has no effect on the pain severity. There was a statistically significant relationship between the level of previous training in prehospital management procedures and knowledge of the effect of nitroglycerin on the severity of chest pain ($p=0.03$).

In the study group, most of the respondents believe that administration of nitroglycerin allows to differentiate between myocardial infarction pain and coronary pain. Additionally, there is a statistically significant relationship between the source of knowledge about prehospital management of a patient with chest pain and

the factor based on which myocardial infarction pain can be differentiated from coronary pain (p=0.04).

Nearly three-fourths of the respondents believe that administration of nitroglycerin can affect blood pressure values in a patient with chest pain. There was a statistically significant relationship between the source of knowledge about prehospital management of a patient with chest pain and knowledge about the effects of nitroglycerin on the human body (p<0.001).

In the surveyed group of students, nearly 40% (110 people) indicated lectures as a source of information on the management of intensifying chest pain. 21.38% (59 people) informationabout the management of a patient with increasing chest painfrom self-education, and 17.75% (49 persons) from classes carried out in a secondary school. On the other hand, 13.04% (36 people) do not have such knowledge.

The surveyed cohort identified tachycardia as the cardiac arrhythmia that occurs most frequently with worsening chest pain.

Nearly three-fourths of the respondents would call emergency medical services immediately when encountering a patient with chest pain outside the hospital. There was a statistically significant relationship between the respondents' self-assessed level of knowledge and the management procedure when encountering a patient with chest pain outside the hospital (p<0.001).

Over half of the surveyed group, mostly students aged about 21 years, indicated acetylsalicylic acid (ASA) as a medication that can be administered to a patient with chest pain outside the hospital, which shows a statistically significant relationship between the respondents' level of education and the choice of medication to be given (p<0.001).

In the study group, most of the respondents indicated ST-segment elevation on electrocardiography as an element that should be considered when monitoring the heart function of a patient with chest pain.

Among the students, a vast majority indicated that a patient with chest pain should take a sitting position when dyspnea worsens. There was a statistically significant relationship between the source of the students' knowledge about chest pain and management of a patient with aggravating dyspnea (p<0.001).

Nearly 100% of the respondents would perform cardiopulmonary resuscitation (CPR) in patients with sudden cardiac arrest.

In the surveyed group of the respondents, the vast majority would use an AED defibrillator, if available, to monitor an unconscious patient with suspected cardiac arrest.

The respondents most frequently identified ventricular fibrillation as the type of heart arrhythmia in which defibrillation should be performed. There was a statistically significant relationship between the students' self-assessment of their knowledge level with heart arrhythmia which is an indication for defibrillation (p<0.001) and their assessment of their level of previous training and their knowledge of heart arrhythmias requiring defibrillation (p<0.001).

There was a statistically significant relationship found between the respondents' self-assessed level of knowledge about the prehospital management of a patient with chest pain and their age (p<0.001) and level of education (p<0.001).

DISCUSSION

The conducted study aimed to determine the level of knowledge on rendering first aid to patients with chest pain among nursing and midwifery students.

The nursing/midwifery profession is a profession whose primary motivation is the desire to provide help and care to other people [8].

In Poland, the nursing/midwifery profession is mainly practiced by women. Men constitute a small group in the profession. The survey shows that women are the vast majority of those studying at the Medical University of Lodz.

In a study by Rachybińska et al., the largest number of students came from cities with a population of less than 100,000 and from rural areas [9]. In the present study, students from cities with over 500,000 inhabitants represented the largest group. Individuals from cities with a population of 100,000-500,000 accounted for about 11% of all the respondents.

The research conducted so far shows that students are rather eager to participate in surveys [10]. The results of the present study demonstrate that first-year first-cycle program students participated in the study most willingly, whereas third-year first-cycle program students were those who took part in it least often.

Nursing is a field of study where students gain knowledge about diseases and management of patients in various health conditions [11].

The survey found that the most common way students learned about chest pain were classes attended during the course of their studies.

It is a moral duty and a legal obligation to render first aid in the case of a life-threatening situation or a serious health impairment. However, fulfillment of this obligation is possible provided one knows the principles of first aid. The available literature shows that almost half of adult respondents have good knowledge of first aid [12]. In contrast, in earlier studies experts have shown that only about 30% of junior high school students and about 65% of high school students attend extracurricular first aid classes [13]. The present study, where the largest group was composed of first-year first-cycle program students, demonstrates that respondents mostly assess the training they have received so far as satisfactory, with only a small group reporting it to be at a very good level. The youngest group of the respondents also assessed their level of knowledge about prehospital patient management at a similar level.

The available literature shows that the primary symptom present in myocardial infarction is retrosternal pain

[5]. The results of the present study also indicate that retrosternal pain is the most common sign of myocardial infarction.

In previous studies, experts have emphasized the use of nitroglycerin in chest pain. The response to nitroglycerin makes it possible to differentiate myocardial infarction pain from that of other origins [14]. The results of the present study prove that a majority of students believe that administration of nitroglycerin has an impact on chest pain severity. Additionally, in the surveyed group of respondents, the vast majority believe that nitroglycerin helps differentiate myocardial infarction pain from coronary pain.

Nitroglycerin is contraindicated in hypotonia (<100 mm Hg). After its administration, the patient may experience a further drop in blood pressure [15]. The survey shows that a vast majority of the respondents believe that nitroglycerin can affect blood pressure values.

Tachycardia is often associated with cardiac conditions. Myocardial ischemia, particularly the condition after myocardial infarction, is among the most common cardiac causes of sinus tachycardia and tachyarrhythmia [16]. In the study group, tachycardia was indicated as a type of cardiac arrhythmia often occurring with chest pain.

Prehospital care, which should be provided by any witness to illness, involves mainly calling for qualified assistance. In Poland, these are emergency medical services [17]. The present study confirms students' knowledge that if they encounter a patient with chest pain outside the hospital, emergency medical services should be called immediately.

The role of acetylsalicylic acid (ASA) in the treatment of atherosclerotic diseases, including ischemic heart disease, has been confirmed in the guidelines issued by scientific societies. In these patients, acetylsalicylic acid is used both in the acute phase of the disease and after stabilization of the clinical condition. The efficacy of acetylsalicylic acid in these indications has been repeatedly confirmed by studies, which resulted in the inclusion of acetylsalicylic acid in the treatment regimens of many cardiac conditions [18]. In the present study, most of the students indicated acetylsalicylic acid as a prehospital therapy for patients with chest pain.

The available literature recommends that in patients with chest pain, a 12-lead electrocardiogram should be performed, with particular attention paid to ST-segment elevation [19]. It is also crucial to establish the diagnosis within up to ten minutes.

The study found that the students most often identified ST segment elevation as a factor that was particularly important on electrocardiography.

The available literature shows that dyspnea is one of the most common and alarming signs, and its underlying causes can be numerous, including cardiovascular disease. In a significant percentage of patients with acute coronary syndrome, dyspnea may occur as the predominant symptom. Patients may also present dyspnea both during hospitalization and in the following weeks as a result of the development of heart failure [20]. The study found that when dealing with patients suffering from aggravating dyspnea, the students would recommend taking a sitting position to alleviate the symptom.

The available literature shows that monitoring patients is very important as long as it is possible to use a cardiac monitor outside the hospital. Performing resuscitation procedures is essential in patients with sudden cardiac arrest, while defibrillation is necessary in those with ventricular fibrillation [21, 13]. In the surveyed group of the respondents, it was shown that they would mostly use an AED for monitoring and defibrillation in the event of occurrence of a health life-threatening arrhythmia in patients.

CONCLUSIONS

1. The level of knowledge of first-year undergraduate students on pre-hospital management of a patient with chest pain is sufficient. What is noteworthy is the percentage of students who do not know the characteristics of pain typical of acute coronary syndrome, which should be discussed in detail during classes conducted during studies.
2. Cardiovascular diseases are the main cause of death in Poland, therefore, especially students of every medical field at the beginning of the education cycle should acquire knowledge and skills in the field of pre-hospital management of a patient with chest pain.
3. The main source of knowledge about chest pain are classes carried out during studies. Therefore, they should be implemented by professionals and using a variety of teaching methods and techniques that guarantee a high level of achievement of learning outcomes. Classes conducted at the Medical Simulation Center may prove to be a great didactic support.

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CONFLICT OF INTEREST

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REVIEW ARTICLE

ADVANTAGES AND DISADVANTAGES OF LAPAROSCOPIC PROCEDURES IN RELATION TO THE OPEN METHOD IN PEDIATRIC SURGERY

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ABSTRACT

There are many studies which present advantages and disadvantages of the use of both minimally invasive and open method procedures in pediatric surgery. This paper highlights the advantages of minimally invasive surgery and the resulting conclusions for use in clinical practice (e.g. the use of laparoscopy in children is associated with significantly less postoperative stress). The disadvantages of the described surgical techniques and other possible complications observed after the use of laparoscopic techniques and the open method are also presented. It was emphasized that surgical trauma, regardless of the surgical method used, causes not only a post-traumatic immune-inflammatory response of the body, but is often associated with the risk of developing infections (local or generalized) and the occurrence of recurrences. The study focuses on summarizing the current state of knowledge on minimally invasive pediatric surgery, in particular on the effectiveness of laparoscopic appendectomy, laparoscopic inguinal hernia repair and laparoscopic procedures used in pediatric oncology, taking into account postoperative immune response disorders. Moreover, progress was analyzed in the use of minimally invasive robotic surgery, which becomes an increasingly common method of treatment of many typical surgical diseases in children.

KEY WORDS

pediatric minimally invasive surgery, laparoscopy of the appendix and inguinal hernia, laparoscopy in pediatric oncology, laparoscopy and open surgery, robotic surgery, postoperative immunosuppression

INTRODUCTION

The history of laparoscopic pediatric surgery reaches the 1970s. The first documented case of using minimally invasive surgery in children as a diagnostic tool was noted in 1971, when Stephen Gans has conducted an inguinal hernia operation in a child and has published his report [1]. In many clinical situations laparoscopic surgery is now the method of first choice. The most frequent pediatric diseases which may be treated with laparoscopy include developmental defects, such as abdominal cryptorchidism or congenital inguinal hernia, acute diseases of the abdominal cavity, including appendicitis [2, 3]. Additionally, laparoscopic surgery is a reliable solution for diagnostic uncertainties in selected cases of blunt or penetrating abdominal injury in children; in a hemodynamically stable patient with a distressing and ambiguous result of an imaging examination it provides sensitive diagnostic capabilities and a chance for a final repair of the injured tissue [4]. Due to the widespread use of laparoscopy in pediatric surgery, which is recommended in many other diseases (including in adrenalectomy, nephrectomy, gallstones, treatment of gastroesophageal reflux disease, diagnostics of tumors and liver diseases, treatment of nodular lesions in the scrotum and kidneys, as well as in urological procedures) we have limited ourselves to describe the most frequent cases of its use [5-10]. In case of lack of clear indications for the surgical technique, the choice should be up to the parents and the surgeon. There is still no detailed research on preferences of parents for the manner of conducting of surgeries, and the available data indicate that their decisions are dictated mainly by clinical prognosis and sometimes by the price of the procedure rather than e.g., esthetic reasons.

For the purposes of this review, a review of English-language literature from the last 5 years (that is 2017-2022) was conducted in order to confirm the advantages of minimally invasive surgery and laparoscopic procedures in infants and children. At the same time, we looked for hard data on postoperative immune response to an inflicted surgical injury in order to be able to identify possible differences between the response of the child's body after classical open surgeries compared to minimally invasive procedures. Moreover, we looked for information about the preferences of parents for the method of surgery in their child and about their biggest

fears. With this objective in mind the PubMed electronic database of articles was searched, using keywords - laparoscopy children, laparoscopic pediatric surgery acute appendicitis, advantages and disadvantages of minimally invasive surgery in children, scale of pain in children after laparoscopic inguinal hernia surgery, inguinal hernia repair children, inguinal hernia surgery techniques children robotic surgery, postoperative immunosuppression. This review was divided into the issues of treatment of inguinal hernias, removal of appendix and laparoscopic treatment of cancers in children. A total of 739 full-text publications on minimally invasive pediatric surgery were found, among which 73 concerned laparoscopic inguinal hernia repair in children. Moreover, an additional database search for hernias in children was performed using keywords - surgery inguinal hernia infants, inguinal hernias in children, inguinal hernia surgery techniques children, differences open and laparoscopic inguinal hernia surgery in children, hernia surgery outcomes in children, paediatric hernia treatment. The selected titles and abstracts were analyzed, followed by a full-text review. 9 publications were selected which discussed more comprehensively the effectiveness of laparoscopic surgery in comparative studies of both treatment techniques of congenital inguinal hernias in pediatric patients. These articles have analyzed the duration of the surgery, complications and rate of relapse. In case of laparoscopic appendectomy 56 articles on this subject were found, of which 4 have compared the open method with laparoscopy. For the use of minimally invasive surgery techniques in pediatric oncology 69 articles were found in the PubMed database, including two comparing the results of surgeries performed with both classical and laparoscopic method. One of the articles presents the results of studies from robot-assisted surgeries. No articles were found which would directly discuss postoperative immune response in children after laparoscopic and classical surgeries. Single publications were found however presenting postoperative levels of pro-inflammatory cytokines after laparoscopic surgeries compared to open method surgeries.

THE AIM

The aim of the study was to analyze the advantages and disadvantages of laparoscopic procedures in relation to the open method in pediatric surgery and to answer the question whether laparoscopic procedures are a beneficial surgical method.

REVIEW AND DISCUSSION

INGUINAL HERNIA IN CHILDREN

Inguinal hernia is one of the most frequently diagnosed developmental defects in children and it is estimated that its surgical repair is performed annually in approx. 20 million children globally [11, 12]. It is diagnosed primarily in male infants. Right-sided hernias are encountered most often. Bilateral hernias are diagnosed mostly in premature infants. Opinions are divided concerning which surgical method is more effective in the treatment of hernias (i.e., laparoscopic or open). As shown by a review of 9 selected articles published in PubMed, in most publications there is no significant difference in the rate of relapse after laparoscopy and open surgery. However, a significantly lower rate of complications has been observed after procedures performed with the laparoscopic method [13]. There is still no hard proof however, confirmed by randomized control studies, which would demonstrate the superiority of laparoscopic surgery over open surgery of a hernia [14]. As specified by the authors of analyzed publications, one of the main advantages of the use of laparoscopic method is shortening of the time of surgery and the possibility of better visualization of the inguinal area. An advantage is also the possibility of early diagnosis of the development of metachronous contralateral inguinal hernia (MCIH), the occurrence of which is noted mainly in infants and children with relapse after a surgery of unilateral inguinal hernia [14]. An analysis of the articles enabled the presentation of differences in the duration of surgery. The duration of laparoscopic surgery varied from 14.3 to 33.7 minutes in case of a unilateral hernia, and in case of a bilateral hernia the surgeries took from 20.4 to 65 minutes [14-17]. Only in one study, where laparoscopy was performed through a single incision the duration of the surgery was longer than in case of open surgery and of standard laparoscopic surgeries, where the number of inserted trocars may differ depending on the type of procedure. It amounted to 32.8±9.2 min in boys, 30.4±9.1 min in girls for unilateral inguinal hernia, and in case of open surgery 23.3 ±12.0 min in boys, and 17.2±9.6 min in girls. In case of a surgery of bilateral hernia the time needed for laparoscopic surgery amounted to 45.5±12.7 min for boys, and 42.2±11.6 min for girls, whereas the time needed for open surgery amounted to respectively 42.0±19.9 min for boys, and 31.4±9.2 min for girls. The duration of the procedure was extended since the cosmetic appearance of the bellybutton was also taken care of [18].

Shortening the duration of the procedure is important in particular due to the action and possibility of complications after anesthesia in children. There is a concern that extended duration of anesthesia during surgery in early childhood may be related to an increased risk of developmental impairment [19]. The issue of anesthesia in pediatric surgery constitutes a significant challenge for anesthesiologists due to the possibility of circulatory and pulmonary failures. Currently laparoscopic procedures are conducted even on neonates, which is made possible by the miniaturized tools and the increasing experience of pediatric surgeons [20]. All hernias in children may be treated surgically with the exception of premature infants until approximately 60th week from the moment of conception. In case of such small children there is an increased risk of occurrence of postoperative apnea and other serious complications, in particular after general anesthesia [21]. The risk of complications in every field of

pediatric surgery is higher the younger the child is, and may lead to injury of some organs, in particular liver and kidneys, but also to anoxia of the central nervous system [22]. Extending the duration of anesthesia in surgeries on premature infants may result in the cognitive disorders and lowering of motor skills when the child reaches the age of two years [19]. In children up to 60 weeks since the moment of conception the best technique which allows avoiding postoperative respiratory complications was so far considered to be local anesthesia. An alternative was epidural anesthesia combined with slight inhalation anesthesia [23]. A drawback of laparoscopy is considered to be the need to use in most cases a general intratracheal anesthesia, which may cause various negative consequences. At this moment it should be noted that the action of long-term anesthesia is the most harmful, which is also confirmed by the FDA (Food and Drug Administration), according to which multiple or prolonged general anesthesia used in pediatric surgery may cause disorders in the development of a child's brain [14]. Thus, the most anxiety is felt by aware parents before a child's surgery in relation to the side effects of anesthesia and to postoperative pain [24].

Even though there are not enough studies documenting the impact of anesthesia on immune system in children, it is known that general anesthesia causes a reduction of the body's immunity. One of the studies has confirmed the impact of inhaled anesthetics on the behavior of immune cells [25]. It seems that the impact of general anesthesia and short surgeries on the immune system of healthy patients is low, and the immune system disturbances are related to the surgical injury (in particular after undergoing large surgical procedures). Anesthesia has a significant impact on the secretion of pro-inflammatory and anti-inflammatory cytokines. Inhalation anesthesia, in a dose-dependent manner, inhibits the secretion of cytokines, decreases the proliferation of lymphocytes, induces apoptosis of lymphocytes and inhibits the function of neutrophils [26]. Moreover Shibamura-Fujiogi et al. have observed that higher doses of sevoflurane are connected to a higher probability of occurrence of postoperative wound infection after planned intestinal surgery in children [27]. In the analyzed articles no significant differences in the frequency of relapses were established and were determined to be similar to the rate of relapse after open surgery [2, 4]. The need to conduct further in-depth analyses of the risk of relapse hernias due to the variety of available surgical techniques is also emphasized. Dreuning et al. has noted a study in a literature review with a higher rate of relapses and increased post-operative pain after laparoscopic surgeries compared to the rate of relapses after a classical open procedure [14]. Wanting to increase the knowledge on the rate of recurring hernias after laparoscopic and open method surgery, an additional search of publications on this subject was conducted. Among the obtained results special attention was paid to the publication of the results of single-center retrospective study of the effects of laparoscopic surgeries of inguinal hernias in children conducted by Geiger et al., the objectives of which included, among others, the assessment of rate of relapses. The results of the conducted analysis indicated that a relapse of the hernia is one of the main post-operative complications; it may be caused by,

Table 1. Comparison of obtained results — laparoscopy *vs.* open method surgery.

Specification	Laparoscopy	Open surgery
Inguinal hernia		
Duration of the procedure		
Unilateral hernia	14.3 to 33.7 min	Girls 17.2 ±9.6 min Boys 23.3 ±12.0 min
Unilateral laparoscopy with 1 incision	Girls 30.4 ±9.1 min Boys 32.8 ±9.2 min	
Bilateral hernia	20.4–65.0 min	Girls 31.4 ±9.2 min Boys 42.0 ±19.9 min
Bilateral laparoscopy with 1 incision	Girls 42.2 ±11.6 min Boys 45.5 ±12.7 min	
Appendix		
Duration of the procedure		
	57.3 min	47 min
Complications		
Abscesses	2.6–15.38%	3.1–5.26%
Bowel obstruction	2.56–3.7%	5.7-7.89%
Infection of the site of surgery	1.5–5.13%	2.1–15.79%.
Duration of hospitalization		
	2.4–5.39	6.0–6.2

Table 2. Use of minimally invasive surgeries and robotic-assisted surgery.

The use of minimally invasive surgeries in pediatric oncology	The use of robotic-assisted surgery
Biopsy	Urology Cardiac surgery General pediatric surgery
Large cell lymphoma	
Ovarian cancer	
Suspicious lesions in the liver	
Suspicious lesions in the kidneys	
Resection of a pulmonary lesion	
Chronic myeloid leukemia	
Acute lymphoblastic leukemia	
Neuroblastic tumor	
Wilms' tumor	
Rhabdomyosarcoma	
Hodgkin's' disease	
Ganglioneuroma	
Pheochromocytoma	
Mesothelioma	
Cardiac surgery	
General pediatric surgery	

Source: Own work, based on a literature review

among others, insufficiently high ligation of the hernia sac, surgical injury as a result of damage to the inferior wall inguinal canal, lack of tight closure of the internal ring in girls and post-operative hematoma and wound infection [28]. Moreover, the use of dissolvable (absorbable) sutures was listed as one of the causes of relapses. The authors of the study have observed a much higher rate of relapse after laparoscopic surgery than in previously analyzed 9 publications, where no significant difference was observed between the rate of relapse in both methods of surgery, and the rate of relapse after laparoscopic surgery of the hernia was in the range of 0.6% to 3% [14-18], whereas in this discussed study this rate amounted to 6.5%. According to the authors the potential cause may be the learning curve. They have referred their results to a study of a learning curve for laparoscopic hernia surgery, in which Wright et al. have established that a longer learning curve is required to conduct laparoscopy [29]. The lack of knowledge of inguinal anatomy and the time needed to master the ability to operate within a limited space was considered to be the main reason for extending the learning curve. The lower rate of relapses in the 9 analyzed articles may result from a shorter time of observation of the studied persons or a low number of the studied group, and thus a possible underestimation of the rate of relapse after laparoscopic surgeries, as noted by Geiger et al. [28].

No unequivocal conclusions concerning the level of post-operative pain may be reached based on the analyzed publications. The authors of the two publications have noted that laparoscopic surgeries of children were related to lower pain and lower need for pain medication [14-15]. Moreover, the results of one of the publications have indicated a lower need for pain medication after laparoscopic surgery in which intracorporeal suturing was used [14]. Due to insufficient data concerning post-operative pain in selected publications, a decision was made to analyze the results of the previously mentioned retrospective study and to conduct a repeated search of the previously selected 73 articles related to laparoscopic inguinal hernia surgeries in children. Additional 3 publications were found which discuss results of research of operative pain, however none of them has provided an unequivocal answer to the question of the level of pain felt. Among the 19 publications found, one of them discussed in a more detailed manner the use of methods of pain assessment after laparoscopic surgery based on the results of a randomized single-blinded prospective trial. Postoperative pain was assessed using the FS (Face Scale) and FLACC (Face, Legs, Activity, Cry, Consolability) scales at different times, including a primary endpoint set at 2 hours after leaving the operating room. Pain medication was administered in accordance with the results of the FS scale. Pain assessment based on the FS scale was done by the parents, with the authors stipulating that the assessments could differ from the opinion of medical personnel. In order to assess post-operative pain in small children and infants the FLACC behavioral scale is usually used. The studied pain level was at around 3 after 25 minutes since the surgery ended, and after 4 hours it was assessed at slightly below 2. In case of the FS scale this pain was assessed in both cases below level 2, with a slight increase after an hour after the surgery. The pain assessment was performed on two study groups, comparing the analgesic effect of ultrasound-guided rectus sheath block to local anesthetic infiltration of the surgical field. No significant differences in the assessment of pain with the use of both these methods were noted [30]. In case of same-day surgeries such as inguinal hernia laparoscopy, the PPPM (Parents' Postoperative Pain Measure) form may be additionally used, which enables the assessment of pain by the parents after returning home with the child. In the analyzed results of the study the PPPM scale was however not used. Geiger et al. have observed in the previously mentioned retrospective study that children which underwent open surgery required the administration of more post-operative analgesics than children in whom the procedure was laparoscopic. However, this difference was deemed statistically insignificant. Most (63.8%) of operated children required the administration of pain medication for 1-3 days after the surgery [28].

APPENDICITIS IN CHILDREN

In case of laparoscopic appendicitis in children, a correct diagnosis is the most difficult part. Among the 56 publications special attention is drawn by an article which summarizes the guidelines for diagnosis and treatment of appendicitis which were formulated for both adults and children. In accordance with the observations by Di Saverio et al. an early diagnosis may be hindered by the fact of presence of atypical clinical symptoms and the lack of possibility of conducting a reliable medical interview and physical examination, in particular in the youngest age groups. Based on a literature review, the authors have demonstrated that laparoscopic appendicitis is related to a reduced frequency of wound infection and other complications, as well as enabling the shortening of hospitalization [31, 32].

There are multiple scales which facilitate the differential diagnosis of appendicitis. For adults the Alvarado scale may be helpful, and for children the PAS (Pediatric Appendicitis Score) proposed by Samuel [33, 34]. These scales, which also include selected laboratory parameters in addition to clinical symptoms, along with the testing of levels of diagnostically useful biomarkers (e.g., interleukin-6, CRP, neutrophil lipocalin) are an important diagnostic tool for appendicitis in clinical practice [35, 36].

In a study the objective of which was to create a clinical assessment of potential risk of appendicitis in children reporting to ER with acute stomach pain, the assessment of clinical symptoms was supplemented with the study of the level of leukocytes, neutrophils and CRP. It turns out that performing the aforementioned laboratory tests enables a much faster confirmation or exclusion of acute appendicitis in children [37].

In the discussed literature review it was established that in case of a simple appendicitis in children, performing an appendectomy within 24 hours reduces the risk of complications, including perforation. In case of complicated appendicitis, it is recommended to perform the procedure within 8 hours from the moment of admission [31]. In order to establish which method of surgery is related to the lowest risk of complications and whether there are statistically significant differences in the intensity of post-operative pain, the need for repeated operations, the duration of the operations, and the period of hospitalization studies which meet the above criteria were searched for in the PubMed database. Among the listed 56 publications 4 were selected, and among them 3 which described the results of trials which compare a laparoscopic and an open method operation for post-operative complication, the duration of the operation, and time of hospitalization; one report was a review of publications intended to demonstrate differences between a laparoscopic operation and conservative treatment with antibiotics. In all publications it was established that laparoscopic appendectomy in children seems to be a safer surgical technique [31, 38]. However, none of the publications indicated significant differences between laparoscopic and open method of surgery. Moreover, it was noted that although in the case of simple appendicitis the method of first choice is laparoscopy, in cases of complicated appendicitis both methods can be used without clear differences in results [38, 39]. One of the analyzed publications focused solely on the assessment of incidence and risk factors of small bowel obstruction. Although this study may not be used to compare the aforementioned criteria, it is interesting from the point of view of differences between of both surgical techniques that this complication was not identified as a consequence of surgical approach, but rather to of perforated appendicitis and postoperative intra-abdominal abscess [40].

The authors of the qualified publications consider the lower risk of occurrence of adhesions, which is argued to result from a smaller injury to the abdominal cavity wall to be an undisputed advantage of the laparoscopic method. Moreover, the next listed advantages include lower post-operative pain and slightly shorter convalescence period [41]. Concerning the pain criterion Liu et al. have noticed that pain was assessed as lower in children who were operated on with the laparoscopic method in the period of 2 to 26 days after the operation. Pain resolved in all studied patients after 1 month. Special attention should be paid to the fact that in children operated with the laparoscopic method lack of pain occurred after 2 weeks from the moment of operation, and in children operated on with the open method the pain has resolved significantly only on the 26th day. The highest intensity of pain was noted in the first day after operation, both with the open and laparoscopic method [38, 41]. Moreover Liu et al. have observed that the frequency of major complications in children operated on with the laparoscopic method was lower than in children who were operated on with the open method, but on the other hand it was similar in case of minor complications [38]. The most frequent complications after laparoscopic and classic appendectomy included wound infection, perforation, abscesses and recurrence. Minor complications included an antibiotic-related rash, fever, diarrhea, vomiting and paralytic ileus. Whereas the study by Botchway et al. did not demonstrate any complications in children who underwent a procedure in case of simple appendicitis, moreover no relapses and re-admissions were noted in that group [39].

As for the remaining complications, in accordance with the data obtained from the analyzed publications abscesses formed in 2.6–15.38% of children undergoing laparoscopic surgery. This rate was much smaller for the group which underwent open method surgery, 3.1–5.26% [39-41]. Ileus has developed in 2.56–3.7% of patients in the group after laparoscopic procedure compared to 5.7–7.89% among children after open surgery in the analyzed studies [39, 40]. A surgical wound infection was observed in 1.5–5.13% of children after laparoscopic surgery. In case of an open surgery this rate was 2.1–15.79% [39-41].

Looking at the hospital stay duration after laparoscopic surgery compared to open surgery it was statistically shorter in case of laparoscopic method, in the range of 2.4–5.39 days compared to over 6 days of hospital stay in case of an open surgery (6.2 days) [38, 39, 41]. In all analyzed publications it was emphasized that the choice of the method of operation was up to the surgeon. Moreover, in a publication discussing the risk and consequences of small bowel obstruction after an appendicitis it was noted that this choice depends on many factors, including the local situation, the experience of the surgeon and the preferences of the patient. The need to conduct more comprehensive prospective trials comparing the effectiveness of both methods, categorized by age, sex, body weight, degree of advancement of the appendicitis and surgeon's experience was also indicated [42]. This is also confirmed by an observation by Botchway et al. who have noted that the selection of the operating method was dependent on the time from observation of the symptoms until the moment the parents report to the hospital with the child. If it was long, the surgeons have selected the open surgery as the best method [39]. There are interesting observations by Bada-Bosch et al., who decided to check what types of surgical procedures were performed during the SARS-CoV-2 pandemic in one analyzed hospital. This article was not included in this review because of the described results which apply to an unusual period of sanitary restrictions. However, the observation by the authors is worth noting that in this period a significant reduction in the number of procedures and an increase of urgent cases were noted. Due to the delay in reporting to the hospital, cases of appendicitis required immediate surgery and were mainly performed using the open method. A probable cause of

the increase of the number of procedures with the open method could be the use of additional preventive measures intended to lower the risk of transmission of the virus. However, in recommendations of medical facilities it is noted that the selection of the method should be dictated by the good of the patient, and in case of laparoscopy the use of additional safety measures is recommended [43].

LAPAROSCOPY IN PEDIATRIC SURGICAL ONCOLOGY

In the last years the use of minimally invasive surgery techniques in pediatric surgical oncology has been gaining popularity. This technique consists of making a smaller incision, usually half-length compared to the open method, enabling avoiding the cutting of tendons or injuring of muscles. In case of pediatric oncology there are still not enough randomized studies which would demonstrate differences compared to open surgeries. In their study Acker et al. have proposed a hypothesis that minimally invasive techniques may be useful in diagnosis and safe resection of tumors in pediatric oncology [8]. So, the use of MIS in this field of medicine is becoming more and more popular, although minimally invasive techniques are used more frequently for diagnostic purposes than for resection of tumors. In the opinion of Abdelhafeez et al. there are still not enough of studies which compare the use of minimally invasive techniques with an open operation in case of treatment of abdominal and lung tumors. Unfortunately, the available publications are not randomized studies, so it is difficult to make a comparison without concrete proof. However, the authors indicate that laparoscopic tumor biopsy and resections compared to thoracoscopy result in a lower number of complications [4]. Many solid tumors in children require a biopsy which may be performed with laparoscopic or open surgery. Tumors in the abdominal cavity of children are not only a significant diagnostic challenge, but also a technical challenge [45]. An advantage of laparoscopy is the ability to collect a larger amount of tissue, which enables better diagnostics [44, 46]. According to Phelps et al., resection of tumors, including in particular neuroblastic tumors using minimally invasive techniques may constitute an integral element of oncological treatment. According to the authors the MIS techniques enable a safe and effective resection of neuroblastic tumors in children; however, a large tumor volume and other risk factors such as surgeon experience or comorbidities of the child may constitute a limitation [44, 47].

Another problem observed by van Dallen et al. in their review of publications is the difficulty in comparing e.g., survival rates which result from the use of pre- and post-operative chemotherapy or radiotherapy [9]. The lack of clinical studies which compare both surgical techniques is also confirmed by Simmons et al. noting that operations with minimally invasive technique are still rarely used in children with kidney tumors. As shown by a review published by the authors only 10% of teenagers and 1% of small children undergo minimally invasive surgeries when diagnosed with kidney tumors [10]. Laparoscopic surgery was successfully conducted in girls with diagnosed ovarian tumors. The use of minimally invasive surgical techniques in oncology is subjected to an increasing number of studies. There are however not many studies which describe the results of resection of liver tumors in children. The use of single incision laparoscopic surgery (SILS) technique in case of pediatric tumors is still also rare; there are many limitations, for this reason caution is recommended in the selection of MIS technique.

ROBOT ASSISTED PEDIATRIC SURGERIES

The first surgical operation with the use of a robot in a child was a fundoplication conducted in 2000. Since that time robot assisted surgery is used in many fields of pediatric surgery, including urology, cardiac surgery and general pediatric surgery. There are many advantages of robot assisted surgeries, including lower post-operative pain, shorter hospitalization time, smaller post-operative scars and less complications caused by infections [48]. In urological oncology in children most procedures are performed with the open method. Moreover, the use of a robot provides greater technical possibilities than classic laparoscopy [49]. However, its implementation in the field of pediatric surgery was limited mainly by the unavailability of instruments sized appropriately to a child's anatomy, which required more technologically advanced. According to Navarrete Arellano et al. the biggest obstacles which prevent the use of robotic surgery in children include, among others, the learning curve, the size of the robotic instruments, and the costs of the procedure [50]. Whereas Wong et al. have noticed that robot assisted laparoscopy in case of pyeloplasty of ureteropelvic junction obstruction, although took more time (225 minutes) compared to other centers which perform surgery using the same technique (on the average 155-155 minutes) has slightly shortened the hospitalization time from 3 days vs. 3.8 day for non-assisted laparoscopy and promoted faster tissue recovery [51].

Summing up, surgical operations in children may cause a series of complications and post-operative immunological disorders which result in post-injury immunosuppression and secondary local or generalized infections. So, a surgical injury, regardless of the used technique causes not only a post-injury stress reaction in a child, but frequently may also be related to a risk of infection and relapse. The use of laparoscopy in children is related to significantly lower post-operative stress compared to open method surgery. After a surgery performed using the open method, the levels of inflammatory biomarkers are significantly higher than after laparoscopic surgery, the level of pain after open procedure is also higher [52]. The selection of the operation method depends mainly on the surgeon, current epidemiological situation and preferences of the parents. Even

though this review indicates superiority of laparoscopy over open method, still 80% of European surgeons operate using the open method in most cases. For comparison, the percentage of surgeons choosing this method in the United States is slightly higher, as many as 85% of inguinal hernia operations in children are open surgeries. The situation in Denmark, Germany or in Korea looks similar [53]. Clinical effects of minimally invasive techniques, both classic and robot assisted also depend on the learning curve, which is particularly important in case of surgeries conducted on premature infants, babies and young children. The fact of the type of anesthesia used and its impact on the future development of the child and on its immune system also cannot be disregarded. During an analysis of the available publications, it was noted that there is a clear deficit of comparative studies focused on individual aspects such as: post-operative pain, number of infections of the surgical site, immune system response depending on the anesthesia used and method of operation and the effectiveness of the pharmacotherapy used. It also seems justified to conduct a more detailed studies which focus on the initial parameters of the studied pediatric patients, such as congenital defects or body mass, which may have an impact on the final post-operative complications (e.g., the impact of obesity on the risk of development of surgical wound infection).

There are still no high-quality studies which discuss the disadvantages and advantages of the use of minimally invasive techniques in pediatric oncological surgery and the use of technology of robotic assisted surgery. The issue of the response of the immune system to the surgical injury is also not without significance. Although studies exist concerning the immune response to surgery in adults, the immune consequences of surgical injury in children have not been examined extensively enough. During an analysis of publications only a few publications were found, the main purpose of which was to examine the reaction of the immune system to surgery in children. Post-operative levels of pro-inflammatory cytokines were consequently lower after the conducted laparoscopic surgeries compared to open-method surgeries, which indicated smaller tissue injury during laparoscopy. Moreover, it was observed that immunological sequelae caused by the surgery depend on the age of the child; the younger the child, the higher the immunosuppression effect caused by the surgery [54]. Although it was noted that minimally invasive techniques have a lower impact on the immune system of children than open surgeries and are related to lower post-operative injury, minimizing the risk of immune function disorders, more randomized clinical studies are needed [54, 55].

CONCLUSIONS

Advantages of minimally invasive surgery compared to open method surgical procedures include lower post-operative pain, shorter time spent in hospital and lower rate of repeated hospitalizations, lower posttraumatic stress and risk of postoperative wound infections or generalized infections, and also faster recovery [2, 56-58]. Therefore, it should be emphasized that laparoscopic methods are a clinically useful surgical method that is becoming more and more common in pediatric surgery.

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CASE STUDY

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INSIDIOUS, DEADLY, COMMON - POLYTRAUMA WITH PELVIC FRACTURE

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ABSTRACT

Polytrauma patients with pelvic injuries have a high mortality rate, particularly in those who are haemodynamically unstable, reaching up to 42%. This case study involves a 66-year-old cyclist struck by a tram in Gdańsk, Poland in October 2022. Upon arrival at the Emergency Department of the Medical University of Gdańsk, the patient exhibited stability but later entered the initial shock phase. Comprehensive imaging unveiled flail chest, bilateral pneumothorax, spinal fractures, and an unstable pelvis. Despite a negative point-of-care ultrasound, the planned orthopaedic pelvic stabilization surgery transitioned to endovascular intervention due to deteriorating shock and suspected retroperitoneal bleeding. Despite a successful procedure, the patient succumbed to irreversible shock and multiple organ failure the next day in the intensive care unit. The significance of rapid identification of internal bleeding followed by timely endovascular intervention and retroperitoneal pelvic packing is underscored, as it has demonstrated decreased mortality in similar cases.

KEY WORDS

embolization, shock, polytrauma, pelvic fractures

INTRODUCTION

Unstable pelvic fractures along with retroperitoneal bleeding fall among the most fatal blunt injuries in the human body. In case of negative visible external bleeding, the first phases of haemorrhagic shock can be easily overlooked, undermining the severity of the patient's status. Pelvic injuries occur in nearly 25% of polytraumatized patients which is a major contributor to mortality [1, 2], combined with haemodynamic instability, mortality reaches around 40% [3-5].

Although prompt diagnosis and treatment increase the likelihood of survival, in experienced trauma centres, the mortality index for this group of patients is higher when combined with the age variable (>60 years) [6].

THE AIM

This case review highlights the importance of early diagnosis and treatment of traumatic pelvis injuries and associated complications.

MATERIALS AND METHODS

The following case study is based on a 66-year-old male cyclist, who was by a tram in Gdańsk, a few km from the hospital. He was admitted to the clinical emergency department (ED), Medical University of Gdańsk, in October 2022.

CASE PRESENTATION

Upon initial assessment by the paramedic team at the scene of the accident, the patient was conscious, normotensive, slightly tachycardic and complained of tenderness of the chest, back, pelvis and left thigh. Suspecting a high-energy collision injury, the team decided to rush him to the regional trauma centre, the university hospital. During transport peripheral intravenous (IV) access was established, administration of Fentanyl 0.2 mg IV, Midazolam 5 mg IV, Paracetamol 1000 mg IV, Plasmalyte 500 ml IV along with passive oxygenation and thermal insulation blanket was initiated.

Twenty minutes later, upon ED admission, the patient was conscious but with signs of shock including tachycardia and unmeasurable non-invasive blood pressure. Lab results showed no anaemia, but an elevated plasma lactate level was noted (Fig. 1). Prior to polytrauma computer tomography (CT), the patient was sedated and underwent rapid sequence induction (RSI) with subsequent mechanical ventilation. Fluid resuscitation was continued according to the local protocol. Polytrauma CT revealed bilateral pneumothorax, lung contusion, numerous fractures in the ribs and sternum, blunt injury to the paraspinal muscles, numerous fractures in the lumbar spine, as well as multiple unstable pelvic fractures and retroperitoneal hematoma (Fig. 2-4).

Bilateral chest tubes were inserted along with an external pelvic stabilisation splint. Prompt rescue blood transfusion with packed red blood cells (PRBC) and fresh frozen plasma (FFP) was initiated along with norepinephrine and tranexamic acid, as well as external heating. The patient was qualified for an external pelvic

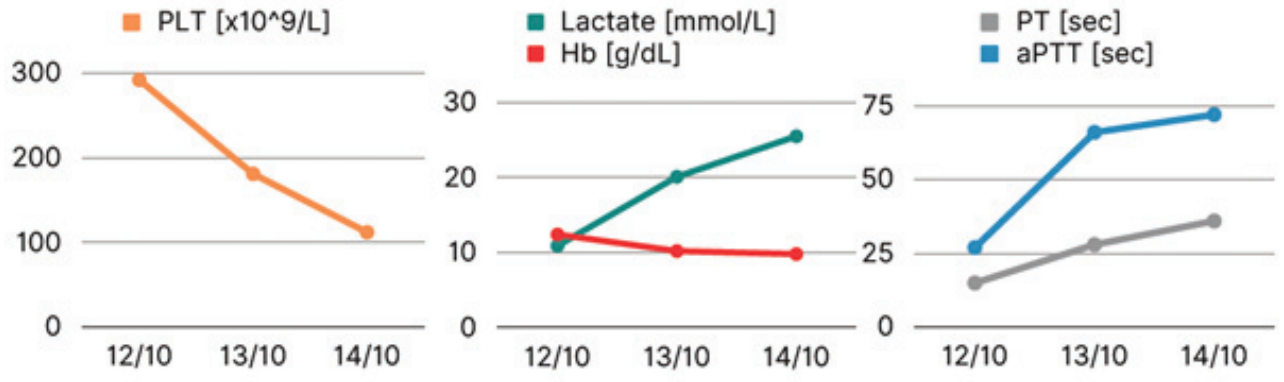

Fig. 1. Biochemical markers.
Laboratory results show the values of platelets (PLT), lactate, haemoglobin (Hb), prothrombin time (PT) and activated partial thromboplastin time (aPTT) from 12/10 to 14/10.

stabilisation surgery, but the orthopaedic surgical team was preoccupied with other operations and the patient had to wait in the ED.

Despite vigorous fluid resuscitation, the patient continued to deteriorate. Approximately 90 min after ED admission, the patient suffered a critical drop in blood pressure leading to a transient cardiac arrest. Return of spontaneous circulation (ROSC) was achieved after 20 min of resuscitation. The repeated point-of-care-ultrasound (POCUS) examination was negative for any visible intraperitoneal bleeding, cardiac tamponade, or any other cardiac injuries. No significant blood outflow was collected from chest tubes.

Due to uncertain shock sources, plans for orthopaedic stabilisation were abandoned, prioritising interventional radiology arteriography and embolization attempts. The right obturator trunk, the left internal iliac trunk and the right intercostal artery were found actively bleeding and were embolized 3 hours after ED admission.

After the procedure, the patient was transferred to the Intensive Care Unit (ICU) in critical condition. He was put on continuous infusion with vasopressors including epinephrine, norepinephrine and vasopressin, followed by continuous venous-venous haemodialysis to combat the water-electrolyte and acid-base imbalance. Transfusion of blood products was continued, however, the subsequent lab workup showed progressive coagulopathy (Fig. 1). The following day, the patient's status did not improve and he developed signs of irreversible phase of shock with multiple organ failure. The patient died on the second day after the accident.

DISCUSSION

The World Society of Emergency Surgery (WSES) presents guidelines and classifications for handling pelvic trauma patients according to their haemodynamic stability status and degree of pelvic ring injury [7]. This classification utilises the Advanced Trauma Life Support (ATLS) definition of an 'unstable' patient. The presented guideline recommends that first-line treatment

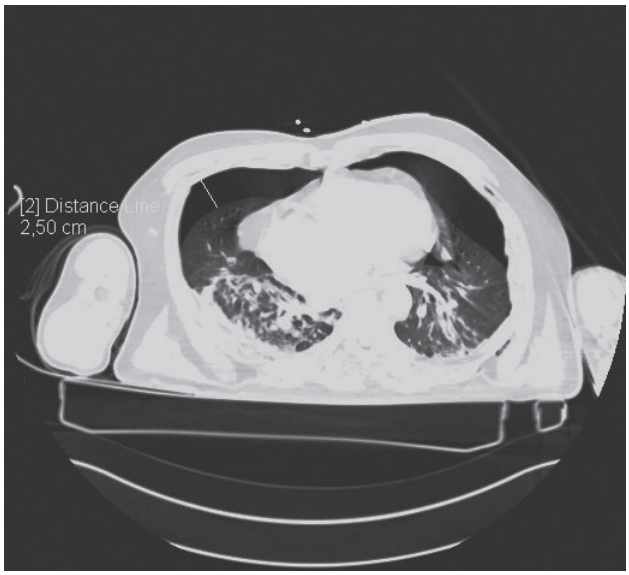

Fig. 2. CT image showing bilateral pneumothorax and multiple rib and sternum fractures.

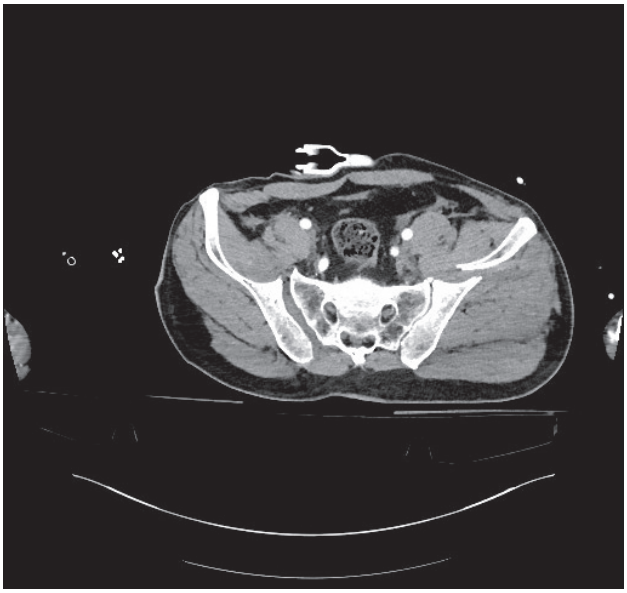

Fig. 3. CT image showing unstable pelvic fractures as well as the pelvic splint.

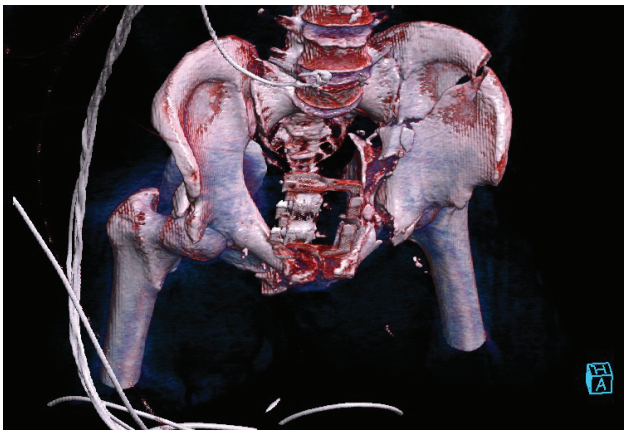

Fig. 4. CT reconstruction of the pelvis depicting multiple unstable fractures.

for haemodynamically unstable pelvic trauma patients should include pelvic binder in the field and preperitoneal pelvic packing as early as possible after admission. Mechanical fixation, angioembolization and resuscitative transient endovascular balloon occlusion of the aorta (REBOA) are alternatives and bridge therapies if the initial interventions are not sufficient or unavailable.

Of note, the subjective patient had no confirmed active retroperitoneal bleeding visible in the initial polytrauma CT. The large number of diagnosed bone fractures and internal injuries blurred the diagnostic search for the most important bleeding source.

It has been suggested that angiography and subsequent arterial embolization should be offered to all patients above 60 years of age with blunt pelvic injury, regardless of their haemodynamic status [8].

CONCLUSIONS

The first step in the management of pelvis trauma patients is awareness of internal bleeding from various sources. The approach steps for trauma patients are based on the C-ABCDE algorithm: catastrophic haemorrhage; airways; breathing; circulation; disability; exposure. Early diagnosis and intervention are crucial to prevent the irreversible phase of haemorrhagic shock. The 'golden hour' rule [9] is essential in the prehospital phase. Infusion of IV fluids while observing the 'permissive hypotension' rule [10], early administration of tranexamic acid and switching to blood products when available. Strive to facilitate a near 1:1:1 ratio of PRBC and FFP and platelets [9]. Once the haemorrhagic shock is suspected, it is critical to prevent the 'death triad' [10, 12] of coagulopathy, acidosis and hypothermia. When no visible external bleeding and negative in CT or during POCUS, one should suspect retroperitoneal or gastrointestinal tract bleeding. In cases where patients with traumatic pelvic injuries deteriorate haemodynamically, radiological intervention is a potential option.

It is essential to note that while endovascular intervention can be lifesaving, it may not always be successful. Bleeding from traumatic pelvic fractures occurs most commonly from veins (80%) compared to arteries (20%) [11, 12] with the highest mortality related to arterial bleeds. Based on the literature, a median time to an endovascular intervention of <90 min has shown to lower in-hospital mortality in patients with pelvic fracture and haemorrhagic shock [13]. The late shock stage is extremely difficult to reverse as it is a self-accelerating state leading to death, hence rapid and vigorous interventions are of high priority.

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CASE STUDY

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EMERGENCY MANAGEMENT OF ORAL CORROSIVE POISONING BASED ON CASE STUDY

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ABSTRACT

Poisoning is one of the reasons for which Emergency Medical Teams are called. They range from mild and asymptomatic incidents to those complicated by shock and Sudden Cardiac Arrest. The causes of poisoning may be related to accidental contact with a potentially poisonous substance, but also to deliberate use or exposure to poison for suicidal purposes. Some of these events are classified as situations subject to the assessment of forensic specialists. Rescue procedures in case of poisoning depend on the type of poison, the course of poisoning and the clinical signs presented by the patient. Medical Emergency Procedures should always be based on the pursuit of circulatory and respiratory stability of the patient. Pre-hospital management is aimed at limiting further absorption of the poison and, if possible, implementing causal treatment through the supply of antidotes. In the absence of a specific antagonist, the patient should be treated symptomatically.

KEY WORDS

acute poisoning, corrosive substances, sulfuric acid, emergency procedures

INTRODUCTION

The concept of poisoning is understood as a set of disease symptoms occurring as a result of the adverse effects of a poisonous substance in a dose showing harmfulness. Poison can be almost any chemical compound given in a lethal dose, and the symptoms and course of poisoning can be varied [1]. Poisoning can occur in ways such as by oral, intravenous, inhalation, and direct absorption through the skin. Poisoning can be intentional as a suicide attempt or intentionally to cause harm to health or death through the planned action of third parties. Intoxication can also take place in the situation of mistakenly taking poison or overdose of a substance into a toxic dose, as well as in connection with contamination of the patient's living environment [2]. Due to the presence of clinical symptoms and the dynamics of the course, acute, subacute and chronic poisoning can be distinguished. In the case of Emergency Medical Teams (EMT) and Hospital Emergency Departments (ED), the most common incidents are acute poisoning requiring immediate medical interventions to save the patient's life [3,4].

THE AIM

The aim of the study was to present the proceedings of the Medical Rescue Team (ZRM) and the staff of the Hospital Emergency Department towards a patient with oral poisoning with a corrosive substance, being in a life-threatening condition.

MATERIAL AND METHOD

The retrospective examination included a man to whom EMT was dispatched due to suspected drinking sulfuric acid. The patient's poisoning was severe and complicated by shock. In this paper, the case study method was used. The research material was obtained through the analysis of the Medical Emergency Operations Card (KMCR), the Departure Order Card (KZW) EMT and the hospital treatment information card.

CASE REPORT

On 31.05.2023 at 16:57, the basic ZRM, consisting of two members: a system nurse and a paramedic, was dispatched in the emergency code 2 with the reservation of departure using signals to an event in which the medical dispatcher determined one person requiring medical assistance. The medical history stated that the patient: is conscious, breathing, lying, there is swelling of the face, he could have drunk some acid. Due to the lack of available nearest ZRM, the arrival time of the dispatched ZRM to the event was 20 minutes. Upon arrival at the scene, the patient was found lying on his side in a small boiler room. He was conscious, without verbal con-

tact, groaning. Next to him was a glass of colorless liquid and a partially emptied bottle of vodka-type alcohol. In the interview, the family suspected a suicide attempt, claiming that the substance probably drunk could have been battery fluid. The family denied the patient's allergies and reported chronic treatment for depressive syndrome, epilepsy, chronic gastritis and lumbosacral spinal pain syndrome. The patient moved in a wheelchair due to permanent hemiparesis of the right side as a consequence of craniocerebral trauma suffered in 2011 with extensive contusion of both cerebral hemispheres and bilateral subdural hematomas. No information was available considering the pharmacology used by the man and the time of consumption of the last meal. In the GCS examination, the patient received 8 points, opened his eyes to pain, uttered incomprehensible sounds, and in the motor assessment there was an escape from pain. In further evaluation, the airways were unobstructed, swelling and redness of the face and tongue were present. There was a risk of airway patency at risk, breathing was heavy and accelerated to about 28 breaths per minute. In the study, auscultation found bilateral furls over the pulmonary fields. The initial oxygen saturation was 84%. The pulse on the radial arteries was imperceptible, while on the carotid and femoral arteries it was possible to examine, obtaining a result of a measured heart rate of about 70 beats per minute. The capillary recurrence was prolonged to about 3 seconds, the skin in the assessment pale and moist. In the temperature measurement, 35.8oC was recorded, and a sharp and unpleasant smell was felt from the mouth. Blood pressure (BP) was 60/20 mm Hg, and abdominal examination showed significant pain and increased palpation tenderness. The abdomen, despite tenderness, was soft, peristalsis remained preserved. On neurological examination, muscle strength remained symmetrical and there was increased muscle tone. The plantar reflex was present, the pupils remained symmetrical of the correct width, and the reaction to light was slow. The glycaemic level was normal at 106 mg/dl. In the electrocardiographic recording from the limb leads, sinus rhythm was diagnosed, measured with ventricular activity of about 100-120 beats per minute. Additional features of the ECG are the intermediate axis, without the presence of features of fresh myocardial ischemia. Based on the patient's clinical condition, shock was diagnosed, hence passive oxygen therapy with a flow of 12 liters per minute was implemented, achieving an increase in saturation up to 96%. Two 18G intravenous punctures were obtained and intensive fluid therapy was started, at the same time deciding on urgent transport to the emergency room. The patient was transported in a neutral position with constant control of airway patency along with the assessment of the quality and effectiveness of breathing, as well as monitoring of basic vital signs. A total of 1500 ml of fluids was transfused intravenously. In the reassessment, the pulse on the radial artery was present but remained filiform. The staff of the nearest emergency room, in whose structures the Acute Poisoning Department is located, was informed about the patient's condition and the approximate time of arrival of the ZRM of 24 minutes. Upon reaching the hospital, the patient in general serious condition was immediately admitted to the intensive care room in the emergency department. A protected solution was submitted for analysis, part of which the patient drank. The man was analgosedated and inducted into general anesthesia and then intubated. Endotracheal intubation was described as difficult. Significant swelling of the airways was found. Intubation was performed using a videolaryngoscope using a size 6.0 endotracheal tube. The patient was mechanically ventilated. After the respiratory tract supply, a continuous infusion of catecholamines and propofol was implemented using an infusion pump. Fluid therapy was also continued, obtaining a CTK of 120/70 mm Hg. The heart rate was stabilized and was about 80 beats per minute and the saturation level was 97%. A significant amount of hemolyzed blood was identified in the inserted gastric tube. In turn, red urine was collected from the inserted urinary catheter. In the general examination of urine, proteinuria was present, ketone bodies and erythrocytes were present, the pH remained normal. In a rapid study of the acid-base balance of arterial blood, metabolic acidosis was found. In turn, in laboratory blood tests, attention was drawn to the following results: Procalcitonin-5.21 ng / ml, WBC-12.9 thousand / ul, RBC-3.84 million / ul, HGB-11.9 g / dl, HCT – 35.6%. These results suggested sepsis with a high risk of progression and significant blood loss. In addition, the presence of ethyl alcohol in the blood at a concentration of 1.13 per mille was detected. The remaining results of laboratory blood tests were within the physiological norm. In the chest X-ray, bilateral inflammatory changes in the lower parts of the lungs, larger ones located on the left side, were described. In the laryngological assessment, the oral cavity was filled with saliva mixed with bloody contents. Macerated mucous membrane of the throat, soft palate and ovula swelling and maceration were present. Abdominal and pelvic tomographic examination revealed perfusion disorders and signs of inflammatory or toxic liver infiltration. In addition, there were disorders of the perfusion of the spleen, diffuse thickening of the wall of the esophagus and stomach, without perforation features. In addition, there was fluid in the vicinity of the curvature major and the spleen. The loops of the small intestine were widened with numerous levels of fluid suggesting paralytic obstruction. The patient was transferred to the Intensive Care Unit.

DISCUSSION

The etiology and types of poisoning are reflected in the current literature. In his publication, Joarder M. et al. describe a retrospective study of 1420 patients in which paramedics or medical dispatchers contacted the Poisons Information Centre (PIC) for advice on an episode of poisoning. The study group included patients from January 1, 2020 to December 31, 2020. It was shown that

about 35% of poisoning cases concerned children in the number of 492 patients. Of these, the most numerous subgroup were paediatric patients aged 1–4 years. With regard to the type of poisoning, it was observed that more than 53% of the study group was poisoning with pharmaceuticals (756 people), about 39% were exposed to chemical toxicity (557 people) and 4.9% were related to drug use intoxication (69 people). In cases of drug poisoning, the most commonly used substances were paracetamol, quetiapine and sertraline. Hospitalization after contact and PIC recommendations required about 54% of the subjects (761 people). About 30% of poisonings in the study group concerned incidents of intentional self-poisoning for suicidal purposes (428 people). The authors draw attention to the essence of cooperation between EMT and PIC, thanks to which paramedics receive information on the treatment possibilities in a specific type of poisoning, recommendations for the need to transport the patient to the hospital or outpatient treatment and observation when the condition did not require urgent hospitalization [5].

The analysis of cases of intoxication was also undertaken by Koziołek M. et al., who in their work compared suicide incidents by poisoning in two time periods in the years 1930-1939 and 2010-2019. In the first of them, 184 cases of suicide by poisoning were recorded. The most commonly used substances were carbon monoxide – about 23% of the study group (43 people) and corrosive substances, in particular acetic acid – about 18% (34 people) and hydrochloric acid – about 11% (21 people). Drug poisoning affected about 11% of the cases studied (20 people), of which the vast majority (16 people) involved intoxication with drugs from the group of barbiturates, including the use of soneryl, luminal and veronal. The remaining part of the group, i.e. (4 people) were exposed to unspecified hypnotics, the name of which was not specified. The remaining cases of poisoning concerned the harmful effects of mercury (II) chloride, accounting for about 7% of cases, cyanide in about 3% of cases, and arsenic in about 2% of cases. Few cases of intoxication with such substances as: carbolic acid, iodized tincture, sulfuric acid, soda lye have also been described. Among the other cases mentioned above, 2 incidents of sulfuric acid poisoning were identified. The authors also paid attention to age and gender in the study group. About 35% of poisoning cases were in men, and the average age was 31 years between 16 and 70 years [6].

The second study group concerned the time period 2010–2019 and included the observation of 138 suicides with the use of poison. A statistically significant gender difference was observed in the study group. The number of males was then about 70% of cases, while the average age was 35 years (range 15–71 years). It was also found that the type of substances most commonly used for suicidal purposes has changed. About 45% of all poisonings (62 people) were multidrug poisoning, while about 22% (31 people) were poisoned using a single drug. In total, more than 73% of the cases of the entire study group were subject to drug intoxication. The most common of these were cases of opioids, benzodiazepines, neuroleptics and antidepressants. Less commonly used were cardiac drugs, zolpidem, antiepileptics, hydroxyzine, barbiturates and non-opioid analgesics. Among extradrug-induced poisonings, fatalities were reported as a consequence of the consumption of new psychoactive substances, in particular legal highs: U-4770, HEXEN, dihydro-4-MCM in the amount of about 3% of cases in the study group and cannabinoids also in the amount of 3% of the population in the study group. Referring to the comparison in the first time period analysed, the authors conclude that the use of corrosive substances or carbon monoxide for suicidal purposes was rare between 2010 and 2019. No case of sulfuric acid poisoning has been indicated, so the case described in this paper is an unusual situation [6].

In the work Rao KN et al. Suicide due to sulfuric acid ingestion in a case of major depressive disorder, attention was drawn to the absence of obvious situations of exposure to sulfuric acid. An 18-year-old man was presented in whom poisoning and imminent threat to life caused by the use of sulfuric acid was not noticed in the physical examination undertaken. The man presented depressive symptoms, was calm, was not inclined to make verbal contact. In the course of hospitalization, it was decided to undertake therapy in the field of psychiatry. During the implementation of medical intervention, an irritating smell was smelled from a man. As a result of deteriorating vital signs (tachycardia), chest pain and epigastric pain, he was referred to the emergency department for diagnostics, verification of the life-threatening condition. The patient was exposed to oral sulphuric acid and the pain was a consequence of this exposure. The patient died two hours after starting treatment in the emergency department. The autopsy found massive damage to the digestive system and abdominal organs caused by the ingestion of sulfuric acid. Another case described in this way, in reference to the source work, confirms the ruthlessness of the lethal effect of sulfuric acid when taken orally [7].

In digestive burns by simultaneous oral and rectal self administration of ingestion sulphuric acid: an unusual mode of suicide by Soro KG et. al. Differences related to suicide through the use of sulfuric acid were presented. The described cases concerned the supply of sulfuric acid both by oral and additionally by rectal route. The described case studies involved two women aged 26 and 31. The first presented the initial symptoms of abdominal pain, vomiting and the presence of bloody diarrhea. She was diagnosed with esophageal burn damage in emergency endoscopy and bleeding damage to the entire colon and rectum. The patient died on the 30th day of treatment in intensive care. The second woman used the same suicidal method, causing damage to the esophagus, stomach and peritonitis. Surgical intervention was immediately undertaken, during which the patient died. On the basis of the analysis of the described

cases and the results obtained regarding the effects of exposure to sulfuric acid through the digestive and excretory systems, a high risk of death due to damage to numerous internal abdominal organs and disturbance of homeostasis of the body was confirmed [8].

CONCLUSIONS

1. Poisoning is a very broad concept, so each case should be approached individually and an appropriate algorithm for medical emergency procedures should be implemented.
2. Constant monitoring of vital signs and physical control examination plays an important element of the management due to the risk of a rapid change in the patient's clinical picture, including the development of shock being a life-threatening condition.
3. It is important to find the cause of poisoning, hence a medical history with the patient or witnesses of the event, family, is helpful. It is also important to carefully observe the scene of the incident in order to find a substance that could potentially be the cause of poisoning.
4. Based on observations, it appears that currently the most common method of intentional poisoning is taking medication. Cases of poisoning with corrosive substances occur statistically much less frequently.
5. In the case of oral poisoning with a corrosive substance, the timing of the implementation of hospital treatment plays a significant role. The timing of the intervention significantly affects the patient's further prognosis, although the initial chances of saving his life are low in the above diagnosis. The possibilities of saving the patient decrease with every minute of delay in the implementation of targeted treatment.
6. In the case of patients with inhalation poisoning or oral corrosive substances, there is a very high risk of airway obstruction disorders. In this situation, the need for endotracheal intubation should be considered.
7. Endotracheal intubation in patients with inhalation poisoning or oral corrosive substance is inherently difficult intubation due to possible swelling of the airways.

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CONFLICT OF INTEREST

The Authors declare no conflict of intertest.

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