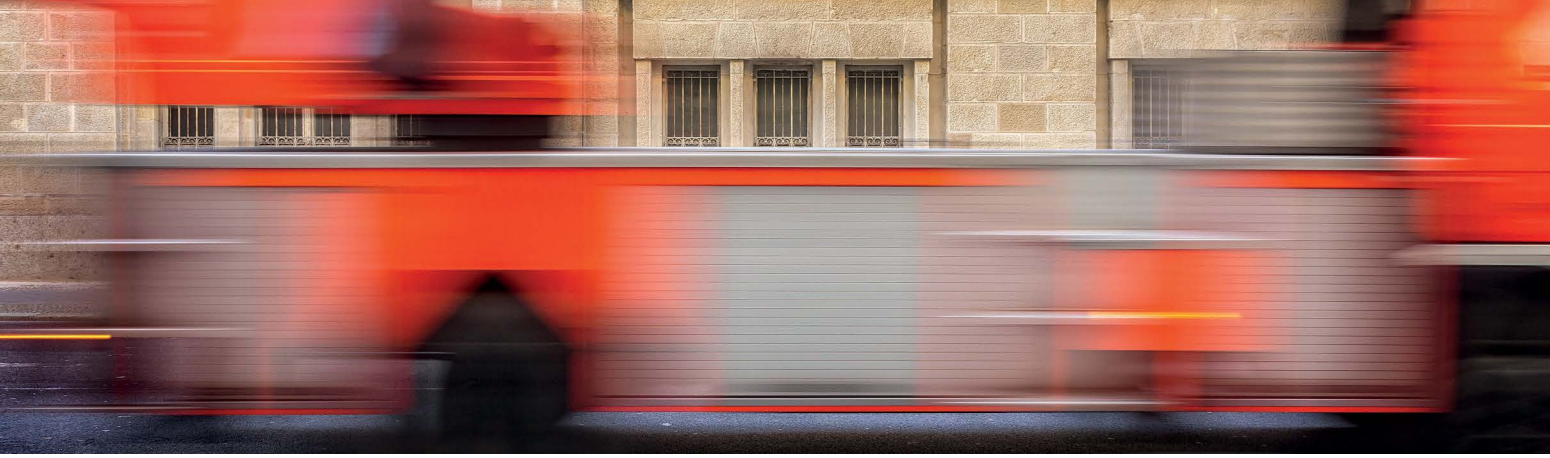

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TABLE OF CONTENTS

ORIGINAL ARTICLES

REVIEW ARTICLE

CASE REPORT

LETTER TO THE EDITOR

VIA MEDICA

ORIGINAL ARTICLE

Disaster and Emergency Medicine Journal
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PROFILE OF PRACTICES AND KNOWLEDGE ON STROKE AMONG POLISH EMERGENCY MEDICAL SERVICE STAFF

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ABSTRACT

BACKGROUND: Stroke is a leading cause of disability and death in both developed and developing countries. While hemorrhagic stroke often necessitates immediate neurosurgical intervention, ischemic stroke is treated with reperfusion therapies such as thrombolysis with intravenous recombinant tissue plasminogen activator (IV rtPA) and early endovascular thrombectomy for broad vessel occlusions.

OBJECTIVES: Early diagnoses, accurate emergency medical services (EMS) dispatch, rapid EMS transfer, and stroke team activation have helped reduce door-to-IV tPA time and continue to be critical in saving time for stroke patients' treatment.

MATERIAL AND METHODS: One reason for prehospital delays may be incorrect qualification by emergency team members due to incomplete medical records and incorrect evaluation of symptoms by dispatchers or paramedics. The dispatcher's precise identification of the report helps them decide on the patient's priority disposal of the ambulance. In comparison, a correct initial diagnosis by paramedics allows the patient to be transported immediately to the destination hospital, i.e., the unit with a stroke unit. Extending the time it takes for the patient to enter the stroke facility due to the patient being moved through stages reduces the probability of successful treatment being introduced significantly.

RESULTS: We hypothesized that paramedics' knowledge of prehospital stroke management protocols would be linked to their clinical experience as well as their stroke preparation.

CONCLUSION: A secondary goal of this study was to evaluate and compare the theoretical knowledge on stroke management among paramedics and identify factors associated with high knowledge. 468 EMS providers agreed to complete a questionnaire that included demographic questions, practical experience questions, and 14 theoretical information questions. Our research found that paramedics in Poland have significant awareness gaps in existing stroke treatment guidelines.

KEY WORDS: prehospital care, stroke, EMS, questionnaire, paramedics

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INTRODUCTION

Stroke is a significant cause of disability and mortality in developed and developing countries [1]. About 80–90% of cerebrovascular incidents are caused by ischemic stroke [2], which the most critical etiologies include large artery atherosclerosis (macroangiopathy), cardioembolism, and small-vessel cerebral disorder (microangiopathy).

So although hemorrhagic stroke frequently needs immediate neurosurgical intervention, ischemic

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stroke is treated with reperfusion therapies such as thrombolysis with intravenous recombinant tissue plasminogen activator (IV rtPA) and early endovascular thrombectomy for large vessel occlusions. Both methods are intended to recanalize the obstructed artery efficiently, preserve normal blood supply and, as a result, reperfuse brain tissue. Therefore, the central aspect preventing the usage of both thrombolytic treatment and mechanical thrombectomy in ischemic stroke is that both forms of therapy have a brief utilization period.

Early identification, accurate emergency medical services (EMS) dispatch, quick EMS transfer, and stroke team activation have helped to minimize door-to-IV tPA time and remain vital in saving time for the care of stroke patients [3].

Until 2021, the recommended treatment window was limited to 4.5 h for intravenous alteplase and 6–24 h for thrombectomy. Recent experiments have expanded these windows to patients chosen by imaging and have modified the definition from a set to an individual treatment window [4].

Additionally, as the time between the onset of stroke symptoms and the start of treatment increases, cerebral thrombolysis's effectiveness decreases. In mechanical thrombectomy, its drawbacks are the high cost of therapy and the probability of conducting it only in highly specialized facilities and a similarly restricted time window. Unfortunately, in 44 European countries, stroke authorities reported that only 7.3 percent of ischemic stroke cases underwent intravenous thrombolysis (95% CI 5.4–9.1), and 1.9% underwent endovascular therapy [5]. Therefore, the earliest possible completion of therapy and the prevention of undue delays remain a crucial component of clinical success in the stroke's acute phase.

Symptom detection by medical staff

One explanation for the incidence of prehospital delays may be incorrect qualification by emergency team personnel, resulting from inaccurate medical records and inaccurate diagnosis of symptoms by dispatchers or paramedics. The dispatcher's specific identification of the report allows deciding on the patient's priority disposal of the ambulance. In contrast, paramedics' proper initial diagnosis allows the patient to be transported directly to the destination facility, i.e. the unit with a stroke unit. Extending the time, it takes for the patient to reach the stroke facility, resulting from the patient being transferred across stages, dramatically decreases the likelihood of successful treatment being introduced.

To ensure proper prehospital treatment of suspected brain stroke and transportation to a specialist stroke unit, the Ministry of Health, in collaboration with State consultants in neurology and emergency medicine, issued guidelines on January 24th, 2019 — the so-called „Good praxis in treating patients with suspected brain stroke for medical dispatchers and EMS teams".

MATERIAL AND METHODS

Study design

The study was approved by the Institutional Review Board of the Polish Society of Disaster Medicine (approval No. 10.10.2020.IRB).

The questionnaire was developed using NB and ŁSz clinical expertise and was validated in a pilot study conducted in December 2020 in Warsaw, Poland. The comments of the participating EMS members were used to improve the wording of some items in the questionnaire and eliminate redundant questions. The pilot study also allowed to determine the time needed to complete the questionnaire.

The final version of the survey asked EMS providers about demographics, their practices — methods to identify stroke, ambulance management, the information they provide for prenotification, how often they prenotify hospital EDs of an incoming suspected stroke patient, and knowledge questions — such as the time windows for IV tPA administration and mechanical thrombectomy, stroke symptoms, and mimics.

The questionnaire consisted of both closed-ended and open-ended questions, using a combination of Likert scales, single- and multiple-choice questions, and free text fields to enable the collection of both qualitative and quantitative data. Participants were scored based on several correct answers. A scoring system was devised, with each correct answer earning one point and no negative marking. Every participant has graded a total score (0 being the lowest and 14 being the highest possible score).

Recruitment

A web link to the survey was sent by e-mail to members of the Polish Society of Disaster Medicine and the promotion of the survey on social media. The

survey was open for six weeks between January 1st, 2021, and February 15th, 2021.

STATISTICAL ANALYSIS

Statistical analysis was performed with the Statistical Package for Social Science (SPSS) version 27.0 software (SPSS, Inc., Chicago, IL, USA). We classified participants into less experienced (up to 10 years of professional experience) and more experienced (10 and more years of professional experience). Descriptive statistics were used to summarize the baseline characteristics of each group. Demographics were categorized by gender, years of experience, workplace, monthly duties, and the number of interventions in stroke patients per month.

Descriptive statistics were used to describe survey responses. Frequencies and proportions were used to describe categorical variables. Responses to open-ended questions were grouped and described using frequencies and proportions.

Table 1. Demographic and descriptive information

		n (%)
Gender	male	402 (86%)
	female	66 (14%)
Stroke patient interventions per month	less than 5	300 (64%)
	5 and more	168 (36%)
Has attended workshops/courses on stroke patient management	yes	258 (55%)
	no	210 (45%)
Years of professional experience	11–15 years	126 (27%)
	1–5 years	120 (26%)
	6–10 years	102 (22%)
	more than 15 years	90 (19%)
	less than one year	30 (6.4%)
Workplace	ambulance services	432 (92%)
	other	18 (3.8%)
	ED	18 (3.8%)
Monthly duties	less than 15	282 (60%)
	15 and more	186 (40%)

Table 2. Confidence levels regarding interventions

Confidence	mean (SD)	n
Unconscious patient	4.10 (0.633)	468
Stroke patient	4.25 (0.545)	468
Patient with traumatic brain injury	3.91 (0.629)	468
Patient with epilepsy	4.32 (0.631)	468

SD — Standard Deviation

RESULTS

Demographics, professional experience

A total of 468 EMS providers completed the survey. Of the participants, 239 (51%) were less experienced EMS providers, and 229 (49%) were more experienced. The mean age of the participants was 34 (SD = 7.33) years, and 402 (86%) participants were men, which corresponds to the male predominance in the profession. The majority of participants reported previous attendance to stroke workshops/courses (55%) and performed less than 5 stroke patient interventions per month (64%). Most of the responders work in the ambulance services and have less than 15 duties per month (60%). Demographic and descriptive information are summarized in Table 1.

Confidence level regarding interventions

Regarding confidence level, only 30% of the respondents reported that they felt very confident (value = 5) in their ability to recognize an adult patient in stroke. Table 2 summarizes confidence levels compared to the other neurological conditions.

Practices

Prenotification practice

According to the American Heart Association/American Stroke Association (AHA/ASA) guidelines [6], the duty physician, a neurologist of the required facility to whom the patient is delivered, should be told by telephone by the EMS or dispatcher about the patient's age, health diagnosis and symptoms, time of disease, and expected delivery time (prenotification).

Ideally, the EMS can send these details directly to the neurologist on duty as it enables having the most detailed patient records possible at the prehospital level.

Prenotification allows pre-registration of patient details in the goal hospital's database system.

These procedures significantly decrease the duration of early hospital administration for a patient with ischemic stroke, allowing the patient to be planned for admission (the so-called stroke alert) and the stroke unit practitioner to schedule advance access to hospital identification, laboratory, and brain imaging test instructions, as well as Ac-

cess to electronically accessible hospital and outpatient medical history. Only 63% of participants who prenotify hospital staff includes all the necessary information listed in the guidelines.

Stroke assessment scales

FAST was the most commonly used stroke assessment tool and is currently supported by national recommendations. Sensitivities for FAST ranged from 0.64 to 0.97 in four trials, with a summary estimated sensitivity of 0.86, according to a new Systematic Review reviewing the accuracy of clinical instruments for acute stroke assessment [7].

Management of hypoglycemia

According to AHA/ASA and European Stroke Organisation (ESO) [6,8], since symptoms of hypoglycemia can resemble those of a stroke, blood glucose should be tested in any patient with a suspected stroke. Hypoglycemia (defined as blood glucose < 60 mg/dL) should be treated in patients with acute ischemic stroke with glucose 20–40% in 25–50 ml infusion [9]. 76.3% of surveyed participants did not know the current recommendations — the most common mistake was the correction of hyperglycemia during ambulance transfer.

Management of hypertension

AHA/ASA and ESO guidelines for prehospital management of stroke highlight that also with systolic blood pressure near 185 mmHg, which can increase door to needle time, paramedics' immediate prehospital antihypertensive care presents a risk of unexpected decreases in blood pressure; thus, elevated blood pressure care in the prehospital period should be avoided. Almost 80% of paramedics could not provide an answer in line with current guidelines — with decreasing hypertension in the prehospital level being the most common mistake.

Knowledge

Respondents performed well on questions testing general knowledge of stroke — etiology, risk factors, pathophysiology, symptoms, types, components of the FAST scale. They also knew the differences between types of facilities that hospitalize stroke patients. An unsatisfactory percentage of respondents gave correct answers to topics related to stroke mimics, time windows for thrombolytic treatment and thrombectomy, and different stages of the survival chain.

Table 3. Summary of practices regarding prehospital management

Practice	Answer	n (%)
Prenotification	always	324 (69%)
	often	108 (23%)
	rarely	24 (5.1%)
	never	12 (2.6%)
Prenotification data	according to the guidelines	294 (63%)
	not according to the guidelines	174 (37%)
Prehospital scale used	FAST	228 (49%)
	not using any	162 (35%)
	both FAST and CPSS	36 (7.7%)
	both FAST and LAPSS	30 (6.4%)
	LAPSS	6 (1.3%)
	both CPSS and LAPSS	6 (1.3%)
Management of Hypertension	not according to the guidelines	376 (80%)
	according to the guidelines	92 (20%)
Management of Glycaemia	not according to the guidelines	351 (76.3%)
	according to the guidelines	111 (24%)

Table 4. Participants performance in individual questions and rates of correct responses

Task	Answer	n (%)
Correctly identified stroke etiology	correct	294 (63%)
	incorrect	174 (37%)
Knew difference between two types of stroke facilities	correct	312 (67%)
	incorrect	156 (33%)
Correctly identified at least 11 stroke symptoms	correct	348 (74%)
	incorrect	120 (26%)
Knew FAST scale components	correct	240 (51%)
	incorrect	228 (49%)
Correctly identified ischemic stroke types	correct	402 (86%)
	incorrect	66 (14%)
Correctly identified components of stroke chain of survival	incorrect	258 (55%)
	correct	210 (45%)
Correctly named at least four-stroke mimics	incorrect	270 (58%)
	correct	198 (42%)
Knew time window for thrombolysis	incorrect	307 (66%)
	correct	161 (34%)
Knew time window for thrombectomy	incorrect	245 (52%)
	correct	223 (48%)
Correctly developed FAST acronym	correct	338 (72%)
	incorrect	130 (28%)

Stroke chain of survival

As with the Chain of Survival, which is used to describe the sequence of events necessary to survive sudden cardiac death [10], the Chain of Recovery is a metaphor for the series of events that must occur during the emergency care of the possible stroke victim to maximize his or her chances of complete recovery [11]. The chain's critical links include the following: 1. Patient or bystander recognition of stroke symptoms; 2. Immediate activation of the Emergency Medical System (EMS) and proper dispatch with pre-arrival instructions; 3. Emergency medical response, assessment, evacuation, and appropriate prehospital care promptly; 4. Prenotifying the receiving stroke center to prepare and mobilize resources; 5. Rapid definitive diagnosis at a stroke center by experienced specialists.

The Chain of Recovery has been renamed the "Stroke Chain of Survival" in American Heart Association publications. The chain is made up of eight links, which are labeled the "Ds of stroke care" (detection, dispatch, delivery, door, data, decision, drug, and disposition) [9].

Stroke mimics

Stroke mimic is a non-vascular disease characterized by acute neurological deficits comparable to those associated with stroke. According to several small studies, up to one-third of patients evaluated acutely by a stroke team and up to 15% of patients treated with intravenous tissue plasminogen activator (t-PA) have such stroke mimics; possible etiologies include seizures, tumors, migraine, infections, delirium, peripheral nerve injuries, multiple sclerosis, and conversion disorders [12–14].

Time window — thrombolysis

Intravenous thrombolysis with alteplase is currently the standard treatment for acute ischemic stroke. IVT with alteplase remains the standard treatment within the 4.5 hours window after symptoms' onset. It is worth mentioning that after the survey was already disseminated, ESO issued the newest guidelines. High-quality evidence was found to recommend intravenous thrombolysis with alteplase to improve functional outcomes in patients with acute ischemic stroke within 4.5 h after symptom onset. Intravenous thrombolysis with alteplase is also recommended in patients with acute ischemic stroke on awakening from sleep, who were last seen well more than 4.5 h earlier, who have MRI DWI-FLAIR mismatch, and for whom mechanical thrombectomy is not planned [4].

Time window — thrombectomy

Mechanical thrombectomy (MT) is the gold standard of care for acute ischemic stroke (AIS) caused by anterior circulation large vessel occlusion within six hours of symptom onset and can be extended to 24 hours in selected patients [8].

High knowledge factors

To identify potential associations between high knowledge and demographic characteristics, we carried out a linear regression, with the outcome variable of total test score and the explanatory variables of experience, number of stroke interventions per month, previous attendance at workshops, number of monthly duties, and level of self-confidence regarding stroke.

We selected the candidate covariates from the set of collected variables so that there were less than 20% of participants with missing data or variables with less than 5% missing values. The covariates of experience, number of stroke interventions per month, previous attendance at workshops, number of monthly duties, and level of self-confidence regarding stroke were defined a priori based on data from the literature.

Participants were divided into two groups depending on their level of experience. We discovered that paramedics with less than 11 years of experience were more knowledgeable about stroke treatment than their senior colleagues. One potential reason for this disparity is that these junior employees have received their training more recently and up to date with guidelines. Our findings suggest where educational efforts should be focused on the national rising stroke burden and the improving availability of thrombolysis and thrombectomy.

With a 5% risk, by adjusting for the number of stroke interventions per month, previous attendance at workshops, number of monthly duties, and level of self-confidence regarding stroke, there is a statistically significant relationship between total test score and experience. Results of the logistic regression are presented in Table 6.

DISCUSSION

This survey's findings give a brief overview of paramedics' practices and knowledge regarding prehos-

Table 5. Summary of the answers provided by two groups

		Experience — less than 11 years (n = 239)	Experience — 11 years and more (n = 229)	n	p	test
Total test score, mean		7.91 (± 2.14)	6.76 (± 2.35)	468	< 0.001	Welch
Age, mean		28.8 (± 3.38)	39.3 (± 6.40)	468	< 0.001	Welch
Gender, n	Male	208 (87%)	194 (85%)	402	0.47	Chi2
	Female	31 (13%)	35 (15%)	66		
Stroke patient cases per month	Less than 5	151 (63%)	149 (65%)	300	0.67	Chi2
	5 and more	88 (37%)	80 (35%)	168		
Has attended workshops/ /courses on stroke patient management	Yes	100 (42%)	158 (69%)	258	< 0.001	Chi2
	No	139 (58%)	71 (31%)	210		
Practice — prenotification, n	Always	165 (69%)	159 (69%)	324	< 0.01	Chi2
	Often	56 (23%)	52 (23%)	108		
	Rarely	7 (2.9%)	17 (7.4%)	24		
	Never	11 (4.6%)	1 (0.44%)	12		
Prenotification data	According to the guidelines	188 (79%)	106 (46%)	294	< 0.001	Chi2
	Not according to the guidelines	51 (21%)	123 (54%)	174		
Management of Hypertension	Not according to the guidelines	203 (85%)	173 (76%)	376	0.011	Chi2
	According to the guidelines	36 (15%)	56 (24%)	92		
Management of Glycaemia, n	Not according to the guidelines	183 (76.5%)	174 (76%)	351	0.055	Chi2
	According to the guidelines	56 (23%)	55 (24%)	111		
Monthly duties	less than 15	144 (60%)	138 (60%)	282	1	Chi2
	15 and more	95 (40%)	91 (40%)	186		
Confidence — stroke, n	3	21 (8.8%)	5 (2.2%)	26	< 0.01	Chi2
	4	157 (66%)	144 (63%)	301		
	5	61 (26%)	80 (35%)	141		
	4	114 (48%)	120 (52%)	234		
	5	95 (40%)	97 (42%)	192		

Table 6. Results of the logistic regression

		Coefficients	p	p global
Professional experience	Ten years and more vs. less than ten years	-1.29 (-1.70; -0.885)	< 0.001	< 0.001
Stroke patient cases per month	Five and more vs. less than 5	0.882 (0.477; 1.29)	< 0.001	< 0.001
Has attended workshops/courses on stroke patient management	No vs. yes	-0.209 (-0.614; 0.196)	0.31	0.31
Monthly duties	15 and more vs. less than 15	0.824 (0.420; 1.23)	< 0.001	< 0.001
Confidence level — stroke	4 vs. 3	0.479 (-0.385; 1.34)	0.28	< 0.01
	5 vs. 3	1.20 (0.294; 2.11)	< 0.01	

pital stroke management. It is the first time a survey of this kind has been conducted in Poland. A few other interventional studies have tried to evaluate and then increase the expertise of the paramedic in a variety of methods, including training programs [15, 16]. The online training intervention conducted in Catalonia was successful in raising EMS professionals' awareness and prenotification compliance at stroke code activation and in achieving widespread adoption of a new prehospital stroke severity assessment scale (i.e., the RACE scale) [17]. In a study conducted by Hsieh et al., the 1-hour course presented basic stroke knowledge, such as stroke epidemiology, symptoms, diagnosis, treatment, and determining onset time [18]. The educational program increased knowledge about stroke and improved the accuracy of triage by dedicated EMS providers. When assessed immediately after the intervention, an educational lecture proved successful in enhancing stroke awareness in a similar study conducted in Dubai [19]. However, there is a need to re-evaluate paramedics' knowledge at regular intervals to determine the need for prehospital stroke management refresher courses.

Limitations of the study

This study has several limitations. Surveys are not knowledge tests, and respondents may not give a survey answer the same consideration that they would give to a knowledge examination; thus, the percentage of correct answers may not accurately reflect the survey participants' knowledge. Furthermore, respondents may provide answers that they believe are correct but do not reflect actual practice. Furthermore, responding to questions in a survey may not accurately reflect how one would respond in the field. The use of a convenience sample, which introduces the possibility of selection bias is another of the study's limitations. If survey participants did not respond because they were unsure of the correct answer, our findings might understate the number of incorrect answers and lack of stroke management knowledge.

CONCLUSION

This study has shown that in Polish paramedics' stroke knowledge is suboptimal and deficient regarding current prehospital guidelines. With recent advances in stroke care and the lack of education on stroke after initial training, it is not surprising that paramedics are unaware of existing procedures and the vital role they currently play in stroke care. The results of this study indicate the need to change paramedic education, the importance of combining education with prehospital stroke care in stroke detection by paramedics, and the need to prenotify patients within the window of care for thrombolytic and endovascular treatment.

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FIRST RESPONSE OF EMERGENCY HEALTH CARE SYSTEM AND LOGISTICS SUPPORT IN AN EARTHQUAKE

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ABSTRACT

BACKGROUND: An earthquake is an event that differs from any other disaster because it requires a multidisciplinary approach and affects all the people in the region where it occurs. The presented research aims to present healthcare, search and rescue, logistics and support to the magnitude 6.6 Elazığ earthquake by literature sight. This research also provides analysis of local and nearby support provided by Disaster and Emergency Management Authority (DEMA) (AFAD), 112 Emergency Health Services and National Medical Rescue Team (NMRT) (UMKE), equipment, timely manner and staff in the earthquake of Elazıg on 24.01.2020.

MATERIAL AND METHODS: A total of 1942 people, including 120 NMRT Teams (821 NMRT staff) and 276 staff 112 Ambulance teams, were assigned for medical rescue.

RESULTS: Victims: 12 injured and 5 exitus, who were triaged by 112 and NMRT teams, were pulled from the wreckage and transported to the hospitals within the first 30 minutes.

CONCLUSION: As in the Elazığ earthquake, the coordinated and cooperative work of all search and rescue and first aid teams of the region appeared to be one of the most important factors in reducing the mortality and morbidity of earthquake victims and maintaining life comfort.

KEY WORDS: equipment, timely manner, 112, UMKE, AFAD, logistic, staff

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INTRODUCTION

Earthquakes are natural disasters that have a great social impact as they damage infrastructures and cause many deaths [1]. Rapid response after disasters is critical for emergency logistics since emergency aid in the affected areas is required immediately. This issue has recently raised concerns as the outbreak of natural and man-made disasters (earthquakes, terrorist acts, tsunamis) [2] attracted attention.

Post-disaster early response is vital. As a result of the observations made during the earthquakes in Tangshan — China (1976), Campania-Irpinia — Italy (1980) and Armenia (1988), 85–95% of the victims trapped in damaged buildings were rescued within 24 hours. The rates of pulling victims alive after 24 hours are low. It was detected in the post-earthquake studies in Turkey and China that unfortunately less than 50% of the trapped victims were found alive between 24-hours interval after the earthquake. Time is even more important for the victims with conditions such as hemopneumothorax or limb crush injury [3] that can be treated and recovered.

This study aims to present the importance of coordinated and cooperative work of search and

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rescue of first aid teams in reducing the mortality and morbidity of earthquake victims.

MATERIAL AND METHODS

A magnitude 6.6 earthquake with a surface depth of 5 km epicentre of which was Elazığ Sivrice and which lasted 22 seconds occurred on Friday, January 24, 2020, at 20:55.

Starting from the first report after the earthquake the authors retrospectively evaluated the first case given by authorities, moving to the hospital, rescuing, identifying and moving the disaster victims, the hospital treatment processes, determining tent areas, the cooperative work of 112, NMRT and DEMA officers of the region and from the support provinces, examining patients and 112 files and photo images.

RESULTS

After the magnitude 6.6 earthquake that lasted 22 seconds and the epicentre of which was Sivrice, the first call came from Mustafa Paşa District Tahir Şaşmaz Street at 20:56. The Emergency Health Station Team No. 1, which was 2.680 meters away from the location, was the first 112 team to arrive there in 4 minutes. Intense radio talks started from this minute. A number of calls reached the command control centre (CCC) in two hours on the day of the earthquake (Fig. 1). It is seen that the number of calls increased by 8–9 times. There was a total of 39 112 stations in Elazığ province, 13 in the centre and 16 in the districts.

After the earthquake report, 112 CCC started to receive an increased number of calls. Calls continued to be received from the moment of the earthquake. 412 calls were answered from the time of the incident, from 20:55 to 21:55 (the first 60 minutes) (Graph 1 and 2). In addition, medical-based calls and non-medical calls were answered completely, and the other team directions were made. Due to this volume, CCC announced the immediate operating of all NMRT and 112 teams. Graph 1 and 2 show calls received by CCC every 2 hours after the earthquake that happened at 20:55.

Since busy radio communication was predicted from that minute, a mobile repeater was established in a suitable location that could overlook the city, and contacts were provided by offering NMRT teams the possibility of communication between the headquarters and themselves by establishing a different channel than the existing 112 channel. Then, the teams were followed by including the Mobile Command and Control Centre vehicles in the system.

The triage of the injured was done by 112 and NMRT teams that reached the wreckage areas. 112 teams were ordered by CCC via radio announcement to take the injured people to the most appropriate facility accordingly to the victim's condition. In the first 30 minutes after the earthquake, 12 injured and 5 exitus were rescued from the wreckage and transported to the hospitals.

A total of 30 injured people was rescued from the wreckage and transported to the hospitals in Elazığ province: 19 victims to Elazığ State City Hospital and 11 victims to Firat University Hospital.

All staff alerted the Ministry of Health with the earthquake message received from DEMA after the earthquake, and a total of 1942 people were assigned for medical rescue; 120 in NMRT Teams and 821 in NMRT staff. A total of 276 112 Ambulances and 1121 of 112 staff from across the country, especially from nearby support provinces (Tab. 1), were directed for logistics support (Tab. 2). Sent equipment allowed to establish in the province a mobile

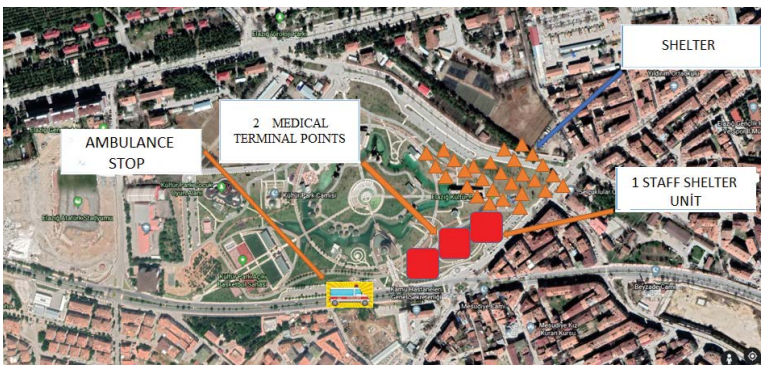

FIGURE 1. The map showing medical terminal points settled in Kültürpark, tent cities and staff accommodation tents

Table 1. Table showing the transportation times and staff support of the first and second support provinces after the earthquake

Number	Province	NMRT (UMKE)	112 Ambulance	NMRT Staff	112 Staff	Additional UMKE Staff	Total Staff	Departure	Arrive
1st Support Province	MALATYA	1	20	5	60		65	00:10	01:19
1st Support Province	TUNCELİ	1	7	5	21		26	21:30	22:30
1st Support Province	BİNGÖL	2	7	10	21		31	21:08	22:18
2nd Support Province	DİYARBAKIR	4	30	26	94	20	140	21:15	22:38
2nd Support Province	BATMAN	4	4	20	12	3	35	21:30	12:00
2nd Support Province	MARDİN	1	2	5	6		11	22:00	00:40
2nd Support Province	SİİRT	2	2	10	3	4	17	22:30	02:00
2nd Support Province	ŞIRNAK	2	2	10	6	3	19	23:15	03:45
2nd Support Province	ERZİNCAN	1	5	5	15		20	22:15	01:00
2nd Support Province	BAYBURT	2	2	10	6		16	22:10	02:30
2nd Support Province	ERZURUM	2	3	7	9		16	21:20	00:34
2nd Support Province	KARS	2	5	10	15		25	22:45	02:55
2nd Support Province	IĞDIR	1	1	5	3		8	22:25	06:40
2nd Support Province	ARDAHAN	1	1	5	3		8	23:19	05:26
2nd Support Province	SİVAS	3	3	15	9	8	32	23:00	02:25
2nd Support Province	TOKAT	1	2	5	6		11	22:35	05:25
2nd Support Province	MUŞ	2	3	10	9		19	21:22	00:12
2nd Support Province	BİTLİS	2	6	10	18		28	22:40	02:20
2nd Support Province	VAN	2	4	10	18	4	32	21:37	02:38
2nd Support Province	HAKKARİ	1	2	5	6		11	22:40	07:50
2nd Support Province	K.MARAŞ	1	8	5	24		29	22:00	02:20
2nd Support Province	GAZİANTEP	2	3	10	9	2	21	21:45	05.00
2nd Support Province	ADIYAMAN	2	2	10	6		16	21:25	00:15
2nd Support Province	Ş.URFA	2	2	10	6	2	18	21:45	01:40
2nd Support Province	KİLİS	1	3	5	9	2	16	00:30	05:30

Table 2. The table showing logistic support and numbers

Logistic Support Equipment	Provinces	Number
Helicopter Ambulance	Malatya 2, Sivas 1	3
Plane Ambulance	Ankara	1
Mobil Call centre Vehicle	Samsun, Malatya, Diyarbakır, Konya, Gaziantep	5
Logistic Vehicle	Gaziantep	10
Truck	Diyarbakır	9
Lorry	Diyarbakır	5
Unit of field Hospital	Gaziantep	8
Unit of staff shelter	Mersin, Gaziantep, Diyarbakır, Ankara	4
Mobile Hospital with 50 beds	Trabzon, Antalya, Kayseri ve Eskişehir	4
Equipment of Mobile Hospital	Şırnak, Mersin, Gaziantep Ve Erzurum	4

hospital with a total of 250 beds. Table 1 shows first and second support province reaction times and staff support. Table 2 shows all province logistics supports and numbers.

About 5 hours after the earthquake, Province Health Disaster Coordination Centre (PHDCC) was constituted with the subordinate command and control centre by installing a communication radio assembly at a department that wasn't affected by the earthquake in the old Military Hospital for the emergency health services. It was going to be conducted by Provincial Health Directorate, and the management of the crisis was taken over from CCC. The work programme of NMRT and 112 teams coming from out of the province was formed, and their pairing with the command-and-control centre was performed.

As from the 48th hour, 9 medical terminal points were settled (MTP) to satisfy the need-based medical needs and chronic diseases near wreck sites, at collective accommodation areas and thoroughfares and in each point. 1 doctor, 5 NMRT staffs and a 112 team of 3 people gave service (Tab. 3). At the emergency units, 1227 patients in the first 7 days and a total of 3509 patients in 17 days were treated. The map of medical terminal points settled in Kültürpark, tent cities and staff accommodation tents are shown in Figure 1.

In this earthquake which occurred in Elazığ province, the total number of injured was 974; 37 people of whom 18 were female lost their lives. The average age of the victims was 46.

There were 35 inpatients, 4 of them were in the ICU unit and had 44 different diagnoses. All patients survived treatment procedures.

12580 people ended up homeless due to the earthquake. All victims that were pulled out of wreckages were vaccinated against tetanus. As of 7.02.2020, the total number of collapsed, urgently to be pulled down and heavily damaged buildings was 8519 and the number of collapsed, urgently to be pulled down and heavily damaged individual units was 19821 (Tab. 4). There were 3843 pitched tents and 2453 of them were filled.

DISCUSSION

While responding to the earthquakes, the two most important aspects are the evacuation of people and the logistics of equipment. Evacuation is the first step of the emergency action phase as it clears the area from the injured and dead. Logistic activities take much more time since they aim to provide necessary disaster relief articles for the people in

Table 4. The table showing the Building Structures of Elazığ after the Earthquake

Elazığ Province		
	Number of Buildings	Separate Parts
Undemolished	25851	102812
Minimal damage	15671	66265
Mid damaged	1540	13867
Heavily damaged	7698	17578
Collapse	263	397
Urgently to be pulled down	558	1846
Unstable (non-enterable)	9571	
Total	61152	202765

Table 3. The table showing MTP areas and staff contents

	Area	Doctor	NMRT (UMKE)		112		MTP	Shelter	Total Unit
			Vehicle	Staff	Vehicle	Staff			
1	Kültür Park Sheltering Area	2	2	10	2	6	2	1	3
2	Ahmet Aytar Area	1	1	5	1	3	1	0	1
3	Cumhuriyet Fuar Area	1	1	5	1	3	1	1	2
4	Mustafa Paşa District Area	1	1	5	1	3	1	1	2
5	Sürsürü District Area	1	1	5	1	3	1	0	1
6	Sanayi District Area	1	1	5	1	3	1	0	1
7	Gezin Waist	1	1	5	1	3	1	0	1
8	Sivrice District	1	1	5	1	3	1	0	1
Total		9	9	45	9	27	9	2	11

the affected area and transport the injured people to the hospitals or emergency medical units in the affected area. Therefore, planning logistic activities adequately at the phase of responding to an earthquake may decrease human life loss at a vast scale in earthquakes.

The basis of logistics is based on transporting the supplied correct products and equipment at the right time and amount, at a convenient place and to the right people. Disaster logistics is the process of controlled planning and applying goods, support, and related knowledge to meet the needs of people in need to the very last needed point [4]. This process includes logistic activities such as supplying necessary materials (inbound logistics), storing for use when necessary, transporting to related places when necessary (outbound logistics) and tracking as in Business Logistics. However, the application area of Disaster Logistics is much more difficult than Business Logistics in terms of current conditions. Especially a great amount of uncertainty prevails [5] in regards to what is going to be transported, when, how much, where, and how often — this process shows very rapid alterations. Transporting all kinds of necessary support, equipment and services to the disaster victims completely and punctually most of the time in long distances in instantly changing conditions becomes more of an issue. Moreover, such disasters affect transportation infrastructure. Inefficacy of airlines or maritime lines because of confluence, infrastructure failures at highways and railways, and the height limits at tunnels or bridges are examples of what prevents carrying out logistic activities effectively [4]. For this reason, alternative means of transportation, transportation routes and distribution channels should be determined according to different scenarios [6]. For example, in an earthquake that occurred in China in 2008, 150 tons of material were sent to the disaster area by air in one day by 19 helicopters and 6 cargo planes along with 5800 medical and rescue units [7]. In the Elazığ earthquake, logistics support of the disaster area was provided co-ordinately both by air and overland.

Collective human movements following disasters can cause significant increases in morbidity and mortality. Collective human movements can seriously complicate the distribution of the planned aid, needs assessments, and transportation of the planned service. It is difficult to intervene for help without information about the location of the affected people [8]. Various projects can be prepared for the implementation of this real-time method, which can make a great contribution to coordinating the search, rescue and first aid, evacuation, and services in Turkey. This may enable transferring the right support to the right people at the right point. In the Elazığ earthquake, the establishment of MTPs in safe places near the wreck areas and near the busiest places of the centre increased the functionality.

Apart from trauma, the most common reason for late mortality after the earthquake is rhabdomyolysis caused by crush syndrome. Acute renal failure following a crush is one of the life-threatening complications and is a reversible treatable condition.

Other complications that may develop after a crush are sepsis, ARDS, DIC, bleeding, hypovolemic shock, heart failure, arrhythmia, electrolyte imbalance and psychological trauma. General disaster algorithms are based on operation plans, transportation, hospitalization, organizing medical staff, early surgery, and the triage strategy for medical intervention. Sever et al. stressed that crush syndrome and kidney failure are as important as general disaster algorithms [9]. They stated that mortality will decrease in health services with appropriate treatment protocols. This study reveals that these complications were noted in the hospitalized cases and none was mortal.

The magnitude 7.2 earthquake that occurred in Van on 23rd October 2011 caused the death of 604 people. 72242 places were detected as ruined and severely damaged [10]. In the Elazığ earthquake, 37 people were killed, and 7961 places were detected as ruined and severely damaged even though the severity was different. The high number of damaged and ruined buildings in Van suggests that the buildings were not built earthquake resistant, and loss of lives was high accordingly.

An increase in 112 calls after the earthquake, triage, and patient registration problems as a result of the increase of inpatient admissions to emergencies, insufficient space to examine the patients, communication problems, increased application of non-earthquake victim patients and problems in patient transport are among the problems that occurred within the first 24–48 hours in emergency services [11–16]. MTPs were established to avoid similar problems in the emergency services of the hospitals in Elazığ and patients were looked after there. There was no registration problem for the patients who applied to the hospitals.

When the post-earthquake admissions to the services were examined in the Marmara earthquake, the Orthopaedics and Traumatology Clinics took place on the top and while 147 of the 330 wounded were hospitalized in the Orthopaedics and Traumatology Clinic, other patients were hospitalized in the general surgery, plastic surgery, and cardiothoracic surgery services [17]. It was observed that most of the patients hospitalized in Kartal Training and Research Hospital after the Marmara earthquake were in the orthopaedic and traumatology service and 96 of the 160 surgeries were performed for orthopaedic reasons, while other surgeries were laparotomy, tube thoracostomy, head and facial bones fixation [11].

In the Gujarat earthquake in India, orthopaedic injuries were at the forefront in 234 (51%) of the wounded [18]. In the Van earthquake, most of the cases were patients of Orthopaedics and Traumatology [10]. In the presented study, 15 of the 35 hospitalized patients were followed up in the Orthopaedics service and were determined as following the literature.

In the magnitude 7.2 earthquake that took place on October 23, 2011, 37 people who were pulled in the Erciş district lost their lives in the hospitals where they were treated. In the Elazığ earthquake, no one died during the treatment. Although the intensities were different, it is believed that immediate treatment and subsequent treatment methods may have caused this difference.

When the post-earthquake deaths are examined, it draws attention that 50% of the deaths are from the young population between the ages of 20–40. Most of the deaths in the Sultandağı earthquake are in the group over 65 years old [19].

In the Elazığ earthquake, the average age of the deceased was 46. The authors believe that what affects the average age of the affected population is whether the region where the earthquake occurred is urban or rural. This will change the needs for prevention and treatment in both acute and chronic periods.

In the Erciş earthquake, 159 NMRT and 7 healthcare teams reached the scene in the first 6 hours. This shows how successfully the mobility and organization capability of Emergency Healthcare Services was organised, even though it was at night.

The authors' biggest wish is that such disasters like earthquakes that deeply affect the entire society never happen. In Turkey which is in the 1st-degree seismic zone, the Elazığ earthquake will probably be followed by others. Therefore, an appropriate preliminary preparation must be made and DEMA-NMRT, NMRT-112, 112-hospital, intra-hospital and inter-hospital communication and effective triage should be given importance. It should be ensured that all healthcare staff is prepared for such disasters by conducting both in-house and inter-institutional practices as in the disasters. As in the Elazığ earthquake, both regional and national effective healthcare organization will help keep disaster losses at a minimum level.

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USE OF INFILTRATIVE ANESTHESIA IN ACUTE ANTERIOR DISLOCATION OF SHOULDER

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ABSTRACT

BACKGROUND: To evaluate the results of infiltrative anesthesia for manual closed reduction of acute primary anterior shoulder dislocation.

MATERIAL AND METHODS: A total of 55 adults with acute anterior dislocation of shoulder who were treated with Hippocratic maneuver were evaluated. Infiltrative anesthesia was applied directly to the deltoid muscle from two anatomic locations in anterolateral and posterolateral of the shoulder with prilocaine hydrochloride and bupivacaine (Citanest® + Marcaine®) was applied to all patients. All patients' reductions were made by the same orthopaedic surgeon. Visual Analog Scale (VAS) of pain was applied to all subjects for evaluating the pain in management after the treatment. Demographic and clinical data, time of duration for reduction, and duration of hospitalization were recorded.

RESULTS: Mean age was 57.9 ± 4.5 years, 22% were women. The reduction was completed with the mean duration of 1.0 ± 0.3 minutes after applying infiltrative anesthesia. The mean VAS scores of the patients used infiltrative anesthesia were 4.6 which indicated moderate pain. The treatment was completed in the emergency room so that patients could be discharged after reduction in the emergency department. No recurrence and complications were observed in the one-year follow-up period.

CONCLUSION: Our study showed that infiltrative anesthesia, in addition to its easy management by orthopaedic surgeons, allows successful and fast reduction by avoiding difficulties caused by the contraction of the deltoid muscle without necessitating sedoanalgesia or general anesthesia.

KEY WORDS: acute, shoulder dislocation, infiltrative anesthesia, emergency

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INTRODUCTION

Anterior shoulder dislocations (ASD) are the most frequent emergency consultation reasons for orthopaedic surgeons [1–3]. The selection of the type of anesthesia and analgesia is very important to achieve reduction quickly and without complication. Several studies have reported different anesthesia methods for the reduction of ASD [4–6]. Currently, intra-articular, sedative and intravenous anesthesia methods are used in orthopaedic clinics [4–6]. In our clinic, both of the methods for anesthesia have been used. Infiltration of local anesthetics around the joint as an analgesic adjunct for postoperative joint surgery pain has been used for decades [7–10]. However, there is no evidence in using for the management of ASD.

Also, several reduction methods for manual closed reduction of acute primary ASD have been

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used such as Kocher, traction-countertraction, scapular manipulation, modified Stimson and Hippocratic method to which we used for this study [1–3, 11, 12]. There is no consensus about anesthesia options and reduction methods. This is a very ancient method — as the name suggests — and it has relatively recently been revived as perhaps the safest method of shoulder reduction [11]. The Hippocratic maneuver is preferred in our center due to its educational value. Besides, this safe maneuver can be quickly applied with a limited number of medical staff.

The most important point in choosing the method of anesthesia in ASD reduction is patient comfort achieved by pain management. Anesthesia relaxes the muscular spasm and thus facilitates reduction. The aim is to relocate the shoulder while minimizing the risk of complications. Choosing the right method of anesthesia greatly reduces the incidence of complications. Anesthesia should provide pain control, increase patient comfort and not cause complications. The surgeon should choose a safe method that is easy to administer. A method of anesthesia that does not require the presence of an anesthesiologist shortens the procedure and lowers the cost. The aim of our study was to report the results of infiltrative shoulder anesthesia in manual closed reduction of acute primary ASD.

MATERIAL AND METHODS

A total of 55 adults with acute ASD aged 38–74 years (43 men and 12 women) were recruited to the study between July 2013–July 2017. All patients who applied with acute primary ASD to the emergency service were evaluated for the study. All patients signed a written consent form. Ethics committee approval was received for this study from the local ethics committee of our institute. 55 patients were included in the study after exclusion of patients who had recurrent ASD, dislocation with fracture, inferior and posterior dislocation of shoulder and patients with alcohol addiction and a history of allergic reactions with local anesthetics.

Infiltrative anesthesia applied with prilocaine hydrochloride 2.5 cc + bupivacaine 2.5 cc (CitanestR + MarcainR) for all patients with the dose of 3–4 mg/kg (maximum single dose not to exceed 500 mg for prilocaine hydrochloride and 2–2.5 mg/kg (maximum single dose not to exceed 175 mg) for bupivacaine [13, 14]. Infiltrative anesthesia was applied directly to the deltoid muscle from two anatomic locations in the anterolateral and posterolateral shoulder (Fig. 1a–c). All the patients' shoulders were reduced using the Hippocratic maneuver by the same orthopaedic surgeon. The duration of the reduction and the duration to discharge were recorded by the medical assistants.

Demographic data such as age, gender, smoking and alcohol consumption status, recurrence of ASD was recorded. In addition, VAS was measured to assess the improvement in pain, with a scale of 0 representing no pain and 10 representing extreme pain. The version of VAS used in this study was standardized into Turkish [15]. VAS is a unidimensional measure of pain intensity, which is widely used in diverse adult populations. To rule out memory problems, patients were numbered between 0 to 10 on the questionnaire due to their pain severity in one-hour time after management. VAS was measured 30–60 minutes after reduction.

All the patients were followed with Velpau bandage after reduction for two weeks. The rehabilitation

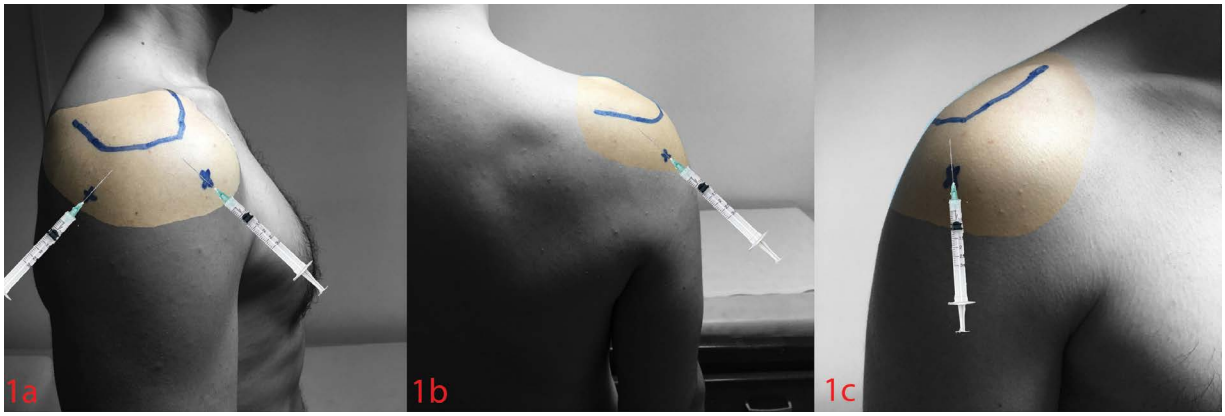

FIGURE 1. Demonstrates the method of performing infiltrative anesthesia procedure; 1a: lateral view, 1b: posterior view, 1c: anterior view

program was started after the third week from the management to gain a normal range of motion. All patients were reevaluated in the clinic one year following reduction.

Data analyses were performed by using SPSS for Windows, version 22.0 (SPSS Inc., Chicago, IL, United States). Data was described as mean ± SD and for normal distributions, and categorical data were described as a number of cases (%).

RESULTS

The study included 55 patients who applied to the emergency service with acute ASD. Of these, 76% were men. The mean age of the patients were 57.9 ± 4.5 years. Three patients who consumed alcohol reported their consumption as less than once a month and more than three times in a year. None of the patients had a history of alcohol or tobacco consumption. The mean duration of reduction was recorded as 1.0 ± 0.3 minutes. Reductions were completed in the emergency room for all patients and none of the patients needed hospitalization. Complications such as fracture or neurovascular damage were not observed. Mean VAS scores of the patients with infiltrative anesthesia were indicated moderate pain. Also, discharge of duration from emergency service after reduction varied between 64.1 minutes to 117.5 minutes. Table 1 summarizes the demographic and clinical data of the patients.

All the patients were evaluated with shoulder MRI in the third week of follow-up. Bankart lesions were detected in 5/55 patients. All five patients with Bankart lesions were elderly patients with sedentary lifestyles and were given conservative treatments for this reason. We choose surgical treatment for patients younger than twenty-five who actively participate in sports and conservative treatment for patients older than forty. Partial rotator cuff tears were detected in 10/55 patients who is older than 54 years old.

All the patients have still been followed up with a normal range of motion in the shoulder after an appropriate rehabilitation program.

DISCUSSION

The optimal type of analgesia and sedation has been subject to debate for a long time in the literature but limited sample sizes and assessments make choosing difficult. A consensus on the optimal type of analgesia has not been reached in meta-analyses [12].

Some studies intravenous anesthetics such as ketamine, propofol, fentanyl alone or their combinations. Some authors preferred midazolam for sedative anesthesia because of its pharmacological properties. Midazolam is a very useful agent with a rapid onset and short half-life and which results in a rapid offset of effect and faster recovery. But adverse effects such as respiratory depression, drowsiness, vomiting, nausea, headache and hypotension have been reported [16–17]. Prilocaine hydrochloride and bupivacaine were preferred in our study for intra-articular anesthesia although other studies mostly used 1% lidocaine [12].

Compared to other studies, our success of reduction is very high with a percentage of 100%. Fitch et al reported 89.9 % success with intra-articular anesthesia and 95.6% success in the patients who received intravenous anesthesia [18]. The success

Table 1. Differences in demographical and clinical outcomes between infiltrative anesthesia and intravenous anesthesia

	Infiltrative anesthesia	Intra-venous anesthesia	P value
Mean Age	57.9 ± 4.5	58,1 ± 5.1	0.144
Sex ratio	2 F/18 M	1 F/14 M	
Recurrence of ADS	No	No	
Duration of reduction (minutes)	2.86 ± 0.85	4.21 ± 1.15	0.044
Adverse effects	No	respiratory depression and hypoxemia in 2 patients drowsiness in 1 patient nausea in 1 patient	
VAS scores	8.2 ± 0.9	7.6 ± 1.2	0.088
Discharge duration (minutes)	90.8 ± 26.7	550.6 ± 180.5	0.014

ADS — Anterior shoulder dislocations; VAS — Visual Analog Scale

rates are variable due to time of application for the dislocation, time for reduction after the dislocation and surgeon's level of expertise [19–20].

The effect of anesthesia on pain is an undeniable fact. The main power of our study is the objective measurement of pain scores. Consistent with the literature, lower VAS scores were obtained compared with the other anesthesia methods [21].

The overall duration of reduction and discharge, not surprisingly, was shorter in this study [22–23]. If the measurement of the effectiveness with pain is enough for researchers, this result revealed that cost-effectiveness is higher in infiltrative anesthesia.

Successful reduction without complications is very important for orthopaedic surgeons. Also, the duration of hospitalization and discharge are directly affected by the complications. We observed no complications with infiltrative anesthesia and Hippocratic maneuver. This is one of the most important reasons why we suggest using infiltrative anesthesia. There are frequent reports of nausea, drowsiness and hypoxemia with sedoanalgesia in the literature [4, 24].

Duration of hospitalization and discharge are affected by several factors such as dosage of anesthesia, development of complications, technique of reduction, experience of surgeon and medical team. In our study, we found a decreased time of duration for discharge. These results are believed to be related to lower complication rates and the use of the same technique for all patients by the same orthopaedic surgeon.

This study has some limitations. We applied the VAS questionnaire after the reduction that mainly depends on patients' memory. Another limitation is the number of participants and the lack of female patients.

Infiltrative anesthesia allows successful reduction without necessitating sedation or general anesthesia by avoiding deltoid muscle spasm and pain and can easily be applied by orthopaedic surgeons. We were able to carry out reduction in a shorter time with less pain using infiltrative anesthesia. Application of intramuscular anesthesia to the points using doses described in the text has resulted in success in terms of both patient and surgeon comfort. However, due to the low number of patients, these results need to be evaluated in a double-blinded randomized study with larger sample size.

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USB-ENDOSCOPE LARYNGOSCOPE IS AS EFFECTIVE AS VIDEO LARYNGOSCOPE IN DIFFICULT INTUBATION

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ABSTRACT

BACKGROUND: Video laryngoscopy (VL) has recently been put into clinical use to minimize the limitations of direct laryngoscopy and assist physicians interested in airway management. However, the high cost is the biggest constraint especially in countries with limited resources. To lower the cost, a custom-made VL obtained by attaching a USB-endoscope camera ($8.5) to the Macintosh laryngoscope (USB-L) can be used.

MATERIAL AND METHODS: All intubations were performed in a difficult intubation model. Intubations were carried out by two emergency physicians. A Glidescope as a VL and a custom-made USB-L were used. In addition to these devices, one bougie to facilitate the advancement of the tube was used. The total intubation time was evaluated.

RESULTS: Correct tube placement for both operators was 100% for both devices. A difference between the operators in the duration of intubations could not be found. Also, there is no difference in the duration of intubations between the devices for both operators.

CONCLUSION: It was concluded that the USB-L and VL are not statistically different in terms of intubation time in the difficult intubation model using bougie. For countries with limited resources, the low-cost USB-L has come to the forefront due to the high cost of VL and difficulty of access.

KEY WORDS: difficult intubation, video laryngoscope, bougie, mannequin, intubation time

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INTRODUCTION

Direct laryngoscopy is a widely used method for endotracheal intubation in the emergency department. Video laryngoscopy has recently been put into clinical use to minimize the limitations of direct laryngoscopy especially in difficult intubation [1, 2]. However, the high cost is the biggest constraint to this method's use, especially in emergency departments of countries with limited resources [3]. To overcome this situation, it has been suggested that a custom-made video laryngoscope obtained by attaching a universal serial bus (USB) endoscope camera to the Macintosh laryngoscope can be used for the same purpose [4]. It has been reported that this custom-made device (the USB-L) can assist in experimental studies and education of medical, paramedic students, and emergency medicine residents [5].

A study was carried out in India on the use of a custom-made laryngoscope in a clinical setting. The authors intubated half of 40 patients with similar age, gender, physical characteristics, American Society of Anesthesiologists, and Mallampati score with a Miller direct laryngoscope and bougie. The other half were intubated with a USB-L. There was no difference between the groups in terms of heart rate and mean arterial pressure after intubation.

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Although the mean of the total intubation times was shorter using the USB-L, there was no statistically significant difference between the two groups ($p = 0.712$) [6].

It is shown that a USB-L provides similar vision, clarity, and ease of intubation to that of expensive video laryngoscopes [7]. The trials carried out by clinicians with this device will provide an idea for companies that can produce low-cost devices that can be connected to smartphones. In addition, during the COVID-19 pandemic, that custom-made devices like the USB-L will help protect healthcare professionals in high aerosol-forming processes in difficult intubation. However, there is no proof that USB-L is effective as a video laryngoscope in difficult intubation.

This study aimed to evaluate custom-made USB-endoscope laryngoscope effectiveness in difficult intubation compared to a well-known video laryngoscope.

MATERIAL AND METHODS

All intubations were performed using the AirSim Advance Bronchi X intubation simulator model (mannequin) (TruCorp, Armagh, N. Ireland) and a difficult airway. Difficult AirSim Airway featured enlarged tongue oedema with an elongated notched epiglottis.

As the low-cost USB endoscope ($8.5), a 5 mm diameter was used, waterproof, illuminated device compatible with Android, 480p and 0.3-megapixel resolution. Similar to previous studies, the USB endoscope was attached approximately 40 mm behind the tip of the traditional Macintosh direct laryngoscope (Fig. 2). The visual orientation was checked before attaching as described previously [5]. The USB camera was linked via a USB cable to the laptop and a micro-USB cable to the mobile device. The CameraFi (Vault Micro Inc., Seoul, Korea) software on the Android phone was used. Before each intubation, the USB camera and the cables were cleaned with alcohol-based medical device surface disinfectants.

We used a Glidescope-Titanium MAC T4 with a 60° hyper angulated blade (Verathon, USA) as a reusable video laryngoscope. In addition to these devices, one bougie in both methods was used to facilitate the advancement of the tube.

Intubations were carried out by two emergency physicians experienced in intubation. The order of difficult intubation with USB or video laryngoscope was randomized with rolling dice.

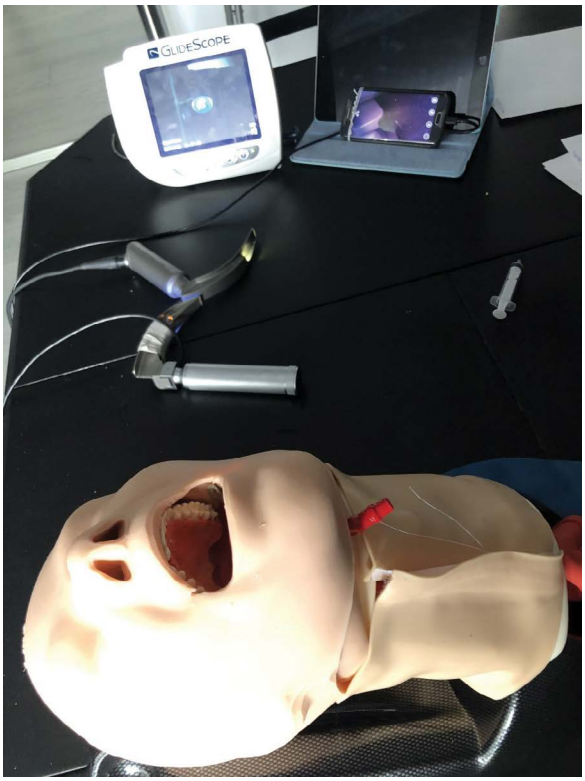

FIGURE 1. Demonstration of USB-L and video laryngoscope

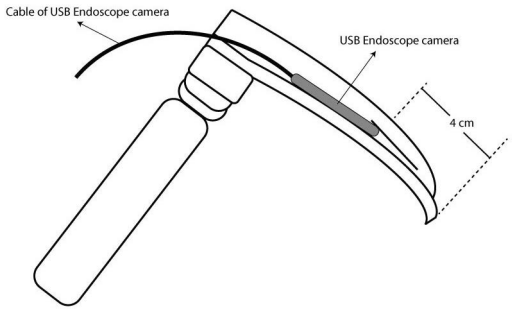

FIGURE 2. Schematic illustration of USB-L

In the study, the total intubation time as the time from entering the laryngoscope blade in the mouth of the mannequin to placing the tube was evaluated. An emergency medicine professor checked all the processing steps as an independent observer.

Statistical Analysis

While calculating the sample size, Cohen's medium effect size was used because no predictions about the parameters to be investigated could be made, as no similar studies in the literature were found. Accordingly, as a result of the power analysis with G*

Power, when the effect width d = 0.50 was taken, it was calculated that a total of at least 102 intubations would provide 80% test power and a 95% confidence level. Since two operators would intubate four times with two devices, it was found that each operator must perform at least 26 intubations with each device. Hereupon, each operator made 27 intubations.

Descriptive statistics like the mean were given [standard deviation (SD)], and intubation times were compared using a paired samples *t-test*. A p-value under 0.05 was accepted to be statistically significant. The statistical analysis using STATA 15.1 (Stata Corp., Collage Station, TX, USA) software was conducted.

RESULTS

The tracheal tube placement and glottic visualization succeeded in all intubations of the two operators for both devices. Operator 1 intubated the difficult intubation model in 26.97 ± 26.98 seconds via video laryngoscope and 20.10 ± 6.53 via USB-endoscope laryngoscope. Besides, operator 2 intubated the model in 22.83 ± 10.52 seconds via video laryngoscope and 18.96 ± 6.11 via USB-endoscope laryngoscope. Table 1 shows the number of intubation, the mean intubation times and standard deviation for Operator 1 and Operator 2.

In the comparison of intubation times of operator 1 and operator 2, both the video laryngoscope intubation time (p = 0.496) and the USB-endoscope laryngoscope intubation time (p = 0.542) was not different. Also, the intubation time via video laryngoscope or USB-endoscope laryngoscope was not different for both operators (Tab. 2).

Table 1. Mean intubation times of the two operators in seconds

	Number of intubation	Number of successful intubation	Mean ± SD (seconds)
Op.1 VL	27	27	26.97 ± 26.98
Op.1 USB-L	27	27	20.10 ± 6.53
Op.2 VL	27	27	22.83 ± 10.52
Op. 2 USB-L	27	27	18.96 ± 6.11

SD — Standard deviation; VL — video laryngoscope; USB-L — USB-endoscope laryngoscope

Table 2. Comparison of means of intubation times by Paired samples *t*-test

	Paired differences		p value
	Diff Mean ± SD	95% CIs of the difference	
Op. 1- VL vs. Op. 1- USB-L	6.84 ± 5.14	-3.72–17.41	0.195
Op. 2- VL vs. Op. 2- USB-L	3.86 ± 2.28	-0.82–8.55	0.102
Op. 1- VL vs. Op. 2- VL	4.11 ± 5.96	-8.14–16.37	0.496
Op. 1- USB-L vs. Op. 2- USB-L	1.13 ± 1.84	-2.64–4.91	0.542

Op. — Operator; CI — Confidence interval; SD — Standard deviation; VL — video laryngoscope; USB-L — USB-endoscope laryngoscope

DISCUSSION

This study could not find a statistically significant difference between the duration of intubations performed by both operators with different devices (video laryngoscope vs. USB-L by operator 1 and 2) individually. A statistically significant difference was not found between the duration of intubations performed by both operators using the same devices (video laryngoscope by operator 1 and 2 & USB-L by operator 1 and 2), respectively. Based on this, it was concluded that the USB-L and video laryngoscope are not statistically different in terms of intubation time in the difficult intubation model using bougie.

Airway interventions are needed in these patients upon the development of the severe acute respiratory syndrome. However, tracheal intubation is a very high-risk method for airway management in these cases due to high levels of SARS-CoV-2 virus load in sputum and upper airway secretions. Therefore, appropriate precautions must be taken to keep personnel safe in the foreground. Although systematic research on healthcare workers' risk of infection is based on limited literature, it has again become prominent with COVID19 [8].

Guidelines recommend the use of an aerosol box covering a patient's head during tracheal intubation in the COVID-19 era. However, intubation can be challenging with protective equipment such as an aerosol box, eye goggles and face shield. Several expert recommendations have been made for the use of video laryngoscopes while intubating these patients so that the time required for intubation is minimized [9–12]. Currently, there are various video laryngoscopes in the market and it has been shown

that they perform differently under these protective measures [13–14]. A study using stimulation of tracheal intubation in a patient with stimulation of COVID-19 showed prominent differences between six video laryngoscopes in patients with inhibited neck movement and limited mouth opening [13]. In a case series including adult patients that intubation with a Macintosh laryngoscope had been difficult, intubation with a video laryngoscope was successful in 290 of 293 patients [15]. Some other randomized, controlled studies comparing different video laryngoscopes have shown a higher success rate of intubation using the video laryngoscopes when compared to Macintosh laryngoscope [16–18]. It is now clear that video laryngoscopes increase the success rate of tracheal intubation with difficult airways.

In a previous study, the success rate of tracheal intubation in the first attempt was found to be around 80%, and the risk of infection of health personnel was said to increase during multiple airway manipulations. For this reason, it is recommended to use airway techniques, such as a video laryngoscope, that are reliable and maximize success in the first attempt [8]. This study compared video laryngoscopy and USB-L. The placement of the tube took place in both methods with 100% accuracy. The authors believe that no significant difference between intubation times was detected because of the similar view and quality of USB-L and video laryngoscopy in intubation.

A study comparing normal and difficult airways with inexperienced operators evaluated the time and rate of successful intubation, the best view of the glottis, oesophageal intubation, dental trauma, and user satisfaction. As a result of this study, intubation-related times, glottis appearance, and operator satisfaction were found to be significantly higher in commercial video laryngoscopes. In contrast, custom-made video laryngoscopy performance was found to be similar to that of a Macintosh direct laryngoscope. As a result, it was found that video laryngoscopes are superior to Macintosh direct laryngoscopes in both normal and difficult airway scenarios for inexperienced users [19]. This study, due to the similar experience of both operators, did not present a significant difference between intubation times in similar devices (video laryngoscopy by operator 1 and 2 & USB-L by operator 1 and 2).

Another study showed that the duration of intubation with the USB-L was shorter than that of the direct laryngoscope similar to this study. The duration of successful tracheal intubation was 26.92 ± 5.03 seconds in the USB-L group and 40.64 ± 5.7 seconds in the direct laryngoscopy group. This difference was considered statistically significant ($p < 0.001$). The authors also reported that the image quality of the USB-L may decrease due to condensation on the lens and secretion in the oral cavity [20]. Since the study was carried out on a mannequin, no imaging problems related to fogging on the lens and secretion were encountered.

In another study which investigated the success of USB-L in 50 elective surgery intubation, external laryngeal manipulation improved vision in 44% of intubations. Of the cases, 20% were intubated with the help of bougie, and the remaining cases were intubated directly with the endotracheal tube. The success rate on the first attempt of intubation was 82%. The remaining 18% were intubated on the second attempt. For 64% of the intubations, the operators reported that intubation was easy and confident [21]. In this study, both operators used USB-L with bougie for all difficult intubations. In no attempts were the endotracheal tubes located in the oesophagus. Furthermore, no difficulty was encountered in guiding and advancing the endotracheal tube in the use of video laryngoscopes in this method. The bougie enabled the tube to move easily through the airway. Unlike in that study, external laryngeal manipulation was not needed, as intubations were not performed on the patients.

In the COVID-19 pandemic, it has been reported that the use of video laryngoscopy is a safer method for healthcare workers, as tracheal intubations are considered very high risk in terms of contamination [8]. During the pandemic, the use of low-cost devices that will be attached to the USB camera instead of a direct laryngoscope has also come into question, especially in a limited resource setting.

CONCLUSIONS

The authors concluded that the USB-L and video laryngoscope are not statistically different in terms of intubation time in the difficult intubation model using bougie. For countries with limited resources, the low-cost USB-L has come to the forefront due to the high cost of video laryngoscopes and the difficulty of access.

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COMPARISON OF THE EFFICIENCY OF THE PAEDIATRIC BRAIN CTS WITH TRAUMA AND NON-TRAUMA RELATED INDICATIONS IN THE PAEDIATRIC EMERGENCY DEPARTMENT

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ABSTRACT

BACKGROUND: This study aimed to determine the appropriateness of the examinations by evaluating the pre-diagnosis of the patients who underwent brain Computed Tomography (CT) in the paediatric emergency departments and the existing pathologies in the brain CTs. In addition, a comparison of the efficiency of the brain CT examinations performed for trauma and non-traumatic reasons was made.

MATERIAL AND METHODS: CT's were examined by dividing into 2 groups according to the indications as trauma (group 1) and non-trauma related (group 2). The 2 groups were compared statistically according to the number of pathologies, distribution of pathologies by gender and age.

RESULTS: Pathologies were detected in 9.3% (n = 30) of the patients in the first group and 21.2% (n = 14) of the patients in the second group. A statistically significant difference was found between the groups in terms of whether pathology was detected (p = 0.023). The rate of pathology detection in the group that underwent CT for non-traumatic reasons was statistically significantly higher than the other group.

CONCLUSION: Precautions should be taken especially with trauma patients to prevent unnecessary CT scans in the paediatric emergency department. In addition, if a CT scan is planned in the paediatric emergency department with the approval of the paediatrician and radiologist, the CT examinations can be made with more accurate indications.

KEY WORDS: Multi-detector Computed Tomography, paediatric, head trauma, radiation, emergency department

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INTRODUCTION

Emergency departments (EDs) are very busy departments in Turkey as well as in the whole world. Patients are admitted to the ED for many different reasons since the diagnostic tests and the treatments are applied faster than outpatient clinics for various type of diseases in these departments [1, 2]. Radiological diagnostic imaging methods are used frequently for the diagnosis of diseases in the EDs [2]. In recent years, among these imaging methods, especially Computed Tomography (CT) is the most frequently used diagnostic method due to its ability to provide very fast imaging, thanks to the increasing technology, and its easy accessibility [2]. The most common CT examination in the ED is the brain CT examination [3]. CT is an imaging method that

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uses cross-sectional imaging by using X-rays. The increase in the number of CT causes an increase in the total exposed radiation dose per patient [4]. It has been reported that 48% of the total radiation exposure in society is with medical CT scans [5]. The use of CT has many disadvantages related to radiation, especially in children. Children younger than 2 years old are much more sensitive to radiation than adults [6]. For this reason, the use of CT with the correct indication is very important in the ED, especially in the paediatric age group. In addition, unnecessary CT scans also increase diagnosis-related costs in the health expenditures [7]. Determining the appropriate examinations that will lead to the diagnosis in emergency departments and requesting the necessary diagnostic tests will prevent patients from unnecessary radiation exposure and reduce the costs to be paid for unnecessary examinations [1].

This study aimed to determine the appropriateness of the examinations by evaluating the pre-diagnosis of the patients who underwent brain CT in the paediatric ED and the existing pathologies in the brain CTs. In addition, a comparison of the efficiency of the brain CT examinations performed for trauma and non-traumatic reasons was made.

MATERIAL AND METHODS

The study was compiled with the guidelines of the Health Insurance Portability and Accountability Act. Local institutional ethics committee approval was obtained by the Ethics Committee of the Malatya Training and Research Hospital Ethics Committee as follows: ethics committee date and number: 25/02/2021 and E-23536505-604.02. Informed consent was taken from the parents of the patients.

In the 2 months between 1.01.2019–28.02.2019, the patients, who underwent brain CT in the paediatric emergency radiology department of the hospital were analysed retrospectively in terms of clinical pre-diagnosis and radiological results. Patients aged 0–17 years who underwent brain CT for non-traumatic or minor head trauma were included in the study. Patients with head trauma, Glascow Coma Score (GCS) of 14–15 and without loss of consciousness were accepted as minor head trauma. Preliminary diagnoses of brain CT examinations were obtained by detailed anamnesis and patient files in the hospital information management system. Patients who did not have sufficient clinical information or anamnesis in the hospital information management system and patient files were excluded from the study. Patients, whose diagnosis was previously known and who applied to the ED for follow-up were also excluded from the study.

Patients were grouped as traumatic (group 1) and non-traumatic (group 2). In addition, according to their age, they were grouped as under 2 years old (infant) and above.

Pathologies diagnosed in patients presenting with trauma were epidural and subdural bleeding, subarachnoid haemorrhage, intraparenchymal contusion-haemorrhage, cerebral oedema, and skull fracture. In non-traumatic patients, mass, abscess, meningitis, hydrocephalus, brain oedema, Posterior Reversible Encephalopathy Syndrome (PRES), and intraparenchymal haemorrhage were the diagnosed pathologies.

The images of the brain CT scans were re-evaluated via Image Storage and Communication Systems (PACS) by one paediatric radiologist and all were reported again. Brain CTs of the patients were obtained with a multi-slice device (16-slice multidetector CT, Philips Medical System MX-16) without intravenous contrast agent administration and in the axial plane. Each area to be examined by the device was obtained by observing the principles of ALARA with shooting protocols at the appropriate dose according to the size (age and weight) of the children [8]. All sections were applied parallel to the orbito-meatal line, 5 mm for the posterior fossa, 10 mm for the supratentorial region and 1 mm intervals. All CTs were examined in the bone and parenchyma windows.

The 2 groups were statistically compared according to the number of pathologies, distribution of pathologies by gender and age, and the relationship between pre-diagnosis and the detected pathologies.

Statistical Analysis

SPSS-17 program was used to evaluate the data. Data were given as numbers and percentages. Chi-square or, when appropriate, fisher-exact test was used in the evaluation of categorical data. In the results, a value of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 389 brain CT scans were examined in this study, 323 (83%) of them were performed for trau-

ma-related and 66 (16.9%) of them were performed for non-trauma related reasons. Demographic characteristics and distribution of pathologies of all patients are shown in Table 1.

While 152 of the patients (39%) were female, 237 (61%) of them were male in this study. There was no statistically significant difference between the two groups in terms of gender (p = 0.490).

The average age of the patients was 8.18. 118 (30.3%) patients were under 2 years old and 271 (69.7%) patients were between 3–17 years old. While 76.2% of the patients in the first group were older than 2 years, this rate was 53% in the second group. There was a significant difference between the two groups in terms of age (p = 0.001).

The distribution of patients and pathologies among the groups are shown in Table 2.

Pathologies were observed in 44 (11.3%) of 389 patients. While pathologies were observed in 9.3% (n = 30) of the patients in the first group, pathologies were found in 21.2% (n = 14) of the patients in the second group. There was a significant difference between the two groups in terms of detection of pathology. The pathological findings were found to be significantly higher in the non-trauma patients (group 2) in the present study (p = 0.023). While 16.7% (n = 5) of the patients with pathology in the first group were in the 0–2 age group, 57.1% (n = 8) of the patients with pathology in the second group were in the 0–2 age group. A statistically significant difference was found between the two groups in terms of positive pathology in the 0–2 age group (p = 0.001).

One (3.3%) of the traumatic patients had an epidural haemorrhage, 5 (16.6%) of them had a subdural haemorrhage, 2 (6.6%) of them had a subarachnoid haemorrhage, 1 (3.3%) of them had intraparenchymal contusion, 1 (3.3%) of them had cerebral oedema, and 24 (80%) of them had skull fractures.

Four (28.5%) nontraumatic patients had mass, 1 (7.1%) had abscess, 2 (14.2%) had hydrocephalus 3 (21.3%) had cerebral oedema, 1 (7.1%) had PRES, and 2 (14.2%) of them had an intraparenchymal haemorrhage.

The clinical preliminary diagnoses of patients with non-traumatic reasons and the number of pathologies in that group are shown in Table 3.

DISCUSSION

Advances in CT technology in recent years has caused CT to be used as a method of triage, especially in the EDs. This has increased the use of CTs with unnecessary indications like some other radiological methods.

Patients with minor head trauma constitute 83% of the present study group and the demographic

Table 1. Demographic characteristics and distribution of pathologies of all patients

		(n)	(%)
Age	0–2 years 3–17 years	118 271	30.3 69.7
Gender	Female Male	152 237	39 61
Age with pathology	0–2 years 3–17 years	13 31	29.5 70.5
Gender with pathology	Female Male	14 30	31.8 68.2

Table 3. Preliminary diagnoses of patients who underwent brain CT for non-traumatic reasons and the number of pathologies in these pre-diagnoses

	(n)	Pathology (n)	Pathology (%)
Headache	22	4	18.1
Seizure	16	3	18.7
Fewer	10	2	20
Confusion	8	2	25
Haematoma	4	1	20
Infarct	2	0	0
Optic neuritis	3	1	33.3
Arrest	1	1	100

CT — Computed Tomography

Table 2. Comparison of patients who underwent brain CT for trauma and non-traumatic reasons

		Traumatic (n)	Traumatic (%)	Nontraumatic (n)	Nontraumatic (%)
Age	0–2 years 3–17 years	87 236	23.8 76.2	31 35	47 53
Gender	Female Male	129 194	39.9 60.1	23 43	34.8 65.2

CT — Computed Tomography

distribution of patients in this group is compatible with the literature [9–11]. In the study of Guneş et al. [10], 58% of the patients were male and 80.3% were above 2 years old, while these results were found 60.1% and 83.3% in this study. Skull fractures constituted most of the pathologies seen in trauma patients (80%) in this study, following the literature. This rate was found to be 82% in the study of Guneş et al. [10], and 57.8% in the study of Er et al. [9].

In the study of Kuppermann et al., it was reported that most of the patients with head trauma admitted to the ED were patients with mild head trauma, and traumatic brain injury was detected in less than 10% of these patients, which is similar to the present study [12]. The 9.3% of the patients with minor head trauma had pathology in this study. Pathology was observed in 6–6.5% of the patients with minor head trauma in the studies of Gunes et al., Er et al. And Mannix et al. [9, 10, 13].

In recent years, as a result of increased accessibility to CT and shortening of examination times due to technological developments, the number of CT examinations has increased significantly in paediatric patients as well as in adult patients. It is difficult to evaluate the history and examination findings in young children. In addition, medicolegal reasons cause this increase in the number of CT examinations [13]. On the other hand, the number of patients applying to ED is very high and the physician of the ED has to make an optimum evaluation in a very short time. This may be a possible reason for the high numbers of radiological imaging in the EDs in Turkey. However, since the children are more sensitive to ionizing radiation, the indications of the CT should be considered very carefully especially in this age group.

Brain CT examinations were found to be normal in 88.7% of all patients included in this study. Although there are many studies on this subject in the literature, these studies are generally related to patients with head trauma [9, 10]. Studies related to the CT examinations of nontraumatic patients are usually done in adult patients [14–16]. The number of studies on the CT of nontraumatic patients in the paediatric ED is few [17, 18]. Although the study of Akca et al. [17] was similar to the present study, there have been serious differences between the presented findings and their results. The percentage of the normal CT scans performed for trauma was 90.7% in this study and 70.4% in the study of Akca et al. One of the reasons for higher normal results in the trauma group may be the consideration of the non-emergency radiopathologies and chronic changes (arachnoid cyst, mega cisterna magna, etc.) not as pathology in the presented reports. The number of normal CTs was found to be significantly higher in the patients with trauma in this study, while the number of normal CTs was significantly higher in the patients with nontrauma in the study of Akca et al.

The most important result of this study was the number of CTs and the radiologically normal rate of examinations in the trauma-related patient group were significantly higher than non-traumatic patients. Paediatric trauma patients are first evaluated not only by paediatricians but also by the practitioner doctors in the hospital. The first request for the radiological imaging of these patients is also made by these doctors. But all nontraumatic patients are evaluated by paediatricians. Because paediatricians are more familiar with the paediatric patient population, they can ask for a more detailed history and make a more accurate physical examination. Thus, the number of CTs and radiology reports without pathology can be significantly low in the non-traumatic patients' group. In addition, paediatricians cooperate with the paediatric radiologists in the hospital, and this contributes to CT scans with the right indication. Some of the nontraumatic patients are applied a brain MRI instead of the brain CT with the recommendation of the paediatric radiologist, which can show the pathology more accurately and so the number of CTs reduces in the paediatric EDs. More detailed studies are needed on this subject, which is very limited in the literature. New studies may be a guide for defining the correct indication and may lead to a reduction in the number of CT scans in the emergency departments.

The study had some limitations. It was a retrospective study and the number of patients in the nontraumatic patient group was lower than the trauma patients.

CONCLUSION

Many studies aim to protect the patients from radiation as much as possible by performing CT scans with more accurate indications, especially in paediatric patients.

Unfortunately, there is still no consensus on the indications of CT imaging. In this study, both the number of patients who underwent CT and the

number of CTs reported as normal in the trauma group were higher than the nontraumatic group. Precautions should be taken especially in patients with trauma to prevent unnecessary CT applications in the paediatric EDs. In addition, if the indications of the brain CT scans are planned with the approval of the paediatrician and radiologist, CT examinations can be made with the correct indication and, if possible, other diagnostic methods can be used instead of CT.

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PLACE OF TRANEXAMIC ACID IN MODERN MEDICINE

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ABSTRACT

Massive bleedings, both internal and external, are among the leading causes of preventable deaths. The research for the appropriate treatment focuses not only on looking for the new drugs but also relies on finding the new indications for the drugs already known in the pharmacotherapy of different disease. However, such an approach requires new protocols in order to be effective. One of the substances in question is tranexamic acid, which uses due to its antifibrinolytic effect is raising both in prehospital and hospital settings.

KEY WORDS: tranexamic acid, TXA, trauma, bleeding, hemorrhage

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INTRODUCTION

Tranexamic acid (TXA) is a low molecular antifibrinolytic drug [1] that has been used for many years to control hemorrhage in patients with hemophilia and other disorders involving coagulation system. The particular interest in TXA use was initially found by its ability to control massive hemorrhages in the prehospital setting, especially in the tactical environment, due to a statistically significant reduction of risk of death, when used in the early stage of pharmacotherapy [2–4]. The search for the safe and effective drug, which may be used in the prehospital control of hemorrhage is related to the epidemiology of injuries and its impact on the mortality of the overall population. According to the data provided by the WHO on their website, injuries are responsible for up to 10% of global deaths annually. In 2003, they caused the death of 5 million people worldwide, mainly as a result of traffic accidents, and required hundreds of millions of medical services provided in emergency departments [5, 6]. In 2019, road accidents accounted for the 7th cause of death in countries with low financial status and 10th in countries with a slightly higher status; in highly developed countries, deaths resulting from traffic accidents were outside the top ten causes of mortality [7, 8]. However, regardless of the socio-economical status of the country, the trauma and associated bleeding is the leading cause of mortality and morbidity worldwide [9, 10]. Therefore, we have decided to dig further into the subject of the usage of TXA and perform this literature review regarding the usage, advantages and disadvantages of TXA application in the real-life setting.

Mechanism of action and the usage of TXA

In order to understand and fully appreciate the TXA mechanism of action, one must realize that coagu-

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lation is not just a process of blood clot formation but also it is dissolving by the plasmin [11, 12]. This delicate balance is maintained by various mechanisms. However, in case of major trauma the coagulopathy ensues resulting in uncontrollable bleeding [13]. Patients in this state require more blood transfusions, longer hospitalization time and overall present higher mortality [13]. This state, however, is not just the result of blood loss alone, patients who undergo major trauma with severe blood loss develop coagulopathy also in the mechanism of hemodilution, hyperthermy, acidosis and finally due to the consumption of blood factors they develop disseminated intravascular coagulation [14]. Therefore, a research for the new drugs that would ideally stop or at least slow down this cascade commenced. This result in the production of TXA which is the synthetic amino acid that inhibits the plasma plasminogen activators and to some extent the tissue plasminogen activators, which in turns blocks the conversion of plasminogen into plasmin. Additionally, TXA presents some activity regarding direct plasmin inhibition [1, 15]. The laboratory findings in the studies show reduced D-dimer concentration, a product of cross-linked fibrin breakdown [16].

All of these biochemical properties of TXA allow for an inhibition of fibrinolysis, which is the process of dissolving the blood clot by plasmin, and therefore it maintains the hemostasis. Additionally, TXA has been proven to increase thrombus formation [15]. All of these mechanisms of action resulted in their widespread use in different fields of medicine. The indications for drug administration include primary and generalized fibrinolysis, bleeding associated with the use of fibrinolytic drugs, vaginal bleeding, e.g. in the course of heavy menstruation, bleeding from the gastrointestinal tract and the urinary tract of various etiologies. These drugs are also used to limit the blood loss resulting from otolaryngological, cardiosurgical, gynecological or abdominal surgery [17–19].

Despite many clinical studies, publications and meta-analyzes, no clear consensus regarding the use of TXA in trauma patients has been established [19]. There are studies that prove a significant reduction in mortality in patients with hemorrhages when the TXA was administered within 3 hours following the injury [20]. A statistically significant reduction in the progression of intracranial bleeding and a statistically insignificant improvement in the results in patients with craniocerebral trauma was proven [21]. Studies also indicate a reduction in overall blood loss and a number of a blood transfusion given in patients undergoing elective procedures: knee and hip arthroplasty and the shoulder-scapular joint [22, 23].

Contraindications for TXA application

The contraindications for the TXA application include mainly the diseases that lead to hypercoagulation, mainly history of venous thrombosis and pulmonary embolism, arterial thrombosis (angina pectoris), history of myocardial infarction and disseminated intravascular coagulation. Additionally, severe renal insufficiency and seizures are also among contraindications for TXA application. As with any drug, the history of intolerance or allergy to the TXA automatically declines the use of this drug. TXA should be avoided in pregnant and lactating women, as well as children below 1 year of age

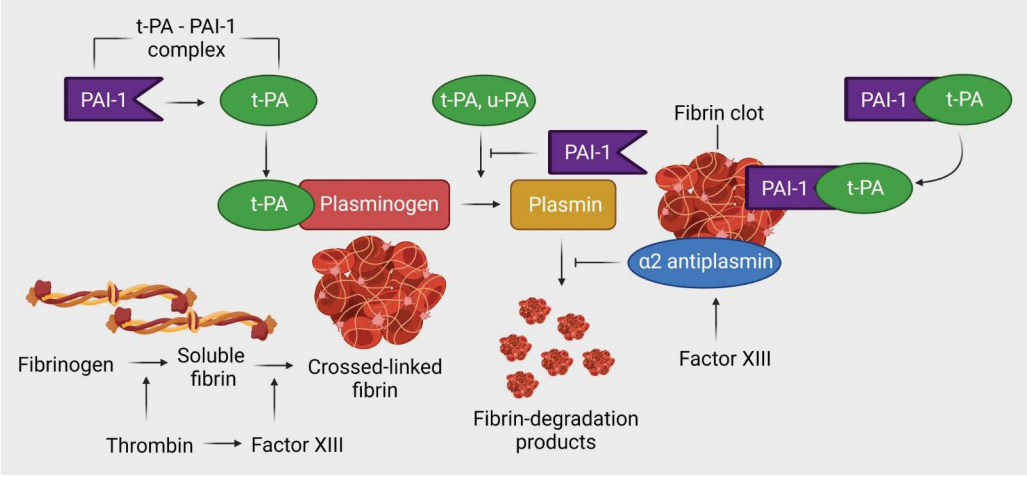

FIGURE 1. Management of tranexamic acid (created with BioRender.com, licensed version)

[24, 25]. One has to be careful when administering TXA in patients who are at risk of slower drug elimination e.g. with renal inefficiency, cardiac or neurological diseases [26, 27]. As TXA has proven to bind to GABAa receptors, thus blocking GABA-mediated inhibition in the central nervous system, these patients are at risk of developing seizures following TXA administration [28]. This complication may be managed by administering the anesthetic agents that would modulate the receptors blocked by TXA, e.g. propofol [29].

TXA as drugs in Poland

In Poland, the drug is available as EXACYL (Sanofi) in three forms oral tablets at a dose of 500 mg, solution for injection at a dose of 100 mg/ml and the solution for digestion with the concentration of 100 mg/ml. When administered orally, it is absorbed quickly and the maximum concentration in the blood serum is reached after 2–3 hours, while after 6 hours following the administration, the drug is not detected. The half-life of the drug administered in the oral form is 1 hour, while in the intravenous form it is 3 hours. The drug is eliminated mainly by kidneys in urine (90%) unchanged within 12 hours after administration [35–37].

Tranexamic acid dosing

The off-label dosing of tranexamic acid has not been established. It is recommended to administer the TXA in a dose of 1 g diluted in 100 ml of 0.9% NaCl within 10 minutes for up to 3 hours from the hemorrhagic injury and to re-administer the drug in a dose of 1 g for the next 8 hours as an intravenous infusion [30–34]. One should pay attention to the factors that may impair the blood clot formation e.g., drop in body temperature or disturbance in the overall fluid status [30]. No consensus regarding the dosing of TXA in patients with craniocerebral injuries or undergoing elective orthopedic surgery has been established [23, 35, 36]. The advantages of using TXA in pre-hospital management have been proven during randomized clinical trials CRASH-2 and CRASH-3, which were carried out by the London School of Hygiene and Tropical Medicine. Dosage and application regimens may be found in the recommendations of various groups, such as Task Force for Advanced Bleeding Care in Trauma, International Trauma Life Support, Tactical Combat Casualty Care or The Committee for Tactical Emergency Casualty Care (C-TECC) [37, 38].

CONCLUSION

New studies constantly show up in the medical literature regarding the possible label use of TXA. These studies report that TXA administration in the emergency settings, both in pre and hospital environment, significantly increases the survival rate of the patients suffering from severe hemorrhagic injuries. Additionally, this relatively cheap and easily available drug may increase the safety of the patients who undergo major elective surgery, due to the reduction of required blood transfusions. Due to the lack of unified dosing protocols and ongoing discussions regarding safety and indications for the TXA administration further analysis of literature is required to establish the consensus on TXA therapy.

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VIA MEDICA

CASE REPORT

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CHALLENGING MULTIVESSEL PERCUTANEOUS CORONARY INTERVENTION SUPPORTED WITH IMPELLA 2.5 VENTRICULAR ASSIST DEVICE

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KEY WORDS: Impella, PCI, MCS

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INTRODUCTION

Dynamic development of interventional cardiology enables percutaneous treatment of patients with multivessel coronary artery disease at high risk of perioperative mortality.

Such high-risk procedures include interventions in patients with severe systolic left ventricular (LV) dysfunction, and patients in cardiogenic shock in the course of myocardial infarction. These groups of patients frequently require short-term mechanical circulatory support (MCS) when undergoing high-risk percutaneous coronary intervention (PCI) [1]. Impella is an axial flow blood pump which can be percutaneously introduced via a 14 French sheath. The right-side Impella device pumps blood from the inferior vena cava into pulmonary artery, providing up to 4 l/min of blood flow. By unloading the right ventricle, it reduces the central venous pressure, enabling the increased pulmonary venous return to the left heart chambers [2, 3]. The left-side device pumps blood from the LV into the ascending aorta, providing cardiac output from 2.5 l/min up to 5.0 l/min, depending on the size of the device. By unloading the LV and increasing cardiac output and coronary flow, left-sided Impella provides hemodynamic stability during PCI procedures. We present a case report of a patient with severe systolic LV dysfunction who presented with sustained ventricular tachycardia and underwent Impella-supported multivessel PCI.

CASE PRESENTATION

A 62-year-old man suffering from heart failure with reduced ejection fraction (HFrEF) was admitted to the cardiology department due to recurrent sVT. The patient had a history of acute ST-elevation myocardial infarction (STEMI) of the anterior wall, treated with systemic thrombolysis (2001), non-ST-elevation myocardial infarction (NSTEMI), with unsuccessful attempt of PCI of the circumflex artery (Cx; 2008) and an episode of sustained ventricular tachycardia (sVT). Moreover, he received implantable cardioverter-defibrillator with resynchronization therapy function (CRT-D) in the primary prevention of sudden cardiac death (2008) due to HFrEF [NYHA class II, ejection fraction (EF) 37%] and left bundle branch block (QRS 176 ms). During the last months, several episodes of ventricular tachycardia occurred, which were ineffectively treated with anti-tachycardia pacing and shock therapy. On admission, the patient was hemodynamically stable, without symptoms and signs of overt heart failure. Electrocardiogram revealed sinus rhythm with heart rate 50/min and biventricular pacing (Fig. 1). Echocardiography showed enlarged LV and both atria, akinetic inferior and posterior wall, hypokinetic lateral wall with LVEF of 20%, diastolic dysfunction grade II and mild mitral and tricuspid regurgitation. Coronary angiography revealed chronic total occlusion of the right coronary artery in the proximal segment with collateral filling from the left coronary artery and

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significant stenoses of the left main coronary artery (LMCA), left anterior descending artery (LAD) and Cx (Fig. 2A, 2B, 2C), which was confirmed based on the fractional flow reserve measurement (0.64 for LAD and 0.73 for Cx).

Considering the intermediate risk of mortality according to the EuroScore II (6.81%) and the high anatomical complexity of the lesions (SYNTAX score 43) the Heart Team opted for surgical revascularization, which the patient refused. Regarding persistent

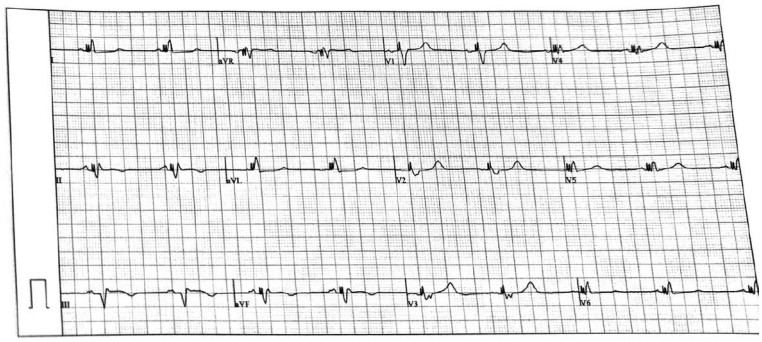

FIGURE 1. Electrocardiogram at admission. Sinus rhythm with heart rate 50/min and biventricular pacing

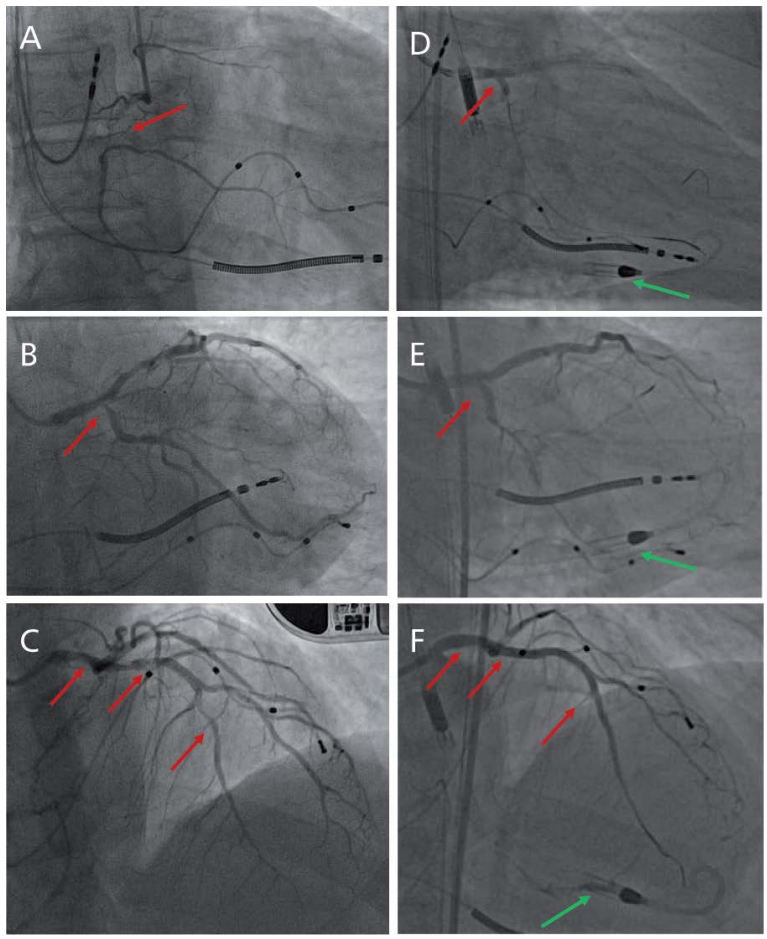

FIGURE 2. Coronary angiography. A: Chronic total occlusion of the right coronary artery in the proximal and middle segment (red arrow) with collateral filling from the left coronary artery. B: Significant stenosis of the circumflex artery (Cx) ostium with FFR value 0.64 (red arrow). C: Significant stenoses of the left main coronary artery (LMCA) and left anterior descending artery (LAD) with FFR 0.73 (red arrows). D–F: Impella-assisted (green arrows) percutaneous coronary intervention with implantation of three overlapping everolimus-eluting stents were implanted to LMCA and LAD (3.5x38mm; 2.5x38mm; 2.25x23mm) and one stent to the ostium and proximal part of Cx (2.75x12mm) using DK crush technique. D: Final kissing with compliant balloons (3.5x12mm in the Cx, 4.0x8mm in the LAD; red arrows). E, F: Final result of the intervention (red arrows)

ventricular arrhythmia, percutaneous treatment attempt was the only available alternative, for which the patient agreed.

An Impella 2.5 pump was inserted through the right femoral artery. Following predilation of the lesions in the proximal and mid LAD, two overlapping everolimus-eluting stents (EES) were implanted to LAD (2.5x38mm; 2.25x23mm) and the proximal part was postdilated with a compliant balloon (3.0x15mm, 20 atm.) In the next step, the bifurcation stenting of the LMCA was done using double-kissing (DK) crush technique, with the implantation of one EES to the ostium and proximal part of Cx (2.75x12mm) and one EES to the LMCA towards LAD (3.5x38mm). Final kissing was done with compliant balloons (3.5x12mm in the Cx, 4.0x8mm in the LAD) obtaining proper expansion and coronary flow (Fig. 2D, 2E, 2F). Control angiography revealed perforation of the distal septal branch. Two vascular coils were successfully placed (Fig. 3A, 3B). Eventually, a satisfactory angiographic result of the procedure was achieved. The vascular access site was closed with ProGlide and AngioSeal devices.

Ten days after Impella-supported PCI, a successful ablation of recurrent VT was performed and patient was discharged on day 15. The pharmacotherapy at discharge included double antiplatelet therapy (acetylsalicylic acid and clopidogrel), proton-pump inhibitor, atorvastatin, beta-blocker (bisoprolol), angiotensin-converting enzyme inhibitor (ramipril), loop diuretic (torsemide), mineralocorticoid receptor antagonist (eplerenone). Control echocardiography showed LVEF of 26%. During the 3-month follow-up, the patient was re-hospitalized for 10 days due to Coronavirus disease (COVID-19), from which he recovered. Further clinical course regarding adverse cardiovascular events was uneventful.

DISCUSSION

Patients in cardiogenic shock and those with severe systolic LV dysfunction and multivessel disease are a challenge of interventional cardiology. Traditionally, intra-aortic balloon pumps (IABP) were used to provide hemodynamic support during high-risk PCI in these clinical scenarios. However, the results of randomized clinical trials are inconsistent and have not confirmed the beneficial effect of IABP on long-term survival [4–6]. In contrast to IABP, which creates a reverse blood flow to coronary arteries during diastole, providing a non-physiological MCS, Impella facilitates blood flow during systole, offering a more effective, physiological support. Preliminary evidence from clinical trials demonstrated the advantage of Impella devices over IABP both in patients with cardiogenic shock and undergoing high-risk PCI [7–9]. However, there is a need to standardize the indications for the use of Impella in patients undergoing PCI [10, 11] and to confirm the positive effect of Impella on the outcomes in large, randomized trials [12]. In the presented case, the use of Impella provided hemodynamic stability despite the low LVEF and multivessel disease enabling the effective performance of a high-risk PCI. The use of the pump did not prevent the recurrence of CT. However, thanks to improved hemodynamic parameters, it was possible to perform ablation and improve patient's condition.

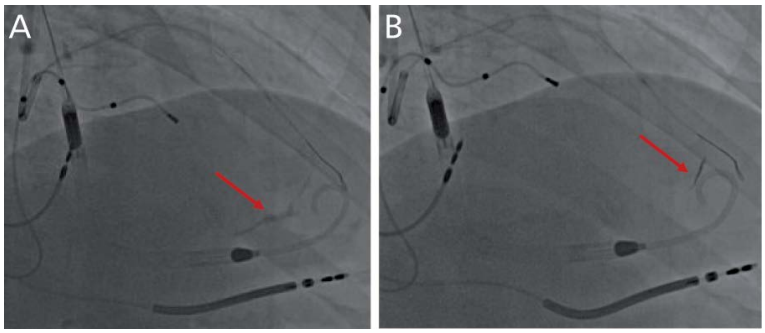

FIGURE 3. A: Perforation of the distal septal branch (most likely a fistula into the ventricle; red arrow). B: Perforation closure with two vascular coils (red arrow)

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LETTER TO THE EDITOR

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SELF-TESTING AS A METHOD OF REDUCING COVID-19 INFECTIONS

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KEY WORDS: COVID-19, self-testing, COVID-19 tests

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To the Editor,

At the end of 2019, a new type of coronavirus appeared in China — SARS-CoV-2, which became a challenge for the health care system [1]. Currently, the fight against the third wave of cases is underway all over the world — too few vaccinated people still do not give us the possibility of obtaining herd immunity, which we are trying to get at all costs to fight the pandemic. Here, our activities should focus on infection prevention. The Indian variant of the B.1.617 coronavirus has recently appeared in the world, about which we still know little, and there are more and more questions about the effectiveness of vaccines against this strain. The Indian variant of SARS-CoV-2 shows two important changes to its genome on the protein surface: E484Q and L452R. Single mutations have been known for a long time. The E484Q resembles the E484K variant, which also occurs in the British, South African and Brazilian mutations. The L452R variant is found in the Californian strain of the coronavirus CAL.20C. In the India variant, both mutations occurred for the first time, so we deal with the SARS--CoV-2 double mutation. When an additional strain of the virus escapes our immune system, a so-called escape variant will arise — increased resistance to neutralization by antibodies and T lymphocytes contracting the Indian mutation of the coronavirus.

Here, we should focus on securing and relieving the medical care system in the best possible way. Antigen and PCR tests performed by specialized medical facilities have become commonplace access to which may become difficult because of the increasing number of infections. Here, one should consider self-testing by patients at home or elsewhere — and this has also been introduced in the US, where self-collection kits and testing are available for prescription or over the counter at a pharmacy or retail store [2]. Rapid Antigen Detection Tests (RADT), which can be used as self-tests for the detection of SARS-CoV-2, are also becoming available in the European Union. These tests require individuals to collect a sample, conduct the test, and interpret the results themselves [3].

Many studies have shown that the agreement of results between the self-test and the test performed by healthcare professionals was very similar. Positive per cent agreement between self-testing results and professional RADT testing was 91.4% (95% CI 77.6–97.0), while negative per cent agreement was 99.1% (95% CI 95.0–100). Although deviations in sampling and testing, i.e., incomplete self-sampling or extraction procedures, or imprecise test performance as volume applied to the test device, have been observed in more than half of the positive samples, it has been found that self-test results may be comparable to those got by qualified medical services [4]. Stohr et al. compared the clinical trial to a home testing situation. 3.215 participants received the BD VeriStor System RADT or RADT self-check kits from Roche Diagnostics and used them on self-collected nasal swab specimens. The sensitivity of the self-tests was compared to gold by the standard method (RT-PCR), which involved taking a sample by a healthcare professional and sending it to a lab-

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oratory for testing. They found the sensitivity to be 75.5% (95% CI: 66.6–82.6) for BD RADT and 80.1% (95% CI: 72.7–86.0) for Roche RADT. Both RADTs showed a very high specificity > 99% [BD RADT: 99.7% (95% CI: 99.2–99.9); Roche RADT: 99.1% (95% CI: 98.5–99.5)] [5].

Both studies show that self-tests performed by patients are as effective as those performed by trained healthcare professionals. After obtaining the result, the only step that the infected person must take is to contact a doctor or the appropriate institution responsible for entering into the register, which prevents the infected person from contacting the rest of the public and thus further spreading the virus. Most people have COVID-19 disease mildly and can be treated at home. Self-testing significantly relieves testing points of patients and health care facilities — an important issue is also to reduce the risk of infection of people who obtain a negative result without exposing them to the risk of infection at test collection points. Self-testing will also rule out infection in people who have flu or have atypical symptoms of COVID-19, such as diarrhoea, headaches, or gastrointestinal disorders. From a public health perspective, self-tests can be of benefit when used in addition to professionally performed RADT or RT-PCR tests. They can improve the availability of tests and enable patients to obtain results very quickly, which can aid in the early detection of infectious cases and reduce further transmission within society.

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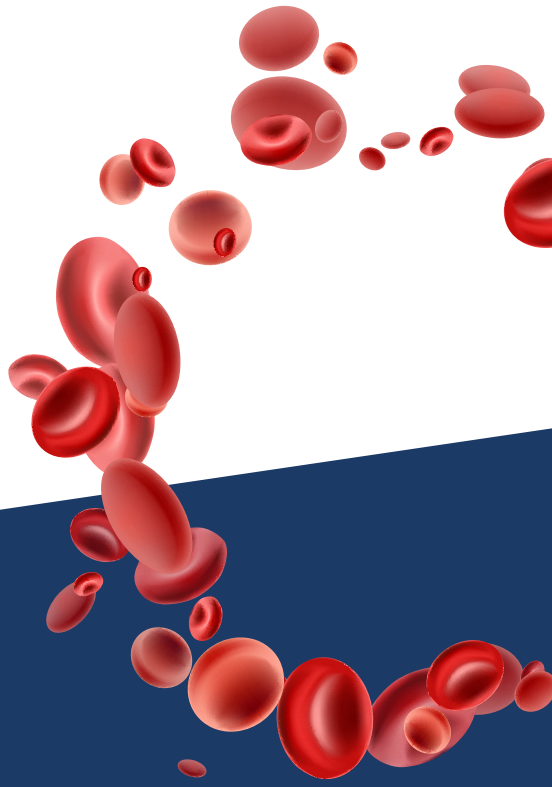

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