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FAST EXAMINATION AND INTERVENTIONAL ULTRASOUND IN THE DIAGNOSIS AND TREATMENT OF COMBAT ABDOMINAL TRAUMA

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Abstract

To improve the diagnosis and surgical treatment of wounded patients with combat abdominal trauma by methods of emergency ultrasound diagnostics and minimally invasive surgery under the control of ultrasound. The purpose of the work is to improve the results of diagnosis and surgical treatment of wounded patients with combat abdominal trauma by emergency ultrasound examination techniques and minimally invasive surgical interventions under ultrasound control. A clinical and statistical analysis of the results of the surgical treatment of 293 wounded patients with combat abdominal trauma treated at the Military Medical Clinical Centre of the Southern Region was conducted. In the main group, additional therapeutic and diagnostic measures were performed — focused assessment with sonography in trauma (FAST), puncture rehabilitation and drainage surgery under the control of ultrasound. In the main group, in contrast to the control group, FAST examination was

conducted in all wounded patients. The widespread introduction of the FAST examination and diagnostic punctures under ultrasound control into diagnostics reduces the level of more traumatic diagnostic laparocentesis from 24.7 to 2.2% and unreasonable surgical interventions from 3.2 to 0.7 %. An algorithm of diagnostic and therapeutic measures for wounded patients with combat abdominal trauma based on the results of the FAST examination was developed. The data obtained indicate that the widespread implementation of FAST, percutaneous puncture and sanitation interventions under ultrasound control in the diagnosis and treatment of combat abdominal trauma and its complications helps to reduce the number of invasive and more traumatic (often useless) interventions, which leads to faster recovery and shorter treatment time.

Keywords: combat abdominal trauma, emergency ultrasound, interventional ultrasound.

The key to effective treatment of abdominal injuries is a timely diagnosis of internal organ damage and measures to prevent the development of complications [1, 2]. Ultrasound imaging as a diagnostic method is widely used in modern surgical practice [3, 4]. However, the peculiarities of its use under conditions of modern warfare are not sufficiently studied [1, 5]. That is why we present our own experience of using emergency ultrasound in the diagnosis and surgical treatment of combat abdominal trauma.

The aim of the study is to improve the results of diagnosis and surgical treatment of wounded patients with combat abdominal trauma by emergency ultrasound examination techniques and minimally invasive surgical interventions under ultrasound control.

Materials and Methods

To determine the effectiveness of the FAST examination for the primary distribution of wounded patients with combat abdominal trauma at the second level of medical care, we analyzed 293 wounded patients with combat abdominal trauma.

The main group (139 wounded patients) underwent complex diagnostic and therapeutic measures including the FAST examination and, if necessary, ultrasound-guided puncture.

The comparison group (154 wounded patients) did not receive medical care using the FAST examination and surgical procedures under ultrasound guidance.

In the main group, unlike the comparison group, 37 (26.6%) wounded patients underwent diagnostic and therapeutic punctures under ultrasound guidance.

Clinical, laboratory and instrumental research methods were used. An ultrasound apparatus EsaoteMyLab 50 (Italy) with a convection transducer from 2.5 to 5 MHz was used.

The manipulation can be performed both with the use of a special removable puncture nozzle to the transducer with a strictly specified puncture angle — 20° and 30°, and by the "freehand" technique. For puncture and drainage of pathological lesions, special instruments were used — needles and catheters of various modifications for transcutaneous manipulations under ultrasound control.

Results

The structure of the FAST examination results in the main group is presented in Table 1.

Table 1

Structure of FAST examination results in the main group

Results of the FAST examination	Main group	
	Abs.	%
Positive	59	42.4
Negative	64	46.0
Doubtful	13	9.4
Uninformative	3	2.2
Total	139	100

A retrospective analysis of the diagnosis and treatment of wounded patients with combat abdominal trauma in the comparison group revealed 9 (5.8%) undiagnosed abdominal injuries at the initial examination. In the main group, the proportion of undiagnosed abdominal injuries at the initial examination was 2 (1.4 %) cases ($p<0.05$ by χ^2 criterion).

The distribution of the wounded patients in the comparison group and the main group, taking into account the diagnostic and therapeutic manipulations performed, is presented in Table 2.

The use of the FAST examination and ultrasound-guided diagnostic puncture reduced the need for diagnostic laparocentesis, which is a traumatic procedure and requires more time and special conditions for its performance. Thus, laparocentesis in the comparison group was performed in 38 (24.7%) wounded patients, while in the main group only in 3 (2.2%) cases ($p<0.001$), when the FAST examination was uninformative due to the objective reasons mentioned above.

Table 2

Distribution of wounded patients in the comparison group and the main group, taking into account the diagnostic and treatment procedures

Diagnostic and treatment manipulation, abs.		Comparison group, n=154		Main group, n=139		Total, n=293	
		%	Abs.	%	Abs.	%	Abs.
Ultrasound diagnostics by the FAST examination		–	–	139	100***	139	47.4
US-guided diagnostic puncture		–	–	37	26.6***	37	12.6
Laparocentesis		38	24.7	3	2.2***	44	15.0
Laparoscopy		15	9.7	27	19.4*	42	14.3
Laparotomy	Total	23	14.9	15	10.8	38	13.0
	of which diagnostic laparotomy	5	3.2	1	0.7	6	2.0
Puncture of the pleural cavity		5	3.2	16	11.5**	21	7.2
Drainage of the pleural cavity		11	7.1	7	5.0	18	6.1
Thoracoscopy		1	0.6	2	1.4	3	1.0
Thoracotomy		3	1.9	1	0.7	4	1.4

Notes. Significant differences with the comparison group: *p<0.05; **p<0.01; ***p<0.001 (by χ^2 and Fisher's exact test).

The number of laparoscopies performed in the comparison group was 15 (9.7%) cases, and in the main group, their number increased and amounted to 27 (19.4%) cases (p<0.05 by χ^2 criterion), which was associated with the definition of clear criteria for laparoscopy: the level of free fluid in the abdominal cavity less than 500 ml, stable haemodynamics, and the absence of pneumoperitoneum. The proportion of laparotomies in the comparison group was 23 (14.9%), and 15 (10.8%) interventions were performed in the main group (p>0.05). In the comparison group, 5 (3.2%) diagnostic laparotomies were performed, and in the main group, diagnostic laparotomy was performed in 1 (0.7%) case — with doubtful results of the FAST examination and the impossibility of diagnostic laparoscopy for technical reasons. So, the combination of ultrasound examination techniques by FAST examination, ultrasound-guided

diagnostic puncture and diagnostic laparoscopy decreased the number of unnecessary laparocentesis and traumatic diagnostic laparotomies, which in turn reduced the number of postoperative complications from 16.9 to 5.2 %. Based on the results of the study, we developed an algorithm of diagnostic and therapeutic actions for wounded patients with combat abdominal trauma based on the results of the FAST examination at the second level of medical care in warfare.

Discussion

In the case of a FAST-positive test result, emergency laparoscopic (with stable haemodynamics; the amount of free fluid in the abdominal cavity is approximately less than 500 ml; absence of pneumoperitoneum) or laparotomy (the amount of free fluid in the abdominal cavity is approximately more than 500 ml or free fluid obtained in the abdominal cavity during a diagnostic puncture of intestinal contents) surgical interventions are indicated for the patient.

With doubtful FAST results and stable haemodynamics, repeated FAST examinations are indicated in 2, 4, and 8 hours; with unstable haemodynamics — emergency surgery by laparoscopy or laparotomy. With a negative FAST result, patients with stable haemodynamics and without severe pain syndrome should be monitored clinically. The patients with severe pain syndrome or predictors of internal bleeding need in repeated FAST examinations in 2, 4, 8 and 12 hours after the first examination and, if possible, computed tomography. The patients with unstable dynamics have a full scope of diagnostic interventions aimed at detecting the cause of haemodynamic instability.

Conclusions

1. The FAST examination should be performed in all injured patients at the second level of medical care, regardless of the location of the injury.

2. The use of US-guided diagnostic puncture in case of FAST-positive result helps in making the correct diagnosis and choosing further diagnostic and therapeutic management.

3. The widespread introduction into the treatment and diagnostic management of the FAST examination and diagnostic punctures under ultrasound guidance can reduce the level of more traumatic diagnostic laparocentesis and unnecessary surgical interventions.

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Author Contributions

Conceptualization, (Herasymenko O.S. & Kashtalian M.A.); methodology, (Kashtalian M.A. & Haida Ya.I.); formal analysis, (Shkliarevych P.O. & Atanasov D.V.); data curation, (Kashtalian M.A.); writing - original draft preparation, (Haida Ya.I. & Okolets A.V.); writing - review and editing, (Shkliarevych P.O. & Atanasov D.V.); supervision, (Herasymenko O.S.).

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Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Conflicts of Interest

The authors declare no conflict of interest.