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Research Article

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Prediction of Complications in Gunshot Wounds of the Pelvis in Women Received in Armed Conflict

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ABSTRACT We have to state with a great regret the fact that armed conflicts do not cease to arise in the modern world. Therefore, life-saving measures are of primary importance, so the prevention of complications in case of gunshot wounds of the pelvis in women deserves special attention.

AIM OF THE STUDY Determination of prognosis of complications in gunshot wounds of the pelvis in women received in armed conflict.

MATERIAL AND METHODS The study included 86 women with shrapnel gunshot wounds to the abdominal cavity, which resulted in damage to the internal genital organs. All victims were civilians, their age ranged from 18 to 45 years, the average age was 34±5 years. Taking into account the admission time, all the wounded were divided into two subgroups: the 1st (Group A) included 45 people (52.3%), whose delivery time did not exceed 1.5 hours; the 2nd (Group B) included 41 women (47.7%), the delivery time from the moment of injury exceeded the specified time. Mathematical processing of the results was carried out using descriptive statistics methods.

RESULTS The conducted study shows that the immediate postoperative period for gunshot wounds of the pelvis in women proceeds more favorably in group A, which is confirmed by both laboratory data and data on the restoration of bowel function. At the same time, any peritonitis is dangerous due to its complications. In our observations, the total number of complications was 26 (30.2%), while in the overwhelming majority of observations (17; 19.7%) they were purulent-septic in nature. In group A, the number of complications was 9 (10.4%), in group B there were 17 (19.7%) complications ($r=0.63$, $p<0.05$).

CONCLUSION Taking into account the fact that the prediction of the development of such a formidable complication as peritonitis and its complications is of great clinical importance, we, using artificial intelligence, analyzed the main indicators influencing the development of complications, which, in turn, made it possible to create two programs: "A system for predicting the likelihood of complications after surgery for patients with peritonitis" and "An Internet service for predicting the likelihood of postoperative complications in patients with peritonitis", for which patents of the Russian Federation have already been received.

Keywords: local armed conflict, early detection of complications, pelvic organs, gunshot wounds, prediction of complications
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ESR — erythrocyte sedimentation rate
PST — primary surgical treatment

INTRODUCTION

The problem of trauma resulting from gunshot wounds remains relevant to this day. It remains an undeniable fact that under such conditions, not only military personnel directly involved in military actions are injured, but also the civilian population. Moreover, the civilian population accounts for a larger share of fatalities and complications than military personnel [1–3].

Quite a few publications have been devoted to the study of abdominal wounds in civilians [4–6], however, despite this, many unresolved issues remain, among which wounds in the pelvic area can be singled out. According to the data presented by V.V. Vlasov, the majority of victims of gunshot wounds die before medical workers arrive, therefore, providing first aid to the injured in the first minutes after receiving injuries is of great importance for saving human life and health [7–9]. The highly polymorphic and specific nature of such trauma, often in combination with damage to several internal organs, makes this trauma complex especially complex. Consequently, life-saving measures are of paramount importance, so the prevention of life-threatening complications deserves special attention.

The aim of the study: to determine the prognosis of complications in gunshot wounds to the pelvis received by women in armed conflict.

MATERIAL AND METHODS

The study is a multicenter, retrospective one. It included 86 women with shrapnel gunshot wounds to the abdominal cavity, which resulted in damage to the internal genital organs. All victims were civilians, their age ranged from 18 to 45 years, the average age was 34±5 years. The wounds were received as a result of a local armed conflict in the Chechen Republic from 1997 to 2005, as well as in the Donetsk and Lugansk republics from 2022 to 2023. The study included women with penetrating gunshot shrapnel

wounds to the pelvis. Patients under 18 and over 45 years old, with multiple and combined injuries to the limbs, head, chest, who refused to participate in the study or were admitted in a moribund state were excluded. The primary documents were: medical histories.

Taking into account the delivery time, all the wounded were divided into two subgroups: the 1st (Group A) included 45 patients (52.3%), whose delivery time did not exceed 1.5 hours from the moment of injury; the 2nd (Group B) included 41 women (47.7%), whose delivery time from the moment of injury exceeded the specified time periods.

The study was approved by the local ethics committee of Reaviz Medical University — protocol No. 6 dated 09.01.2021. For mathematical processing, the study results were initially entered into an electronic database; the study results were analyzed using the descriptive statistics method. The goodness-of-fit criterion χ^2 was used as a criterion. Statistical significance was defined as p <0.01–0.29 — weak positive relationship; r > 0.30–0.69 — moderate positive relationship; r > 0.70–1.00 — strong positive relationship.

RESULTS

Diagnosis of gunshot wounds of the small pelvis was based on the data of objective examination, collection of complaints. In 68 observations (79.0%), the indication for laparotomy was the presence of a penetrating nature of the wound, revealed during primary surgical treatment (PST) of the wound. In the remaining 18 cases (20.9%), PST was not required, since the penetrating nature of the wound was not in doubt, which was due to the release of pathological contents from the abdominal cavity. As an additional research method upon admission, in 31 observations (36.0%), an ultrasound examination was performed as an additional method. Other research methods were not used. The main approach for such wounds was lower midline laparotomy, which was performed in 69 observations (80.2%), in the remaining 17 cases (19.7%), mid-midline laparotomy was used as an approach. The volume of intra-abdominal blood loss in both groups did not exceed 1000 ml.

The analysis revealed that multiple wounds were predominant and were found in 68 victims (79.1%), while isolated injuries were observed in only 18 wounded (20.9%). In the vast majority (78; 90.6%) of cases, the wounds were shrapnel, and gunshot wounds were found in only 8 cases (9.3%). In the vast majority of cases (65; 75.6%), damage to the internal organs of the abdominal cavity was found, while penetrating wounds without damage to the internal organs were found in only 3 cases (3.5%). The organs damaged by such wounds, depending on the group, as well as their number, are presented in Table 1.

Table 1

Number of damaged organs in gunshot wounds in groups A and B

Damaged organs	Amount of damage depending on the group				Statistical significance	
	Group A		Group B			
	n	%	*n*	%	*r*	*p*
Uterus	32	37.2	29	33.7	0.65	<0.05
Ovaries	8	9.3	5	5.8	0.15	>0.05
Bladder	12	10	7	8.1	0.61	<0.05
Sigmoid colon	8	9.3	3	3.5	0.17	>0.05
Rectum	9	10.5	6	6.9	0.64	<0.05
Total	45	52.3	41	47.7	0.67	<0.05

The nature of the operation performed was determined by several factors: the nature of the damage to the internal organs, the severity of peritonitis, its presence or absence, and the stability of hemodynamic parameters. The localization of the wound in the area of the fundus of the uterus was noted in 54 observations (62.8%), in the area of the body of the uterus - in 23 (26.7%), and in the area of the lower segment of the uterus - in 9 (10.5%), i.e., wounds of the fundus of the uterus predominated. The types of operations performed for wounds of this localization are reflected in Table 2.

Table 2

Operations performed for injuries to the pelvic organs

Type of operation	Number in groups				Statistical significance	
	Group A		Group B			
	n	%	*n*	%	*r*	*p*
Extirpation of the uterus	22	25.6	24	27.9	0.17	>0.05
Suturing of the uterine wound	10	11.6	5	5.8	0.67	<0.05
Adnexectomy	8	9.3	5	5.8	0.15	>0.05
Suturing of the bladder wound	12	10	7	8.1	0.61	<0.05
Hartmann's	8	9.3	3	3.5	0.17	>0.05
Suturing of the rectal wound with the imposition of an end colostomy	9	10.5	6	6.9	0.64	<0.05

The data presented in Table 2 show that the main operation performed for uterine injuries in both Group A and Group B was extirpation — 46 (53.5), and uterine preservation was performed only in 15 cases (17.4%). Further analysis revealed that uterine removal in most cases (32; 37.2%) was associated with the penetrating nature of the injury to this organ, while in the remaining 14 cases (16.3%) uterine extirpation was performed with non-penetrating injury and no signs of peritonitis. This suggests that uterine removal was performed in the absence of indications for it. In our opinion, an important reason for the radical nature of the intervention was the lack of obstetricians-gynecologists and the performance of operations by general surgeons — 18 cases (20.9%). After laparotomy, all patients underwent drainage of the abdominal cavity and pelvis.

As the conducted analysis showed, out of 86 patients with the given localization of injury, peritonitis was detected in 26 people (30.2%). Of these, in group A — in 8 patients (9.3%), in group B — in 18 (20.9%) (r = 0.84, p <0.05). By the nature of the effusion: serous — in 12 observations (13.9%), fibrous — in 9 (10.5%), purulent — in 3 (3.5%), fecal and urinary peritonitis accounted for 1 case each (1.2%). The clinical analysis showed the following results for the prevalence of peritonitis: local peritonitis was noted in 16 observations (18.6%), respectively, in group A — in 8 (9.3%), in group B — in 8 (5.8%) (r = 0.17, p >0.05); diffuse — in 7 (8.1%), in all observations in group B (r = 0.65, p < 0.05) and generalized peritonitis — in 3 (3.5%), in all observations in group B (r = 0.62, p < 0.05). The dynamics of the number of leukocytes in the peripheral blood of patients of the two compared groups in the immediate postoperative period is reflected in Table 3.

Table 3

Dynamics of peripheral blood leukocytes in patients of two groups in the immediate postoperative period

Postoperative days	Results in groups		Statistical significance	
	Group A (*n*=45)	Group B (*n*=41)	*r*	*p*
Upon admission	13.7 [11.5; 14.8]	15.3 [13.4; 16.4]	0.67	<0.05
1st	13.8 [13.7; 17.9]	15.3 [13.4; 16.4]	0.67	<0.05
3rd	17.4 [16.3; 18.6]	15.6 [13.5; 16.8]	0.67	<0.05
5th	10.5 [9.8; 11.7]	18.4 [16.5; 19.6]	0.67	<0.05
7th	9 [7; 11]	16 [14; 19]	0.87	<0.05
10th	8 [6; 10]	8 [6; 9]	0.17	>0.05
13th	8 [6; 10]	9 [7; 10]	0.17	>0.05

As the conducted study showed, the number of leukocytes in the peripheral blood upon admission in group A was 13.7±2 [11.5; 14.8] $\times 10^9$/l, in group B, respectively, 15.3 ±3 [13.4; 16.4] $\times 10^9$/l (r = 0.67, p <0.05). When studying this indicator in dynamics, it was found that in group A there was a sharp increase in this indicator on the 3rd postoperative day, when it grew to 17.4±3 [16.3; 18.6] $\times 10^9$/l, while in group B on this day the number of leukocytes on this day did not change and was 15.6±2 [13.5; 16.8] $\times 10^9$/l (r = 0.67, p <0.05). In group B, the increase in the number of peripheral leukocytes in the peripheral blood

increased by the 5th postoperative day to 18.4 ± 3 [16.5; 19.6] × 10^9/l, in group A by the 5th postoperative day there was a decrease in the number of leukocytes to 10.5 [9.8; 11.7] × 10^9/l (r = 0.67, p < 0.05). It was further noted that the restoration of the number of leukocytes to physiologically normal values in group A occurred by the 7th postoperative day, and in group B - by the 10th. In this case, when assessing the indicators of blood leukocytes, a very important indicator is the number of band neutrophils (in %). Dynamics quantities band-shaped neutrophils shown V Table 4.

Table 4

Dynamics of the number of band neutrophils in patients of two groups in the immediate postoperative period

Postoperative days	Results in groups		Statistical significance	
	Group A (n=45)	Group B (n=41)	r	p
Upon admission	3 [2; 4]	3 [2; 4]	0.17	>0.05
1st	4 [3; 5]	6 [5; 7]	0.66	<0.05
3rd	7 [5; 8]	6 [5; 7]	0.65	<0.05
5th	4 [3; 6]	8 [7; 9]	0.68	<0.05
7th	3 [2; 4]	6 [5; 7]	0.77	<0.05
10th	3 [2; 4]	4 [3; 6]	0.17	>0.05
13th	3 [2; 4]	3 [2; 4]	0.17	>0.05

When analyzing the data reflected in Table 4, it is evident that upon admission, the number of band neutrophils in patients of the two groups did not change and corresponded to physiologically normal values, respectively, 3% [2; 4] and 3% [2; 4] (r = 0.17, p > 0.05), then, on the 1st postoperative day, in group A there were no significant changes in this indicator - 4% [3; 5], while in group B there was an increase to 6% [5; 7] (r = 0.66, p <0.05). By the 3rd postoperative day in group A there was a sharp increase in the number of band neutrophils in patients of group A to 7% [5; 8], while in group B this indicator did not change (r = 0.65, p <0.05). By the 5th postoperative day in group A, the number of band neutrophils in patients of group A decreased to 4% [3; 6], and in group B it increased to 8% [7; 9] (r = 0.68, p < 0.05). Subsequently, no significant changes in band neutrophils were detected in group A, in group B there was a decrease in the studied indicator to 6% [5; 7] (r = 0.77, p < 0.05), while in group B on the following day, band neutrophils were restored and began to correspond to physiologically normal values.

Another indicator that reflects the inflammatory process in the body is the erythrocyte sedimentation rate (ESR). The dynamics of ESR in patients of the two groups in the immediate postoperative period is reflected in Table 5.

Table 5

Dynamics of erythrocyte sedimentation rate in patients of two groups in the immediate postoperative period

Postoperative days	Results in groups		Statistical significance	
	Group A (n=45)	Group B (n=41)	r	p
Upon admission	12 [10; 13]	14 [13; 15]	0.76	<0.05
1st	15 [13; 17]	18 [17; 20]	0.84	<0.05
3rd	15 [13; 17]	18 [17; 20]	0.84	<0.05
5th	18 [16; 21]	23 [21; 27]	0.87	<0.05
7th	11 [8; 13]	23 [21; 27]	0.89	<0.05
10th	10 [7; 11]	19 [17; 21]	0.87	<0.05
13th	8 [6; 10]	9 [7; 11]	0.17	>0.05

From the data reflected in Table 5, it is evident that the ESR value occurred from the moment of admission of the wounded, thus, upon admission the ESR value in group A was 12 mm/h±4 [10; 13], and in group B — 14 mm/h±3 [13; 15] (r = 0.76, p < 0.05), later, on the first postoperative day, there was an increase in this indicator in group A to 15 mm/h [13; 17], and in group B — to 18 mm/h±4 [17; 20] (r = 0.84, p < 0.05). The second increase in this indicator occurred on the 5th postoperative day, when the ESR

in group A was 18 mm/h±2 [16; 21], and in group B to 23 mm/h [21; 27] ($r = 0.87$, $p < 0.05$). Subsequently, in group A, the ESR index was restored and corresponded to the physiological norm. In group B, the ESR restoration began on the 13th postoperative day.

Another important indicator reflecting the course of the postoperative period is the restoration of intestinal peristalsis, the amount of drainage from the abdominal cavity and the time of drainage removal. The dynamics of intestinal function are presented in Table 6.

Table 6

Dynamics of bowel function in women with gunshot wounds to the pelvis

The appearance of peristaltic noises				
Postoperative days	Group A (*n*=45)		Group B (*n*=41)	
	n	%	*n*	%
1st	2	2,3	–	–
3rd	34	39.5	12	13.9
5th	9	10.4	21	24.4
7th	–	–	8	9.3
Passage of gases				
1st	2	2.3	–	–
3rd	34	39.5	12	13.9
5th	9	10.4	21	24.4
7th	–	–	8	9.3
The appearance of a chair				
1st	–	–	–	–
3rd	–	–	–	–
5th	10	11.6	4	4.6
7th	23	26.7	8	9.3
10th	12	13.9	18	20.9
12th	–	–	11	12.7

The analysis of the obtained data allows us to conclude that in group A the appearance of peristaltic noises during auscultation occurred earlier than in group B. Thus, on the 1st day in group A the appearance of peristaltic noises was noted in 2.3%. In most observations in group A the appearance of peristaltic noises was noted on the 3rd day - 39.5%, whereas in group B - on the 3rd postoperative day the appearance of peristaltic noises was noted in 13.9% ($r = 0.87$, $p < 0.05$). By the 5th postoperative day in group A the appearance of peristaltic noises was noted in 10.4%, and in group B - in 24.4% ($r = 0.86$, $p < 0.05$). The passage of gases in the wounded into the pelvic area corresponded to the appearance of peristaltic noises during auscultation. The appearance of stool in group A on the 5th day was recorded in 11.6% of cases, in group B - in 4.6% ($r = 0.88$, $p < 0.05$), by the 7th day, respectively 26.7% and 9.3% ($r = 0.86$, $p < 0.05$), by the 10th 13.9% and 20.9% ($r = 0.87$, $p < 0.05$).

The timing of removal of drainage from the abdominal cavity in patients of the analyzed groups is presented in Table 7.

Table 7

Timing of removal of abdominal drainage

Deletion deadlines, postoperative day	Results in groups			
	Group A (*n*=45)		Group B (*n*=41)	
	n	%	*n*	%
3rd	19	22.0	–	–
5th	21	24.4	12	13.9
7th	5	5.8	19	22.0
10th	–	–	10	11.6

From the data reflected in Table 7, it is evident that in group A on the 3rd postoperative day it occurred in 22.0% of cases, in group B drainage removal was not performed on this day, on the 5th

postoperative day in group A - in 24.4% of cases, in group B - in 13.9% (r = 0.76, p <0.05), by the 7th postoperative day, respectively, 5.8% and 22.0% (r = 0.96, p <0.05) and on the 10th day - in 11.6% of cases, all in group B.

DISCUSSION

Thus, the presented study shows that the immediate postoperative period for gunshot wounds of the pelvis in women proceeds more favorably in group A, which is confirmed by both laboratory data and data on the restoration of bowel function. Any peritonitis is dangerous due to its complications, in our observations their total number was 26 (30.2%): in group A, complications were observed in 9 wounded (10.4%), and in group B - in 17 (19.7%) (r = 0.63, p <0.05). In the overwhelming majority of cases - 17 (19.7%) - complications were purulent-septic in nature.

CONCLUSION

Taking into account the fact that the prediction of the development of such a formidable complication as peritonitis and its complications is of great clinical significance, we, using artificial intelligence, analyzed the main indicators influencing the development of complications, which, in turn, made it possible to create two programs: "A system for predicting the likelihood of complications after surgery for patients with peritonitis" [10] and "An Internet service for predicting the likelihood of postoperative complications in patients with peritonitis" [11, 12], for which patents of the Russian Federation were received.

FINDINGS

1. Conducting a clinical analysis showed that the following results were obtained in terms of the prevalence of peritonitis: local peritonitis was noted in 16 observations (18.6%), respectively, in group A - in 8 wounded (9.3%), in group B - in 8 (5.8%) (r = 0.17, p > 0.05); diffuse - in 7 (8.1%) observations (r = 0.65, p < 0.05); generalized peritonitis - in 3 (3.5%) observations (r = 0.62, p < 0.05), and both diffuse and generalized peritonitis were noted only in patients of group B.

2. An important indicator reflecting the course of the postoperative period is the restoration of the functional state of the intestine, the amount of discharge from the abdominal cavity through drainage and the timing of drainage removal, and bowel defecation.

3. Analysis of the data in the presented study showed that the immediate postoperative period for gunshot wounds to the pelvis in women proceeds more favorably in group A, which is confirmed by both laboratory data and data on the restoration of the functional state of the intestine.

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