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Ventral hernia repair surgery after abdominal gunshot wound

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Gunshot wounds to the abdomen frequently result in significant damage to the abdominal organs, which is accompanied by peritonitis and the further development of different complications (anastomotic leakage, formation of abscesses, repeated bleeding, etc.), which require repeated surgical interventions that contribute to the formation of postoperative ventral hernias. The surgical management of ventral hernias is challenging due to severe adhesion in the abdominal cavity (irrespective of the time period since the injury and the last surgical interventions), the difficulties in closing massive defects of the muscle-aponeurotic component of the anterior abdominal wall, contracture of the anterior abdominal wall, and the development of the abdominal compartment syndrome in the postoperative period. As a result, there is still some debate over the best surgical treatment for postoperative ventral hernias.

Objective — to carry out a comparative analysis of open and video-assisted laparoscopic operations for the selection of the most optimal surgical strategy for the management of ventral hernias after gunshot wounds to the abdomen.

Materials and methods. We analyzed the surgical treatment of 45 wounded patients with postoperative ventral hernias that developed after operations for abdominal gunshot wounds. The patients were treated at the Military Medical Clinical Center of the Southern Region (Odesa) from 2014 to 2021; 32 of them had penetrating gunshot wounds, and 13 patients had a closed gunshot wound to the abdomen with injuries to the abdominal organs. 66.7 % of those injured had one operation on their abdominal organs, 22.2 % had two operations, 6.7 % had three operations, and 4.4 % had five operations. The size of the hernia orifices and severity of recurrence risk were determined according to the SWE classification: W1 (width of the hernia orifices up to 4 cm) — 28.9 %, W2 (from 4 to 10 cm) — 44.4 %, and W3 (over 10 cm) — 26.7 % of patients. The patients who had laparoscopic hernia repair (LHR) (IPOM-Plus method — 17 patients, sIPOM — 2 patients) belonged to the LHR group (n = 19). The patients who had open hernia repair (OHR) (IPOM-Plus method — 7 patients, sublay technique — 11 patients, onlay technique — 8 patients) were added to the OHR group (n = 26). The patients of both groups did not statistically differ by age, nature of a gunshot injury, number of operations before hernia repair, or hernia parameters (all $p > 0.05$).

Results. Postoperative hernias after gunshot wounds are associated with pronounced adhesions in the abdominal cavity. The mean value of the peritoneal adhesion index averaged 11.7 ± 0.7 points (from 5 to 23 points) and did not statistically differ between groups: in the OHR group — 12.4 ± 0.9 points, in the LHR group — 10.8 ± 0.9 points ($p = 0.339$). Laparoscopic and open hernia repair in injured patients did not differ in the frequency of intraoperative complications — 19.2 % and 15.8 %, respectively ($p = 0.766$). There were fewer postoperative complications (10.5 % vs. 38.5 %, $p = 0.036$), a shorter operation duration — 79.5 ± 6.8 min vs. 105.9 ± 4.7 min, $p = 0.002$, a shorter bed-day — 8.6 ± 0.4 days vs. 10.8 ± 0.5 days, $p = 0.004$, and fewer patients required narcotic analgesics within the first two days after surgery ($p < 0.05$). During the one-year follow-up, no hernia recurrence or adhesion signs were detected in the groups.

Conclusions. In the structure of postoperative ventral hernias after gunshot wounds to the abdomen, patients with open gunshot injuries predominate and amount to 71.1 % ($p = 0.007$). Among them, patients with combined and multiple wounds make up 65.6 %, while those with isolated wounds make up 34.4 % ($p = 0.112$); 33.3 % of patients require more than one operation before hernia repair. The laparoscopic IPOM-Plus technique should be considered the operation of choice in the treatment of hernias after gunshot wounds to the abdomen. At the same time, for extensive cosmetic defects of the anterior abdominal wall, open operations are preferable, especially the IPOM-Plus technique. If this is technically impossible, a sublay or onlay hernia repair using the tension-free allohernioplasty technique should be performed.

Keywords
abdominal gunshot wounds, ventral hernias, surgical treatment.

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In recent decades, the number of military conflicts has increased. It contributes to an extreme rise in the frequency of gunshot wounds resulting in severe destruction of abdominal organs (most often the small intestine at 50 %, the large intestine at 40 %, the liver at 40 %, and the intra-abdominal vascular system at 30 %), which is accompanied by peritonitis and the further development of different complications (anastomotic leakage, formation of abscesses, repeated bleeding, etc.). Such conditions require repeated surgical interventions, which contribute to the formation of postoperative ventral hernias [34, 36, 37, 38]. The surgical management of ventral hernias is challenging due to severe adhesion in the abdominal cavity (irrespective of the time period since the injury and the last surgical interventions), the difficulties in closing massive defects of the muscle-aponeurotic component of the anterior abdominal wall, contracture of the anterior abdominal wall, and the development of the abdominal compartment syndrome in the postoperative period. As a result, there is still some debate over the best surgical treatment for postoperative ventral hernias.

Objective — to carry out a comparative analysis of open and video-assisted laparoscopic operations for the selection of the most optimal surgical strategy for the management of ventral hernias after gunshot wounds to the abdomen.

Materials and methods

The prospective study included 45 wounded patients with postoperative ventral hernias as a result of operations for abdominal gunshot wounds. The patients were treated at the Military Medical Clinical Center of the Southern Region (Odesa) from 2014 to 2021.

The injured were all men, ranging in age from 19 to 56 years old, with an average age of 33.2 ± 1.2 years; 32 (71.1 %) had penetrating gunshot wounds, and 13 (28.9 %) had a closed gunshot wound of the abdomen with abdominal organ injuries.

With penetrating abdominal gunshot wounds, 11 (34.4 %) patients with postoperative ventral hernias had isolated injuries, 18 (56.2 %) patients had multiple injuries, and 3 (9.4 %) patients had combined injuries.

Abdominal bullet injuries were observed in 13 (40.6 %) patients; shrapnel injuries were observed in 29 (59.4 %) patients.

30 (66.7 %) wounded patients had one operation on the abdominal organs. 10 (22.2 %) patients underwent two operations; 3 (6.7 %) patients underwent three operations; and 2 (4.4 %) patients underwent five operations.

Purulent-inflammatory complications were observed in 21 (46.7 %) patients with ventral postoperative hernias in the postoperative period (after primary operations), with the involvement of the laparotomic wound in 14 (66.7 %) patients and of the abdominal cavity in 7 (33.3 %) patients.

The dimensions of the hernia orifices were determined according to the classification recommended by the European Hernia Society (EHS) [7, 8]: W1 (hernia orifice width up to 4 cm) — 15 (33.3 %) patients; W2 (from 4 to 10 cm) — 18 (40.0 %) patients; and W3 (over 10 cm) — 12 (26.7 %) patients. Out of the patients with W2 and W3 hernias, 8 (26.7 % or 17.8 % of the total number) were treated using the Damage Control approach [5].

The midline hernias occurred in 39 patients, and the lateral hernias in 6 patients.

Depending on the approach applied to hernia repair, the patients were divided into two groups. The 19 patients who underwent video-assisted laparoscopic access were included in the laparoscopic hernia repair group (LHR group). The 26 patients who underwent hernia laparotomies were included in the open hernia repair group (OHR group).

Patients in both groups did not differ statistically in terms of average age, $p = 0.887$; the correlation of closed combat injury of the abdomen (CCIA) and abdominal gunshot wounds (AGW), $p = 0.734$; bullet and shrapnel wounds, $p = 0.598$; the specific gravity of isolated, multiple, and combined injuries with AGW, $p = 0.510$; the number of operations prior to hernia repair, $p = 0.233$; the frequency and nature of complications prior to hernia repair, $p = 0.197$ and $p = 0.537$, respectively; and the correlation of patients in terms of the size of the hernia orifices, $p = 0.761$ (Table 1).

In the structure of postoperative ventral hernias after gunshot wounds to the abdomen, the patients with open gunshot injuries prevailed, at 71.1 % ($p = 0.007$). Among them, the patients with combined and multiple wounds made up 65.6 %, while those with isolated wounds made up 34.4 % ($p = 0.112$); 33.3 % of patients required more than one operation before hernia repair.

The effectiveness of the treatment was evaluated according to the following criteria.

In the perioperative period

- The duration of the operation
- Volume of blood loss
- The frequency and nature of complications
- The dynamics of the pain syndrome on the second, fourth, and sixth days according to the visual analog scale (VAS) [15]
- The presence of pain that requires pain-relieving narcotic drugs,
- The length of a bed-day,

Table 1. **Comparative characteristics of research groups with ventral hernias after abdominal gunshot wounds**

Indicator	Total (n = 45)	LHR (n = 19)	OHR (n = 26)	p
Age, years	33.2 ± 8.1	33.4 ± 7.3	33.1 ± 8.8	0.887
Injuries				
CCIA	13 (28.9 %)	6 (31.6 %)	7 (26.9 %)	0.734
AGW	32 (71.1 %)	13 (68.4 %)	19 (73.1 %)	
Bullets	13 (40.6 %)	6 (46.2 %)	7 (36.8 %)	0.598
Shrapnel	19 (59.4 %)	7 (53.8 %)	12 (63.2 %)	
Injuries with AGW	32	13	19	
Isolated	11 (34.4 %)	6 (46.2 %)	5 (26.3 %)	0.510
Multiple	18 (56.3 %)	6 (46.2 %)	12 (63.2 %)	
Combined	3 (9.4 %)	1 (7.7 %)	2 (10.5 %)	
The number of operations prior to hernia repair				
1	30 (66.7 %)	10 (52.6 %)	20 (76.9 %)	0.233
2	10 (22.2 %)	7 (36.8 %)	3 (11.5 %)	
3	3 (6.7 %)	1 (5.3 %)	2 (7.7 %)	
5	2 (4.4 %)	1 (5.3 %)	1 (3.8 %)	
Complications before surgery	31 (68.9 %)	21 (46.7 %)	10 (38.5 %)	0.197
Types of complications before surgery				
Wound suppuration	14 (66.7 %)	8 (72.7 %)	6 (60.0 %)	0.537
Abscess	7 (33.3 %)	3 (27.3 %)	4 (40.0 %)	
The size of the hernia orifices (EHS)				
W1	13 (28.9 %)	7 (36.8 %)	6 (23.1 %)	0.563
W2	20 (44.4 %)	8 (42.1 %)	12 (46.2 %)	
W3	12 (26.7 %)	4 (21.1 %)	8 (30.8 %)	
Localization of the hernia orifices				
Midline	39 (86.7 %)	17 (89.5 %)	22 (84.6 %)	0.714
Lateral	6 (13.3 %)	2 (10.5 %)	4 (15.4 %)	

In the long-term period (one year after surgery)

- The frequency of hernia recurrence
- The frequency of adhesion disease

The statistical processing of the data was performed with the statistical package IBM SPPS Statistics 22. The descriptive statistics were conducted. The Shapiro-Wilk test was used to evaluate variable distribution. The comparison of groups by one quantitative sign was performed using the Mann-Whitney U test, and the comparison of groups by one quality sign was performed using χ^2-criterion. With a p-value of 0.05, the zero hypothesis of equal variance for all variables was rejected.

Results

Three types of hernia repair were performed in the OHR group: the sublay technique on 11 (42.3 %) patients, the onlay technique on 8 (30.9 %) patients, and the open IPOM (intraperitoneal onlay mesh) on 7 (26.9 %) patients. In the OHR group, the onlay technique was used mainly for W3 hernial orifices (62.5 % of patients), the IPOM technique was used for W1 hernias (66.7 %), the sublay technique was used for W2 hernias (58.3 % of patients) (Table 2).

The open IPOM was always supplemented by reconstruction of the aponeurosis defect with interrupted stitches due to extensive mobilization of its

Table 2. **Hernia repair techniques depending on the size of the hernia orifices in the OHR group**

Technique	Total	W1	W2	W3
IPOM-Plus	7 (26.9 %)	4 (66.7 %)	2 (16.7 %)	1 (12.5 %)
Onlay	8 (30.8 %)	0	3 (25.0 %)	5 (62.5 %)
Sublay	11 (42.3 %)	2 (33.3 %)	7 (58.3 %)	2 (25.0 %)
Total	26 (100 %)	6 (23.1 %)	12 (46.2 %)	8 (30.8 %)

edges or division into components, a so-called IPOM-Plus technique.

In the LHR group, allohernioplasty was performed only using the IPOM technique.

Regardless of the technique used in the groups, the size of the implant was selected so that its edges extended at least 5 cm beyond the border of the hernial defect.

In the OHR group with the sublay and onlay technique, Covidien and Ethicon polypropylene mesh transplants were fixed with Prolen or Mopilen 2—0 thread.

When performing the open IPOM in the OHR group, Covidien (USA) Simbotex polycomposite implants were used, which were fixed with the help of a herniostepler (AbsorbaTack) or transdermally implanted suture with Vicryl 1—0 thread (Fig. 1).

Polycomposite prostheses of Covidien Simbotex and Sil Promesh (Peters, France) were used in the LHR group. Fixation of the prosthesis was carried out with the help of transdermally implanted sutures with 1—0 vicryl thread and the AbsorbaTack stepler. In two cases (the end of 2014 and the beginning of 2015), teflon allografts were used, which were later discontinued. When performing the IPOM technique in the LHR group, the first trocar was inserted according to the Hasson technique (open method), under visual control, through the lower edge of the laparotomy scar along the midline at the suprapubic area. With pronounced adhesion, an optical port with built-in Visiport scissors was used to perform viscerolisis and prepare the space for the introduction of additional Covidien trocars. It was mandatory to close the hernia defect with separate interrupted stitches against the background of reduced CO2 pressure in the abdominal cavity to ensure the absence of tension and complete approximation of the hernia edges. The IPOM-Plus technique was performed in 17 (89.5 %) patients; a bridge-like (standard) technique called sIPOM was performed in two patients with a large (W3) hernia defect.

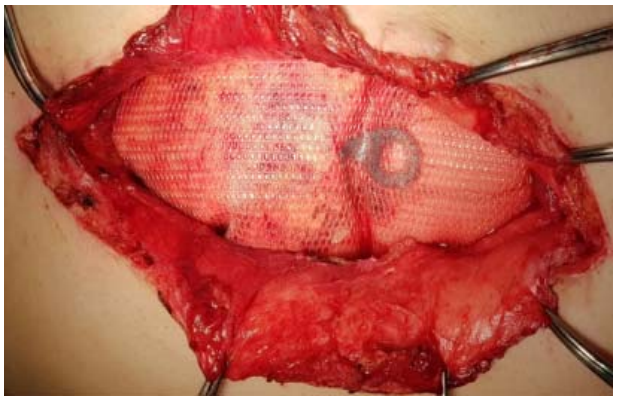

Figure 1. **Location of a Covidien Simbotex composite implant fixed by transdermally implanted sutures in open hernia repair by the IPOM technique**

The onlay mesh in the OHR group was carried out according to the developed tension-free method of hernia repair. At the same time, a split skin flap was excised or de-epithelialized on the anterior abdominal wall through two circumferential incisions, which had been superimposed on the granulations covering the intestinal loops during previous surgical interventions. The rectus abdominis muscles were mobilized from scar-deformed tissues and were separated from the remnants of the aponeurosis along the lateral edge. Further, the rectus abdominis muscles were moved in the medial direction and stitched together side by side. The synthetic allograft was installed on the muscles and fixed along the perimeter: from the sides, to the aponeurotic ends of the oblique muscles of the abdomen and the remains of the aponeuroses of the rectus abdominis muscles; if necessary, from above, to the costal arch; from below, to the periosteum of the pubic bone. Additional mobilization of subcutaneous fat took place with allograft covering. The subcutaneous fat of the abdominal wall was drained by a polyvinyl chloride tube with constant negative pressure in it (according to the Radon type). The operation ended with a layer-by-layer suture of the wound (Fig. 2).

The abdominal cavity adhesion process was observed in all of the operated patients. According to the classification, the peritoneal adhesion index (PAI) [14] averaged 11.7 ± 0.7 points (from 5 to 23 points) and did not statistically differ between the groups:

12.4 ± 0.9 points in the OHR group, 10.8 ± 0.9 points in the LHR group, p = 0.339 (Fig. 3).

In 31 (68.9 %) of the 45 patients, a simultaneous viscerolisis was performed. In all the cases, we conducted partial viscerolisis between the anterior abdominal wall and abdominal organs at the site of implant location and/or viscerolisis if it was necessary for another simultaneous operation.

A total of 55 simultaneous operations on 38 patients were performed (Table 3).

The research groups did not statistically differ from each other by the total rate of simultaneous operations and their certain types, all p > 0.05.

By the frequency of intraoperative complications, 8 (17.8 %) patients of the research groups did not differ statistically: in the LHR group — 3 (15.8 %); in the OHR group — 5 (19.2 %), p = 0.766. There was no significant difference between the groups by the specific gravity of individual complications, p = 0.701 (Table 4).

The above-mentioned complications were removed immediately during the operation.

At the same time, in the LHR group, the mean values of intraoperative blood loss were significantly lower as compared to the OHR group 17.9 ± 7.9 ml vs. 107.7 ± 9.9 ml, p < 0.00, and the duration of the operation was shorter 79.5 ± 6.8 min vs. 105.9 ± 4.7 min, p = 0.002.

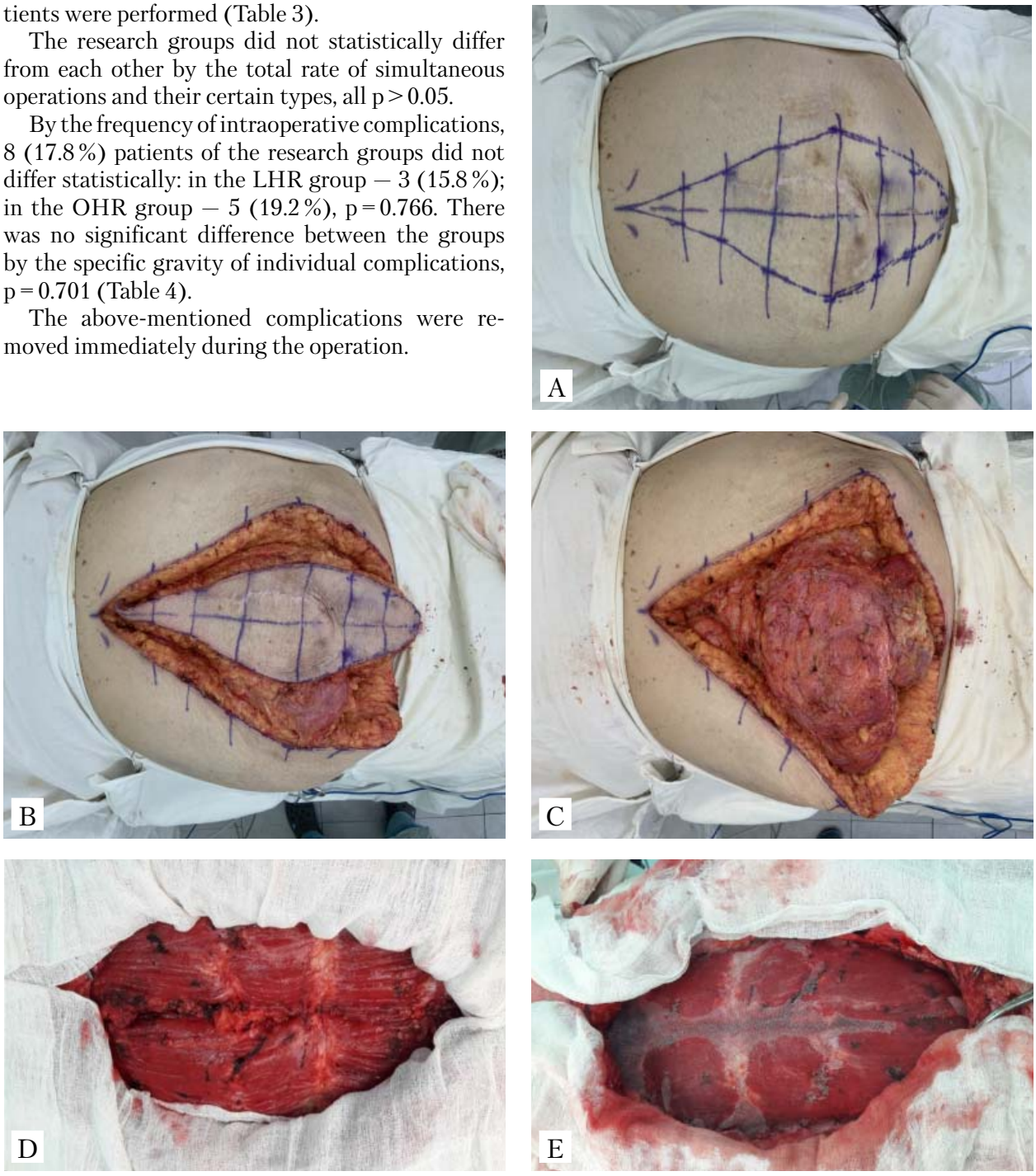

Figure 2. **Wounded V., 49 years old. Eight months after the injury, ventral hernia after a multi-stage surgpical treatment for a penetrating gunshot wound to the abdomen. A — marking of the operating field; B — skin graft incision; C — isolation of a hernia defect from cicatricially-deformed tissues; D — displacement of the rectus abdominis muscles; E — synthetic allograft fixation**

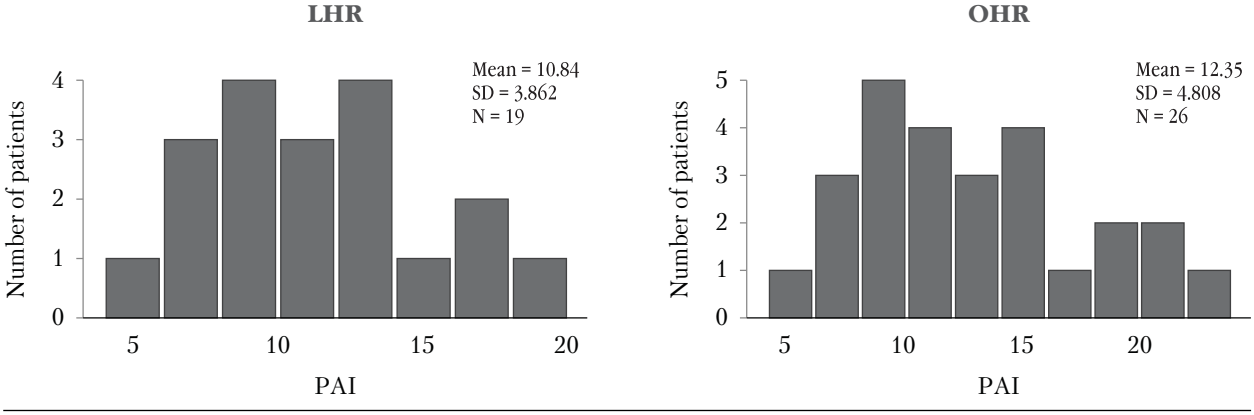

Figure 3. **Distribution of patients according to the PAI in the research groups**

Table 3. **Simultaneous operations in the research groups**

Indicator	Total (n = 45)	LHR (n = 19)	OHR (n = 26)	p
Number of patients with simultaneous operations	38 (84.4 %)	16 (84.2 %)	22 (84.6 %)	0.970
The number of simultaneous operations in one patient				
One	24 (53.3 %)	13 (68.4 %)	11 (42.3 %)	0.203
Two	11 (24.4 %)	3 (15.8 %)	8 (30.8 %)	
Three	3 (6.7 %)	0 (0.0 %)	3 (11.5 %)	
Viscerolisis	31 (68.9 %)	14 (73.7 %)	17 (65.4 %)	0.553
Excision of suture sinus	4 (8.9 %)	0 (0.0 %)	4 (15.4 %)	0.073
Cholecystectomy	5 (11.1 %)	2 (10.5 %)	3 (11.5 %)	0.915
Scar omentum resection	6 (13.3 %)	1 (5.3 %)	5 (19.2 %)	0.173
The small intestine resection	3 (6.7 %)	1 (5.3 %)	2 (7.7 %)	0.747
Restoration of the large intestine continuity	6 (13.3 %)	2 (10.5 %)	4 (15.4 %)	0.636

Table 4. **Intraoperative complications in the research groups**

Indicator	Total (n = 45)	LHR (n = 19)	OHR (n = 26)	p
Deserosis of the small intestine	3 (6.7)	1 (5.3)	2 (7.7)	0.701
Bleeding from anterior abdominal wall centesis	1 (2.2)	1 (5.3)	0	
Deserosis of the large intestine	1 (2.2)	0	1 (3.8)	
Perforation of the small intestine	2 (4.4)	1 (5.3)	1 (3.8)	
Perforation of the large intestine	1 (2.2)	0	1 (3.8)	

Table 5. **Postoperative complications in the research groups**

Indicator	Total (n = 45)	LHR (n = 19)	OHR (n = 26)	p
Pneumonia	2 (4.4 %)	1 (5.3 %)	1 (3.8 %)	0.057
Seroma	8 (17.8 %)	0	8 (30.8 %)	
Intermuscular hematoma	1 (2.2 %)	1 (5.3 %)	0	
Abdominal compartment syndrome	1 (2.2 %)	0	1 (3.8 %)	

In the postoperative period, complications occurred in 12 (26.7 %) patients: in the LHR group, in 2 (10.5 %); in the OHR group, in 10 (38.5 %), p = 0.036. Although there were significantly fewer complications observed in the LHR group, the correlation of some types of complications showed that the groups did not differ statistically (Table 5).

Such a complication as seroma occurred only in the OHR group: with the onlay technique, in 6 (75.0 %) patients; with the sublay technique, in 2 (18.2 %) patients. Seroma was drained under ultrasound in four patients after the onlay technique due to clinical signs of superficial infection of the operative area (local pain, wound hyperemia).

There was no suppuration of the postoperative wounds. Seroma was removed by punctures under ultrasound until the patient fully recovered.

An average pain score in the LHR group on the first, second, and third day was significantly lower as compared to the OHR group at the same time period, all p < 0.01 (Fig. 4).

On the other hand, in the LHR group, the number of patients who needed narcotic analgesics administration was significantly lower compared to the OHR group only on the first two days after the operation: on the first day, 7 (36.8 %) vs. 18 (69.2 %), p = 0.031; on the second day, 3 (15.8 %) vs. 12 (46.2 %), respectively; on the third day, according to this indicator, the groups did not differ statistically: there were no such patients in the LHR group; 4 (15.4 %) in the OHR group, p = 0.073.

In general, the bed day was 9.9 ± 0.4 (ranging from 7 days to 18 days) and was significantly lower in the LHR group 8.6 ± 0.4 days vs. 10.8 ± 0.5 days in the OHR group, p = 0.004.

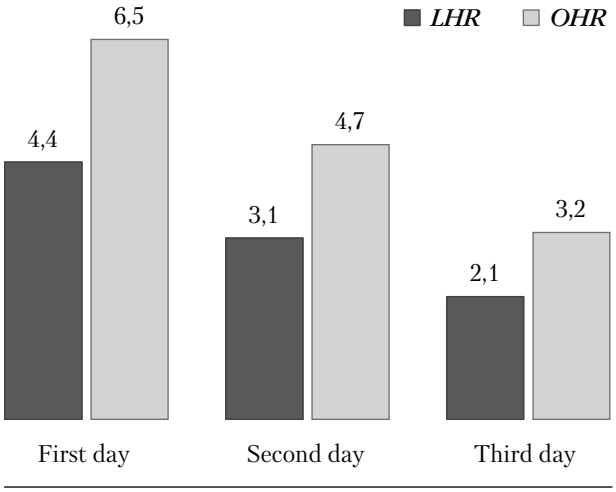

Figure 4. **An average VAS score in the research groups three days after surgery [15]**

Discussion

Ventral hernias after combined and multiple gunshot wounds to the abdomen are the result of a multi-stage surgical treatment, in particular the damage control technique, which is performed against the background of abdominal infection and injury to the abdominal organs and extraperitoneal space [1, 2, 6].

The usage of mesh implants in the treatment of ventral hernias after open abdominal injuries does not increase the frequency of infection as compared to suture plasty, even under potential microbial contamination of tissues [3], and is associated with a lower recurrence rate [9]. The updated guidelines for the treatment of ventral and postoperative hernias suggest using mesh even for small umbilical or epigastric hernias (diameter > 1 cm) in order to reduce the risk of recurrence [10].

The left (Palmer's point) (or right) upper quadrant subcostal along the midclavicular line for mid- and lower abdominal hernias [11] and creating a pneumoperitoneum with a Veress needle [12] are thought to be the most dangerous places to insert the first trocar. In our trial during the laparoscopic IPOM, we inserted the first trocar under visual control (by the Hasson method), through the lower edge of the laparotomy scar, along the midline, at the suprapubic area, taking into account the adhesions from the gunshot wounds and several previous operations. This approach proved to be safe for making carboxyperitoneum in all the cases.

Adhesions between the anterior abdominal wall and abdominal organs take place in almost all postoperative hernias [13]. All of the patients in our study had abdominal adhesion, with an average PAI score of 11.7 ± 0.7 points (ranging from 5 points to 23 points) [14]. So, viscerolisis is an important part of ventral hernia repair, but it is associated with intestinal damage up to 11 % [16, 17] and a mortality rate up to 8 % [17]. It is proven that viscerolisis does not have additional advantages, such as the reduction of chronic abdominal pain [18]. Besides, viscerolisis increases the duration of the operation. When performing viscerolisis, we limited ourselves only to the area of mesh implantation and the area necessary for simultaneous operations, as proposed in the updated recommendations for laparoscopic treatment of hernias [10]. Intestinal damage occurred in 6.6 % of patients; it was immediately removed and had no negative consequences. None of the patients had any signs of adhesion during the year.

The question of the expediency of suturing hernial edges with IPOM is debatable. Several comparative studies between IPOM and IPOM-Plus

have shown that IPOM-Plus is associated with more favorable surgical results concerning recurrence rate, seroma occurrence, and mesh protrusion [20, 21, 22, 23, 24, 26, 28, 31]. According to a meta-analysis, IPOM-Plus (n = 138) as compared with sIPOM (n = 255) provided a lower recurrence rate (0—5.7 % vs. 4.8—16.7 %) and a reduction in seroma formation (5.6—11.4 % vs 4.3—27.8 %) [27]. There are reports that the laparoscopic IPOM-Plus did not lead to relapse reduction, the occurrence of seroma, or infection of the surgical area as compared with sIPOM [29] and sublay techniques [31]. According to Lambrecht JR et al. [30], previous suture closure of hernia defect had no effect on the frequency of seroma, pain in 2 months, mesh protrusion, or relapse. The total rate of complications was higher after IPOM-Plus as compared with sIPOM (OR 3.42; CI 1.25—9.33).

We agree with the opinion about IPOM-Plus expediency, both with laparoscopic and open approaches, even with large defects. Until recently, it was considered that the laparoscopic IPOM had a limit of effectiveness for hernia defects over 80 cm^2, but recent studies have shown that IPOM-Plus can significantly expand the indications for surgery [33]. In the case of the preperitoneal open hernia repair, we additionally sutured the aponeurosis on all wounded patients, including the separation of components by indications. So, we used the IPOM-Plus technique. IPOM-Plus was performed on 89.5 % of patients via laparoscopic access. We did not compare IPOM-Plus with sIPOM, because we used the IPOM-Plus technique. Nevertheless, during the year, there were no cases of hernia recurrence, protrusion of mesh, or seroma with either method.

It is considered that laparoscopic hernia repair of postoperative ventral hernias, which includes hernias after gunshot wounds to the abdomen, has certain advantages over open access [30, 31, 32]. The laparoscopic IPOM compared to the open IPOM had a shorter operative time (median duration 120 vs. 180 min, $p < 0.001$), a shorter stay in the hospital (6 vs. 8 days, $p = 0.002$), a lower complication rate (10 % vs. 23 %, $p = 0.046$) and a lower frequency of the operation area infection (1 vs. 21 %, $p < 0.001$) [32]. The laparoscopic IPOM had advantages over the open sublay method with medium and large ventral hernias concerning the frequency of postoperative complications (19 % vs. 41 %; $p = 0.028$), duration of the operation (88 vs. 114 min; $p = 0.009$) and the term of stay in the hospital (5 days vs. 8 days; $p < 0.001$); with a significantly similar recurrence rate of 13 vs. 7 %, $p = 0.508$) [30]. But, despite the advantages, laparoscopic IPOM has a higher incidence of intraoperative complications as compared to open methods [31]. But we did not observe a difference in the incidence of intraoperative complications between the groups: 3 (15.8 %) in the LHR group and 5 (19.2 %) in the OHR group, $p = 0.766$. On the other hand, the frequency of postoperative complications was higher in the OHR group: 10 (38.5 %) vs. 2 (10.5 %) in the LHR group, $p = 0.036$. The LHR group was distinguished from the OHR group by a shorter duration of operation 79.5 ± 6.8 min vs. 105.9 ± 4.7 min, $p = 0.002$; a lower average pain score at the 1st–3rd day after operation, and fewer patients who required administration of narcotic analgesics on the first two days after surgery: on the first day, 7 (36.8 %) vs. 18 (69.2 %), $p = 0.031$; on the second day, 3 (15.8 %) vs. 12 (46.2 %); a shorter stay in the hospital 8.6 ± 0.4 vs. 10.8 ± 0.5 days, $p = 0.004$, respectively. No recurrence of hernias was registered during the year in either group.

Although the laparoscopic IPOM has definite advantages and is, in our opinion, the operation of choice in the treatment of anterior abdominal wall hernias after abdominal gunshot wounds, it does not remove the cosmetic defect after previous abdominal skin closure. The techniques of open hernia repair are able to remove this cosmetic defect. Should the disadvantages of open operations (compared to laparoscopic ones) be neglected for the sake of a better cosmetic result? This is a debatable problem. However, we agree that, for extensive cosmetic defects of the anterior abdominal wall, open operations are preferable, especially the IPOM-Plus technique.

Conclusions

In the structure of postoperative ventral hernias after gunshot wounds to the abdomen, patients with open gunshot injuries predominate and amount to 71.1 % ($p = 0.007$). Among them, patients with combined and multiple wounds make up 65.6 %, while those with isolated wounds make up 34.4 % ($p = 0.112$); 33.3 % of patients require more than one operation before hernia repair.

The laparoscopic IPOM-Plus technique should be considered the operation of choice in the treatment of hernias after gunshot wounds to the abdomen. At the same time, for extensive cosmetic defects of the anterior abdominal wall, open operations are preferable, especially the IPOM-Plus technique. If this is technically impossible, a sublay or onlay hernia repair using the tension-free allohernioplasty technique should be performed.

Declaration of interests

The authors declare that they have no conflicts of interest.

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Authors contributions

The authors have contributed equally to conception and design, acquisition and interpretation of data, drafting the article.

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Хірургічне лікування вентральних гриж після вогнепальних поранень живота

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Вогнепальні поранення живота часто супроводжуються значним руйнуванням органів черевної порожнини з розвитком перитоніту, а в подальшому — різноманітних ускладнень (неспроможність анастомозів, формування абсцесів, повторні кровотечі тощо), що потребує повторних оперативних втручань, як наслідок — виникають післяопераційні вентральні грижі. Під час проведення операцій з приводу вентральних гриж після вогнепальних поранень живота хірурги зазвичай стикаються з такими проблемами, як значний спайковий процес у черевній порожнині (незалежно від терміну з моменту поранення і виконання останніх операційних втручань на органах черевної порожнини), труднощі із закриттям великих дефектів м'язово-апоневротичного компонента передньої черевної стінки, контрактура передньої черевної стінки, розвиток абдомінального компартмент-синдрому в післяопераційний період. Тому вибір хірургічної тактики залишається актуальною проблемою.

Мета — визначити вибір методу оперативного втручання вентральних гриж після вогнепальних поранень живота шляхом порівняльного аналізу відкритих та відеолапароскопічних операцій.

Матеріали та методи. Проведено аналіз результатів хірургічного лікування 45 поранених з вентральними грижами, спричиненими проведенням операцій з приводу бойових ушкоджень живота, які перебували на лікуванні у Військово-медичному клінічному центрі Південного регіону (м. Одеса) у період з 2014 до 2021 р. У 32 з них були вогнепальні проникаючі поранення, у 13 — закрита бойова травма живота з ушкодженнями органів черевної порожнини. Одну операцію на органах черевної порожнини перенесли 66,7 % поранених, дві операції — 22,2 %, три операції — 6,7 %, п'ять операцій — 4,4 %. Розміри грижових воріт і ступінь ризику рецидивування визначали за класифікацією SWE: W1 (ширина грижових воріт < 4 см) — у 28,9 % пацієнтів, W2 (4—10 см) — у 44,4 %, W3 (> 10 см) — у 26,7 %. Хворих розподіли на дві групи: 19 — виконано лапароскопічну герніопластику (методика IPOM-Plus — 17 пацієнтів, cIPOM — 2) 26 — відкриту герніопластику (методика IPOM-Plus — 7 пацієнтів, sub-lay — 11, on-lay — 8). Хворі обох груп статистично значущо не відрізнялися за віком, характером бойової травми, кількістю операцій до виконання герніопластики, параметрами грижі (всі $p > 0,05$).

Результати. Післяопераційні грижі після вогнепальних поранень асоціювалися з виразним спайковим процесом у черевній порожнині (середнє значення індексу спайкового процесу очеревини (Peritoneal adhesion index) становило (11,7 ± 0,7) бала (від 5 до 23 балів) і статистично значущо не відрізнялося у групах: у групі відкритої герніопластики — (12,4 ± 0,9) бала, в групі лапароскопічної герніопластики — (10,8 ± 0,9) бала ($p = 0,339$). Лапароскопічна та відкрита герніопластика у поранених не відрізнялася за частотою інтраопераційних ускладнень — 19,2 та 15,8 % відповідно ($p = 0,766$), натомість були меншими частота післяопераційних ускладнень (10,5 і 38,5 %, $p = 0,036$), тривалість операції ((79,5 ± 6,8) та (105,9 ± 4,7) хв ($p = 0,002$)), кількість хворих, які потребували призначення наркотичних аналгетиків перші дві доби після операції ($p < 0,05$), ліжко-день ((8,6 ± 0,4) і (10,8 ± 0,5) доби ($p = 0,004$). Протягом року спостереження не діагностовано рецидиву грижі та ознак спайкової хвороби в жодній з груп.

Висновки. У структурі післяопераційних вентральних гриж після вогнепальних поранень живота переважають хворі, які перенесли відкриту бойову травму — 71,1 % ($p = 0,007$), серед них на частку пацієнтів з поєднаними та множинними пораненнями припадає 65,6 %, на частку осіб з ізольованими пораненнями — 34,4 % ($p = 0,112$). Більше однієї операції до герніопластики потребують 33,3 % пацієнтів. Лапароскопічну методику IPOM-Plus слід розглядати як операцію вибору при лікуванні гриж після вогнепальних поранень живота. За наявності значних косметичних дефектів передньої черевної стінки доцільно проводити відкриті операції, віддаючи перевагу IPOM-Plus, у разі її технічної неможливості — методиці герніопластики sub-lay або on-lay за розробленим способом безнатяжної алогерніопластики.

Ключові слова: вогнепальні поранення живота, вентральні грижі, хірургічне лікування.

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