

Intraperitoneal alloplasty combined with the anterior component separation in giant incisional hernias

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ABSTRACT:

The use of the anterior technique for abdominal wall components separation combined with “onlay” alloplasty (ACST + onlay) in giant incisional hernias (IH) may pose a surgical challenge as it does not exclude increased intra-abdominal pressure (IAP) and the occurrence of abdominal compartment syndrome (ACS). There remains a high incidence of surgical site complications. In our view, the use of intra-abdominal alloplasty combined with anterior separation of the anterior abdominal wall components (ACST + IPOM) will contribute to the improvement of surgical outcomes in giant IH.

Purpose: to improve the results of surgical treatment of giant IH using ACST + IPOM.

Materials and methods: Analysis of surgical treatment of 164 patients with giant IH aged 30 to 75 (mean age 54.7 ± 3.3). Depending on the surgery, the patients were divided into two groups. Group I (82 patients) consisted of patients who underwent our modified technique, including ACST + IPOM. The surgery in group II (82 patients) involved ACST + onlay.

Results and discussion: As compared with ACST + onlay, ACST + IPOM surgery contributes to a significantly reduced incidence of ACS [6.1% (group II) versus 0 (group I), (p < 0.05)], seroma [25.6% versus 7.3%, p < 0.05], surgical site infection (SSI) [4.9% versus 2.4%, p > 0.05], meshoma [3.7% versus 0] and hernia recurrences [6.5% versus 1.6%, p > 0.05].

Conclusions: IAP value equal or exceeding 9.1 mmHg (1.2 kPa) during surgery in approximated rectus muscles is prognostic for ACS occurrence and requires intraoperative preventive measures. Utilization of ACST + IPOM in giant IH ensures an optimal abdominal cavity volume without a substantial increase in IAP and reduces the probability of ACS, whereas the use of ACST + onlay results in ACS in 6.1% (p < 0.05) patients. Reduced contact of the mesh with the subcutaneous tissue in ACST + IPOM contributes to a significantly lower incidence of seroma [7.3% vs 25.6% (p < 0.05)], surgical site infection (SSI) [2.4% vs 4.9% (p > 0.05)], postoperative wound infiltrate [2 (2.4%) vs. 11 (13.4%) (p < 0.05)], chronic postsurgical pain [1 (1.6%) vs. 5 (8.1%) (p > 0.05)] and recurrent IH [1 (1.6%) vs. 4 (6.5%) (p > 0.05)] as compared with ACST + onlay technique.

KEYWORDS:

giant postoperative abdominal hernia, ACST, IPOM, onlay, ACS, seroma, suppuration, meshoma

A large-scale implementation of various alloplastic techniques (“sublay”, “onlay”, preperitoneal alloplasty) has significantly improved surgical outcomes in incisional hernias (IH). However, abdominal volume reduction and increased intra-abdominal pressure (IAP) leading to abdominal compartment syndrome (ACS) (2.4–3.6%) and mortality (1.2–3.4%) remain surgical challenges often encountered in utilization of classic methods of alohernioplasty in giant IH [1,4,13]. This justifies the need for a special tensionless technique of giant abdominal wall defect closure that would not cause a rise in IAP. The use of separation of anatomical components of the anterior abdominal wall was first described by Ramirez; combined with “onlay” alloplasty, it provides an extended area of the abdominal wall, increased abdominal volume and improves the outcomes, including reduced incidence of ACS [3, 6, 8]. However, such combined surgery in giant IH does not exclude an increase in IAP and ACS occurrence. In addition, a large contact area of the mesh implant with the subcutaneous tissue results in a high incidence of local complications such as seroma (30.8–60.4%), suppuration (1.5–4.8%), ligature fistula (1.2–3%), meshoma (0.06–1.6%) leading to recurrent IH (10–15%) [9,10,11,12].

In our view, the use of intra-abdominal alloplasty in conjunction with the Ramirez surgery can offer an opportunity to improve surgical results in IH.

Purpose: to improve surgical results in giant incisional hernias using intra-abdominal alloplasty combined with Ramirez surgery.

MATERIALS AND METHODS

A review of surgical results of 164 patients operated on giant IH between 2009 and 2016 was performed. There were 106 women (64.6%) and 58 (35.4%) men aged 30 to 75 (mean age 54.7 ± 3.3) with no significant differences in the selected age groups ($\chi^2 = 0.3$; $\pi = 0.84$).

According to the classification of the European Hernia Society (EHS classification, Ghent, Belgium, 2008) [2], giant IHs were as follows: 52 (31.7%) patients were diagnosed with $M_{1-4}W_3R_0$, 10 (6.1%) - $M_{1-4}W_3R_1$, 63 (38.4%) - $M_{1-5}W_3R_0$, 13 (7.9%) - $M_{1-5}W_3R_1$, 20 (12.2%) - $M_{4-5}W_3R_0$, 6 (3.7%) - $M_{4-5}W_3R_1$. Repairable IH was diagnosed in 60 (36.6%) patients; irreparable IH occurred in 104 (63.4%); recurrent IH was diagnosed in 29 (17.7%) patients. Other complications included contracture of rectus abdominis muscles [72 (43.9%) patients], maceration [8 (4.9%) patients], skin ulcer [5 (3.0%)] and subcutaneous ligature fistula [6 (3.7%)].

IH patients were divided into two groups depending on the method of surgical treatment. The groups were comparable in age, sex, and IH size. All patients underwent special preoperative preparation on an outpatient basis within 10.0 ± 3.2 days, including a residue-free diet, dosed bandage compression of the abdomen, breathing exercises, corrective treatment of comorbid conditions. Antibacterial prophylaxis was performed with the use of third generation cephalosporins two hours before surgery. In order to

Tab. I. IAP values in giant IH (n = 164).

GROUP	BASELINE IAP, MMHG (KPA)	IAP BEFORE SURGERY IN BANDAGE COMPRESSION, MMHG (KPA)	INTRAOPERATIVE IAP IN HERNIOPLASTY MODELING AFTER CST, MMHG (KPA)	IAP IMMEDIATELY AFTER SURGERY, MMHG (KPA)	IAP 6-8 HOURS AFTER SURGERY, MMHG (KPA)	IAP 24 HOURS AFTER SURGERY, MMHG (KPA)	IAP 48 HOURS AFTER SURGERY, MMHG (KPA)
I (n=82)	0.8±0. (0.1±0.02)	3.7±1.3 (0.5±0.2)	5.4±2.1 (0.7±0.3)	6.8±1.2 (0.9±0.2)	7.6±1.3 (1.0±0.2)	6.3±1.2 (0.8±0.2)	4.5±1.1 (0.6±0.1)
II (n=82)	0.8±0.2 (0.1±0.02)	3.8±1.2 (0.5±0.1)	9.1±2.9 (1.2±0.4)	12.7±2.3 (1.7±0.3)	15.4±1.4 (2.0±0.2)	12.1±1.6 (1.6±0.2)	8.1±2.1 (1.1±0.3)

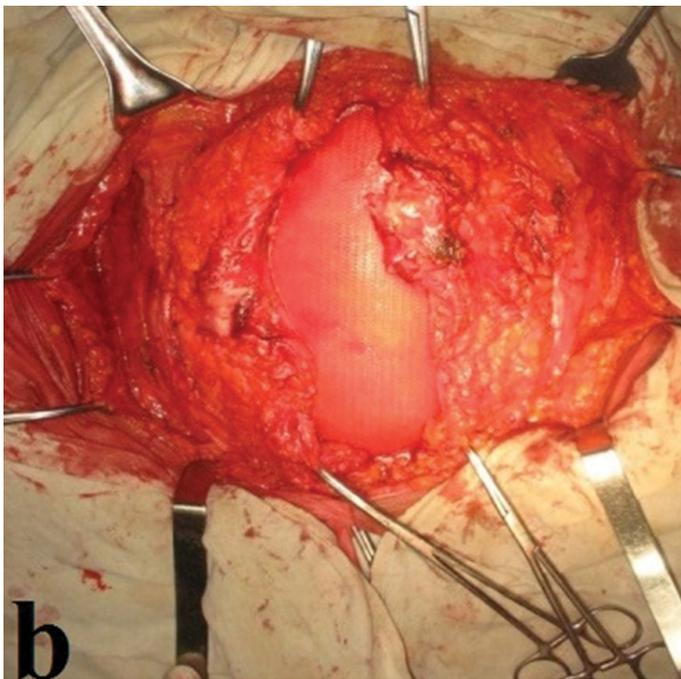
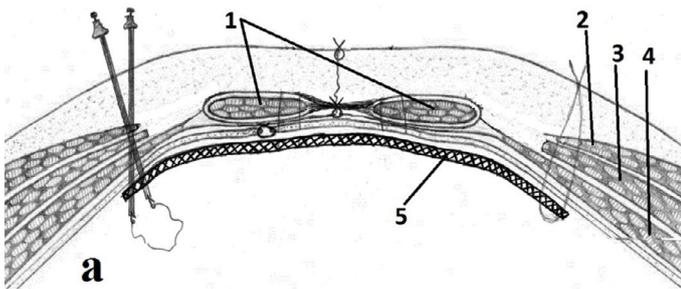


Fig. 1. Picture (a) and image (b) ACST + onlay; 1 - rectus abdominis muscle; 2 - abdominal external oblique muscle; 3 - abdominal internal oblique muscle; 4 - transverse abdominal muscle; 5 - mesh implant.

prevent thromboembolic complications, enoxaparin sodium (40 mg) was injected subcutaneously 12 hours before surgery and once daily after surgery for 7-9 days. Compression garments for lower limbs were worn during surgery and for a month after. Modified ACST + IPOM was performed in 82 (50%) patients of group I (Fig. 1). The essence of the surgery was as follows: after excision of the postoperative scar, the hernia sac was isolated and incised. Fusions in the abdominal cavity were separated, aponeurotic edges of the hernia defect were mobilized from the subcutaneous tissue across the width of abdominal rectus muscles. The aponeurosis of the external muscle was dissected along the margin of the rectus sheath. It was mobilized from the internal oblique muscle, which contributed to a rectus shift towards the midline by an average of 8-10 cm. This procedure was performed on both sides. Then the intra-abdominal mesh (Parietex composite, Proceed) was placed

and fixed. This mesh fixation was performed at dosed approximation of rectus muscles so that IAP did not exceed 5-6 mmHg. IAP was monitored intraoperatively via a Foley catheter (1 cmH₂O corresponds to 0.735 mmHg.) [5]. The operation was completed by vacuum draining of the wound with two silicone drainages and stratified stitching.

In group II, 82 (50%) patients underwent ACST + onlay (Fig. 2). The anterior technique of anatomical components separation was slightly different from the one described in patients of group I. The difference was as follows; after mobilization from oblique muscles, the rectus muscles were stitched by direct contact. Then "onlay" aloplasty was performed. An appropriately sized polypropylene mesh was used and fixed along the perimeter to the aponeurosis of the external oblique abdominal muscle.

Early postoperative therapeutic measures included pain relief, correction of water-electrolyte and protein metabolism, correction of cardiovascular and respiratory disorders, bowel function stimulation, antibacterial and anticoagulation therapy.

RESULTS AND DISCUSSION

Evaluation of the clinical results in groups I and II was performed by IAP monitoring, taking into account the frequency of general and local wound complications, and frequency of chronic postoperative pain and recurrences in the remote postoperative period.

IAP values taken in groups I and II preoperatively, during surgery and in the postoperative period are shown in the table.

As seen in the table, baseline IAP values in patients of groups I and II, as well as in the case of bandage compression were comparable and did not exceed normal limits. After performing CST in the modeling of hernioplasty in group II patients, IAP increased to 9.1±2.9 mmHg (1.2±0.4 kPa). In patients of group I in the modeling of hernioplasty, IAP increased only to 5.4±2.1 mmHg (0.7±0.3 kPa). Immediately after the surgery patients from group I experienced a slight increase in IAP to 6.8 ± 1.2 mmHg (0.9 ± 0.2 kPa). In group II, IAP increase was higher (up to 12.7 ± 2.3 mmHg (1.7 ± 0.3 kPa). 6-8 hours after surgery IAP increase in group I was twice lower than in group II [up to 7.6 ± 1.3 mmHg (1.0 ± 0.2 kPa) vs up to 15. ± 1.4 mmHg (2.0 ± 0.2 kPa)].

The higher level of IAP increase in patients of group II resulted from a higher level immediately after surgery and an increase by an average of 3 mmHg due to enteroplegia. Active mechanical and drug stimulation of bowel function as well as peridural anesthesia contributed to passage recovery and IAP decrease by an average of 3 mm Hg. in 24 hours after surgery. 48 hours after surgery,

IAP decreased to 4.5 ± 1.1 mmHg (0.6 ± 0.1 kPa) in group I and to 8.1 ± 2.1 mmHg (1.1 ± 0.3 kPa) in group II. 24 hours after surgery and within the first day 5 (6.1%), patients of group II experienced stable intra-abdominal hypertension [12.1 ± 1.2 mmHg (1.6 ± 0.2 kPa)], which led to ACS, Grade I. These patients underwent prolonged mechanical ventilation, peridural anesthesia, nasogastric decompression of the stomach, stimulation of bowel function (metoclopramide, proserinum, hypertonic enemas), infusion therapy with crystalloid solutions, etc. These measures renewed the passage through the intestines, IAP decreased to 6.1 ± 1.3 mmHg (0.8 ± 0.2 kPa), ACS signs were eliminated. In group I, IAP was back to normal (4.5 ± 1.1 mmHg (0.6 ± 0.1 kPa)), no signs of ACS were observed.

By way of assessment of intra-abdominal hypertension values in patients of group II who underwent CST combined with “onlay” alloplasty, it was found that IAP increase to 9.1 ± 2.9 mmHg (1.2 ± 0.4 kPa) in hernioplasty modeling (approximation of rectus muscles) during the surgery with a further increase to 12.7 ± 2.3 mmHg (1.7 ± 0.3 kPa) immediately after surgery and to 15.4 ± 1.4 mmHg (2.0 ± 0.2 kPa) 6-8 hours after surgery can be predictive for ACS occurrence. This requires preventive measures during surgery.

Intra-abdominal hypertension in patients of group II occurred due to a reduction in the abdominal cavity volume during CST combined with “onlay” method due to the stitching of rectus muscles and their reinforcement with a polypropylene mesh. This suggests that CST combined with “onlay” alloplasty in giant IH does not always provide an optimal volume of the abdominal cavity and can lead to intra-abdominal hypertension. Dosed and regulated approximation of abdominal rectus muscles at a certain IAP value during surgery, including CST combined with IPOM, allows to create the optimal volume of the abdominal cavity with no significant increase in IAP and prevents ACS development in the postoperative period.

Based on the evaluation of surgical wound complications, it was found that patients in group I showed significantly better results as compared with patients of group II. For example, seroma was seen in 6 (7.3%) patients of group I vs. 21 (25.6%) in group II; surgical site infection was observed in 2 (2.4%) (group I) vs. 4 (4.9%) (group II) patients; necrosis of the wound margins was found in 3 (3.7%) vs. 4 (4.9%) patients; postoperative wound infiltrate was in 2 (2.4%) vs. 11 (13.4%) patients, respectively.

The higher rate of local wound complications in patients of group II was due to the more extended mobilization of the subcutaneous tissue from aponeurotic tissues, including the margin of the dissected aponeurosis of the abdominal external oblique muscles, which was conditioned by the necessity of an optimal overlap with a mesh implant. In addition, the “onlay” method is associated with a large area of the mesh implant’s contact with the subcutaneous tissue. Extended mobilization of the subcutaneous tissue from the aponeurotic tissue and a large area of the mesh implant’s contact with the subcutaneous tissue provides a background to seroma, infection, infiltration and necrosis of the wound margins.

Long-term surgical results were studied in 62 patients of group I and 62 persons of group II within the period from 1 to 5 years using reexamination and questionnaire surveys. Chronic pain at the site of the abdominal wall within 6-8 months after surgery was observed

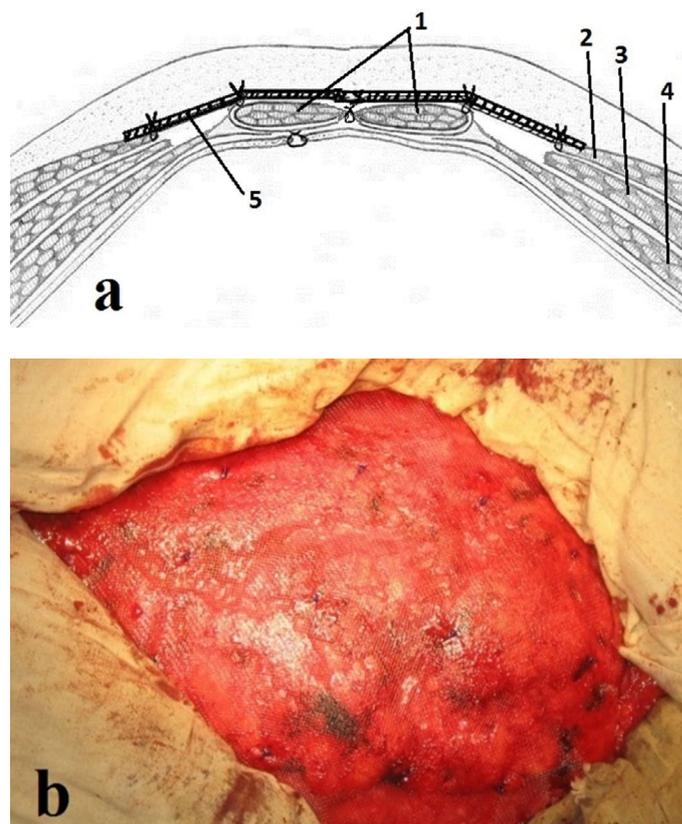


Fig. 2. Picture (a), image (b) ACST + IPOM.

in five (8.1%) patients of group II and in one (1.6%) patient of group I ($p = 0.094$). It was treated via physiotherapeutic procedures and using anti-inflammatory steroid drugs. Recurrent hernias were detected in four (6.5%) patients in group II vs one (1.6%) patient in group I ($p = 0.352$) 8-12 months after surgery.

Reduced incidence of chronic postoperative pain in the patient of group I as compared with group II was associated with less tissue damage to the abdominal wall in CST combined with IPOM. The reasons for recurrent IH in group II included surgical site infections, margin detachment and migration of the mesh implant. A relapse in a patient from group I was seen at the bottom edge of mesh fixation in the suprapubic region. The most likely reason for this was an insufficient overlap of the bottom edge of the abdominal wall defect with the mesh implants.

Based on the frequency characteristics of complications in the two groups compared, higher estimated probability of certain complications was found in group II as compared with group I (Figure 3).

Figure 3. Predictive estimated probability of postoperative complications in group II as compared to group I (odds ratio - OR)

It was found that the utilization of CST combined with “onlay” alloplasty (group II) was associated with 6.39 times higher probability of ACS [OR = 6.39 (0.75-54.29)], 4.36-fold increased probability of seroma [OR = 4.36 (1.66-11.48)], 5.56 times higher probability of postoperative wound suppuration [OR = 5.56 (1.18-26.21)], 6.2 times higher probability of chronic infiltrate [OR = 6.2 (1.33-28.91)] and 1.35-fold increased probability of wound margins necrosis [OR = 1.35 (0.29-6.23)] as compared to CST combined with IPOM (group I).

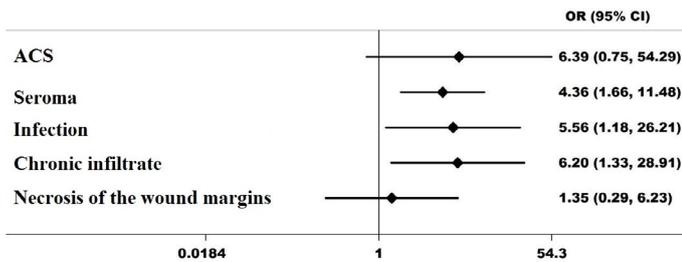


Fig. 3. Predictive estimated probability of postoperative complications in group II as compared to group I (odds ratio - OR).

CONCLUSIONS

1. Intra-abdominal pressure monitoring while performing CST combined with “onlay” alloplasty in patients of group II with giant IH showed that IAP increased to 9.1 ± 2.9 mmHg (1.2 ± 0.4 kPa)

in modeling of hernioplasty and stitching rectus muscles, which resulted in intra-abdominal hypertension (12.7 ± 2.3 mmHg) - ACS Grade I in five (6.1%) patients in the postoperative period. IAP value equal or exceeding 9.1 mmHg. (1.2 kPa) during the surgery in approximated rectus muscles is predictive for ACS occurrence and requires intraoperative preventive measures.

2. Utilization of CST combined with IPOM in group I contributed to a significant improvement of treatment outcomes, namely no ACS events in group I versus 6.1% in group II ($p < 0.05$ patients), reduced frequency of seroma [6 (7.3%) versus 21 (25.6%) ($p < 0.05$)], lower occurrence of surgical site infection [2 (2.4%) versus 4 (4.9%) ($p > 0.05$)], postoperative wound infiltrate [2 (2.4%) versus 11 (13.4%) ($p < 0.05$)], chronic postoperative pain [1 (1.6%) versus 5 (8.1%) ($p > 0.05$)], recurrent IH [1 (1.6%) versus 4 (6.5%) ($p > 0.05$)] as compared to the use of CST combined with “onlay” alloplasty.

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