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Evaluation of Tension Free Principle During Incisional Hernia Repair Procedures by Measuring the Intraabdominal Pressure

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ABSTRACT

The purpose of this study is to perform a correlation between the intra-abdominal pressure variation recorded perioperative by transvesical approach in patients undergoing various types of abdominal wall repair for anterolateral incisional hernias. Materials and methods. The prospective longitudinal study included a total of 103 patients. The following parameters were evaluated: demographics, anatomical location of the hernia, type of abdominal wall repair and intraoperative variations of intra-abdominal pressure measured using a dedicated kit – Abviser ABV 611.

Results: After the statistical analysis of the results a correlation between variations in abdominal pressure and types of parietal defects repair procedures was found. Tension free reconstruction was associated with minimal progression of intraabdominal pressure during abdominoplasty. Alpha

Conclusion: The indirect measurement of intra-abdominal pressure by transvesical approach was able to assess the degree of the abdominal wall plasty tension (evaluation of the tension free principle)

Keywords : incisional hernia, intra-abdominal pressure, tension free

Introduction

Postoperative incisional hernias represent a distance complication of laparotomy of any kind, divided by location in median incisional hernias, over and / or subombilical with the highest frequency (75 % -80 %), lateral incisional hernias appeared after subcostal incisions, pararectal or lombotomies with a low frequency (10%) and exceptional cases of incisional hernias after Pfannenstiel incisions and trauma. [1] The purpose of this study is to establish a correlation between the four types of abdominal wall plasty and variations of intra -abdominal pressure after a protocol well established.

Material and method

Prospective longitudinal study on changes in intra-abdominal pressure in various methods of reconstruction of the abdominal wall was carried out during 2011 and included a total of 103 patients. Surgeries were performed under general anesthesia with endotracheal intubation and mechanical ventilation. Parameters followed at the patients included in the study, were individual data, clinical parameters, types of abdominoplasty and abdominal pressure measurement protocol. The types of surgery were recorded as simple plasty, onlay mesh, retromusculare mesh and substitution mesh. To measure intra-abdominal pressure was used an indirect method by transvezical approach, using ABV611 Abviser dedicated kit and ABV700 monitor.



Figure 1: Measurement of intra-abdominal pressure

Abdominal pressure values were standardized recorded in the following manner:

PIA1 - abdominal pressure value recorded after the patient was anesthetized, with complete muscle induced paralisy, but before incision. Represent the reference value.

PIA2 - abdominal pressure value recorded after the incision, adhesions dissolution and after empowering the small bowels so that the bladder remains free.

PIA3 - abdominal pressure value recorded after restoration of

intestinal loops and omentum in the peritoneal cavity.

PIA4 - abdominal pressure value recorded during parietal reconstruction.

PIA5 - abdominal pressure value recorded at the end of the muscular wall plasty with or without mesh, with patients still in complete muscular paralisy.

PIA6 - the value recorded after closing the subcutaneous tissue and the skin with the patient still in complete myorelaxation conditions. It represents the weight of the subcutaneous tissue and skin tightening after the suture.

Results

In the group studied, the distribution by age and sex incidence of hernia indicates the predominance of women in a ratio of 72.54 %, which are in the age group between 61-70 years. The mean age of patients was 60.15 years with extremes between 26 and 84 years. Regarding the hernia location, most patients were presented with postoperative incisional hernias of the midline over or subombilical (95 cases), and in a smaller number of cases with subcostal incisional hernias (3 cases) and lateral ones(4 cases).

Obesity, a contributing factor in the hernia pathology, was present in a total of 69 patients (67.64 %), in varying degrees, being more common in women(74%) than males(51%).

In most of the cases included in the study were made abdominal wall plasty using polypropylene meshes (82 %) and in a small percentage (18 %), was used the simple plasty. The mesh insertion types were in onlay position most often used in a total of 41 cases (39.8 %), followed by retromusculare position in 31 cases (30.55 %) , while complete substitution parietal defect was used in 12 patients (11.65 %). Intra-abdominal pressure recorded in the six standardized moments provided a series of intraoperative data. Thus PIA1 ranged from 1 to 15 mmHg, with an average of 4.5686275. Differences between PIA1 in the four techniques were not statistically significant, but could be correlated with the degree of obesity. Between PIA1 and degree of obesity, the calculated correlation coefficient is r = 0.267940477. Also PIA1 recorded statistically significant higher values PIA1m = 12.89 (p = 6.19629 E- 25) in patients admitted and opereted in emergency, which was associated with intestinal occlusion.

PIA2 pressure recorded after the release of adhesions and intestinal loops, ranged from 0 to 6, with an average value of 1.862745. PIA2 - PIA1 difference was significantly higher (-8.4444 from -2.1505) in patients admitted in emergency, which has been associated intestinal occlusion (p = 9.537 E- 31).



Figure 2: Linear Graphs PIA2 - PIA1 in chronically surgeries



Figure 3: Linear Graphs PIA2 - PIA1 in emergency surgeries

PIA3, reinstatement pressure after intestinal loops varied very little from PIA2 (PIA3m = 2.186274, PIA2m = 1.8627), except in cases with intestinal occlusion when PIA3 - PIA2= 0.55556 compared to PIA3 - PIA2=0.30108 in chronic cases .(p = 0.34808) Also there were no statistically significant differences between values PIA3 in the procedures performed.

PIA4 pressure recorded during abdominal wall plasty, varied between 0 and 10. The difference PIA4 - PIA1 is the effect of partial abdominoplasty on intra-abdominal pressure. Was the first indicator of a tension free plasty and there are already significant differences.(Tabel I)

PIA4 - PIA1 difference in the four methods showed a minor increase for retromusculare mesh procedure (PIA4 - PIA1 = -1.7419) and the substitution mesh (PIA4 - PIA1 = -1.25), compared to simple plasty (PIA4 - PIA1 = -0.7778) and onlay mesh (PIA4 - PIA1 = -0.2195).

Table	no. I	l: (Correlations	between	the	four	methods	with
the va	ariabl	le a	as PIA4 - PIA	\1				

PIA4-PIA1	Simple plasties	Onlay	Retromuscular	Substitution mesh
Simple plasties		p = 0,34212	p = 0,18194	p = 0,60618
Onlay			p = 0,000353	p = 0,02724
Retromuscular				p = 0,41428

PIA5 pressure recorded at the end of the abdominal wall plasty in conditions of complete relaxation ranged between 2 and 6 to the average of 5.70588. PIA5 - PIA1 difference represented in the present study the most important parameter in assessing the degree of tension in the abdominal wall defects plasty and can be considered a real indicator of the principle tension free assessment.

Comparing PIA5 - PIA1 values between the four types of abdominoplasty we found a high degree of tension (PIA5 - PIA1 = 1.88889) in the case of the simple plasty and in onlay position mesh (PIA5 - PIA1 = 2.60976). The difference was lower in retromusculare plasty (PIA5 - PIA1 = - 0.6452) and minimum in substitution mesh plasty (PIA5 - PIA1 = - 0.4167).

Also analyzing the four methods we found significant or insignificant differences in evaluation of tension free principle. (Table No. II)

Table No. II : Correlations between the four methods	with
the variable as PIA5 - PIA1	

PIA5-PIA1	Simple plasties	Onlay	Retromuscular	Substitution mesh
Simple plasties		P = 0,16968	P = 0,00049	P = 0,00627162
Onlay			P = 3,5618E-11	P = 7,4026E-09
Retromuscular				P = 0,7217384

PIA6 pressure recorded at the end of surgery, after suturing the subcutaneous tissue and skin , keeping the myorelaxation, ranged between 2 and 18 , with an average of 6.63725 . PIA6 - PIA5 difference varied according to the degree of obesity (normal weight = 0.87879; Obesity 1st degree = 0.83333; Obesity 2nd degree = 1.05263; Obesity 3rd degree = 1.1428571). Major changes have occurred in patients with 2^{nd} and 3^{rd} obesity degrees, but not statistically significant (p = 0.798). This difference did not vary significantly between the four types of processes. (0.611111, 0.902439, 1.0967742, 1.083333).

Discussion

Intra-abdominal pressure (PIA) translates into pressure recorded within the peritoneal cavity between its organs . [2]

The concept of intra-abdominal pressure, intra-abdominal hypertension, abdominal compartment syndrome was made in 2004 after the International Congress of Anesthesia and Intensive Care when was founded World Society of Abdominal Compartment Syndrome (WSACS). [3]

Intra-abdominal pressure (PIA) should not normally exceed 12 mmHg, three repeated measurements at 4-6 hours. Intra-abdominal hypertension (HIA) is defined by three values recording every 4-6 hours between 12 and 20 mmHg. [2]

Abdominal compartment syndrome (ACS) occurs when intra-abdominal pressure exceeds 20 mmHg also associating one or multiple organ dysfunction .[3]

Surgical techniques of abdominal wall repair for incisional hernias can be summarized in two categories of interventions: classical methods, with simple sutures or double layer and modern methods replacing or reinforcing the defect with synthetic prostheses. [4].

As a classic procedure, Mayo suture represented the goldstandard in the abdominal wall plasty until 1990. Procedure advantages are: low cost, fast. [5]

Disadvantages: high rate of recurrence (35-58 %), seroma and bleeding complications . [4,5] With the use of synthetic mesh in abdominal wall plasty it was reduced the recurrence rate to less than 8 10%. [5]

Inset mesh can achieve on the aponeurosisis, ", onlay ", over parietal suture at a distance of 5 cm from simple plastic suture, serving as a reinforcement. (reenforcement mesh).

By placing the mesh retromuscular, inside of rectus abdominis sheath is advantageous due to a good qualities receptor site, well irrigated. [6]

Retromuscular procedure applied by us in all cases was a combination between the classic retromusculare plasty but using the hernial bag to close the abdominal wall underneath the mesh for visceral protection considering that we used the polypropylene meshe. It is a very welcome solution in cases of important parietal defects that we do not have a dedicated intraperitoneal mesh (dualmesh). [7]

The results were encouraging, with very small changes of PIA at the end of plasty. Preperitoneal placement is easily accomplished in the subombilical region, especially under Douglas archway where the peritoneum is easily cleaved and with just a small bleedings during dissection. It has the disadvantage of space properitoneal laborious dissection in order to create space for insertion table, major bleeding risk . [8]

Intraperitoneal placement of prosthetic mesh materials require a dedicated and expensive mesh to avoid the adhesion formation between the mesh and viscera. [8]

The choice of surgical technique in the study group was based primarily on the degree of parietal defect and subjective choice related to surgeons "habit". Simple plasty was used in cases where the hernia defect did not exceed 3 cm or in cases where mesh use was contraindicated. Defects up to 5-6 cm were followed by reinforcement plasty (onlay).

Mesh insertion in rectus abdominis sheath was often preferred, whenever parietal defect exceeded 5 cm and local conditions allowed dissection sheaths and hernial bag for placing in between the layers prepared.

In the study the most important element in assessing the tension free principle was the difference PIA5 - PIA1 which indicates the increase of PIA after the abdominal wall plasty.

Value recorded were for simple plasty 1.88889, for onlay plasty 2.60976, for retromusculare mesh plasty 0.6452 and substitution mesh plasty -0.4167.

Also PIA4 - PIA1 can be a guiding element for the surgeon performing surgery of the abdominal wall. PIA4 - PIA1 difference if is progressive, should require, if possible, the choice of another method of abdominal wall plasty.

Obesity is a risk factor of incisional hernia appearance. World Society of Abdominal Compartment Syndrome set the upper limit value of intra-abdominal pressure of 5-7 mmHg. [2]

Still, in people with obesity, or those with chronic obstructive pulmonary disease, the accepted values range to 12 mmHg. [1]

In our study absence of obesity has been found in 33 cases, and its presence in 70 cases. In patients without obesity PIA1m = 3.54545 and in those with various degrees of obesity was 5.05797. Is a significant difference between the average with p value = 0.02527.

Relationship PIA - obesity could be demonstrated in our study and the difference PIA6 - PIA5 which means overlapping the subcutane tissue. PIA6 – PIA5 was 0.87879, without obesity and 0.95652 with obesity and the statistical comparison of average results in p = 0.67522.

Conclusions

Normal values of intra-abdominal pressure should be correlated with the degree of obesity. The most common postoperative incisional hernias are those of the median line . Indirect measurement of abdominal pressure using the urinary bladder aproach could assess the degree of tension of the abdominal wall plasty (evaluation principle tension free).

REFERENCES

1. Basoglu M, Yildirgan MI, Yilmaz I, et al. Late complications of incisional hernias following prosthetic mesh repair. Acta Chir Belg. 2004;104:425-428. | 2. Malbrain ML. You don't have any excuse, just start measuring abdominal pressure and act upon it.Minerva Anestesiologica 2008; 74:1-2. | 3. Sturini E, Saporio A, Sugrue M, Parr M, Bishop G, Braschi A. Respiratory variation of intra-abdominal pressure: indirect indicator of abdominal compliance? Intensive Care Med.2008; 34:1632-1637. | 4. Klinge U, Conze J, Krones CJ, Schumpelick V. Incicional Hernia: Open techniques. World J Surg 2005; 29:1066-1072. | 5. Van t Riet M, Steyerberg EW, Nellensteyn J, Bonjer HJ, Jeekel J. Meta-analysis techniques for closure of midline abdominal incisions. Br J Surg. 2002; 89: 1350-1355. | 6. Stumpf M, Conze J, Klinge U, Rosch R, Schumpelick V. Open mesh repair. European Surgery 2003;35(1): 21-24. | 7. de Vries Reilingh TS, Geldere D, Langenhorst B, et al. Repair of large midline incisional hernias with polypropylene mesh: comparison of three operative techniques. Hernia 2004; 8:56-59. | 8. Luijendijk RW, Hop WJC, van den Tol MP, et al. A comparison of suture repair with mesh repair for incisional hernia. N Engl J Med. 2000;343:392-398.