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Intraabdominal Pressure in Abdominoplasty Patients

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Abstract. Abdominal compartment syndrome is directly related to an increase in intraabdominal pressure (IAP), which can lead in severe cases to serious clinical consequences. Routine measurement of IAP in specific cases has been advocated by some surgical specialties. However, few studies in plastic surgery have focused on the use of IAP. The authors review the literature and describe a method of IAP analysis used for 12 patients who underwent abdominoplasty.

Key words: Abdominal compartmental syndrome—Abdominoplasty—Intraabdominal pressure

Abdominal compartmental syndrome (ACS) is defined as an impairment in normal physiology attributable to an increase in intraabdominal pressure (IAP), and most frequently involving the cardiovascular, pulmonary, and renal systems. Some findings include low cardiac output, increased peripheral vascular resistance, oliguria, anuria, increased airway pressure, low pulmonary compliance, and hypoxia.

The most common cause of ACS is postoperative hemorrhagic coagulopathy. Although it may occur with any abdominal surgical procedure, ACS is most frequently seen in trauma patients [5]. Possible causes of ACS (Table 1) include intraabdominal hemorrhage, small bowel distension, ascites, peritonitis, tumors, and external compression resulting from burns, antishock garments, and high-tension abdominal wall closure.

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History

In 1911, Emerson [9] described the difficulties in measuring IAP and in identifying its mechanisms, although it was known by then that values above 26 cm of H_2O in small animals resulted in respiratory failure, and that values above 46 cm of H_2O led to death. In 1923, Thorington and Schimdt [19] demonstrated that IAP values between 15 and 30 cm of H_2O caused oliguria, and that values above 30 cm of H_2O caused anuria. In 1931, Overholt [16] measured IAP using a catheter connected to a transducer. In 1948, Gross [11] observed that newborns who underwent closure of wide omphaloceles died shortly after surgery. The deaths were attributed to respiratory failure and cardiovascular collapse.

In the years since, pediatric surgeons have adopted methods that allow temporary or progressive closure of such abdominal wall deficiencies [1,12]. In the 1980s, Kron et al. [14] showed that increased IAP could lead to ACS, and that this should be treated through immediate abdominal decompression. The author also proposed a method of pressure measurement using a Foley catheter [5] (Table 2). This method has been widely used because of its safety, low cost, and ease of performance. The work of Kron et al. [14] has served as a landmark, and many authors have followed their principles in the pursuit of an ideal treatment for ACS [4,6–8].

In 2002, Talisman et al. [18] published the first IAP study in plastic surgery. In this study, 18 patients who underwent abdominoplasty were analyzed both preoperatively and on postoperative days 0 and 1. Not only IAP values were considered, but also possible hints of a pathologic condition. Recently, Floros and Davis [10] in 1991 and Al-Qatan [2] in 1997 warned about the risks of major diastases recti plication.

Table 1. Causes of increased intraabdominal pressure

Internal	External
Hemorrhage	Deep burns
Small bowel distension	Antishock garment
Ascites	High-tension abdominal wall closure
Tumors	
Peritonitis	

IAP can be classified in 4 groups (I-IV) according to Burch's classification[1] (measured in cm of H_2O as shown in table 2).

Table 2. Intraabdominal pressure (IAP) groups

Group	IAP (cm of H_2O)
1	10–15
2	15–25
3	25–35
4	>35

RESULTS
All subjects of this study were female with ages varying from 28 to 47 years old. BMI ranged from 24 to 29. The weight of the excised flap ranged between 580 and 1800 grams. The narrowest and the widest diastesis recti were 7 and 16 cm respectively. Table 3 shows the IAP values at 3 different times, as well as observed complications.

Materials and Methods

Between July 2001 and January 2002, 12 abdominoplasty patients who underwent surgery at the Plastic Surgery and Burn Care Department of the Evangelical University Hospital in Curitiba, Paraná (Pr), Brazil were evaluated. These otherwise healthy patients underwent a complete preoperative evaluation by a plastic surgeon, a cardiologist, and a pneumologist. All had the same aesthetic indication for surgery and a body mass index (BMI) less than 30. They all were categorized as American Society of Anesthesiology (ASA) classification 2 for surgical risk.

The operations were carried out by the same surgical team (Rudy and Graça Neto). The patients underwent epidural anesthesia and antibiotic prophylaxis of cefazolin 1 g intravenously. After initiation of anesthesia, with the patient in the dorsal decubitus position, a three-way Foley bladder catheter was placed through the urethra (Fig. 1). The bladder contents were emptied, and after closing of the urinary output port, 100 ml of saline solution was injected through the third port of the Foley catheter. A central venous pressure catheter was used to measure the intraabdominal pressure in centimeters of H_2O.

After complete undermining, the size of the diastesis recti was measured. Plication was performed with a 2.0 mononylon suture as indicated by Pitanguy [17]. In every patient, the flap was attached to the fascia through several stitches, as in Baroudi's technique [3]. It is important to mention that for the next step, the neutral (0) value of the water column must be at the level of the pubis. Using this parameter, measurements were performed according to the method described by Kron at three specific times: preoperatively and on postoperative days 0 and 1.

Results

All the subjects in this study were women ages 28 to 47 years with BMIs ranging from 24 to 29. The weight of the excised flap ranged between 580 and 1800 g. The most narrow diastesis recti was 7 and the widest was 16 cm. Table 3 shows the IAP values at three different times, as well as observed complications.

Discussion

Abdominal plastic surgery was described initially in 1910 by Kelly [13], who proposed the resection of excess skin and fat. Since then, technical evolution has resulted in a procedure that now includes a low transverse incision, flap undermining, plication of the rectus fascia (described in 1960) [17], dermolipectomy, and flank liposuction [15]. This technique has at least two maneuvers that result in IAP elevation: plication of the fascia and flap resection. The dynamics of the abdominal wall allow great volume changes without a proportional rise in IAP values, which nevertheless should be measured. Monitoring of IAP can be performed three different ways: (a) by intragastric analysis, (b) by inferior vena cava measurement, and (c) through a bladder catheter [5]. The latter is a simple, minimally invasive, low-cost method easily performed by the nursing staff. There are no reports of increased risks for either surgical wound infection or urinary tract infection [18].

In this study, two patients were group 2 IAP on postoperative day 0. In the study of Talisman et al. [18] involving 18 patients, 8 were group 2 IAP, whereas 2 were group 3 on postoperative day 0. The higher incidence and the greater values observed are possibly attributable to the width of recti diastases because these were individuals with high BMIs who probably underwent major plications, inducing an increase in the IAP. However, racial and nutritional characteristics need to be considered. Perhaps, a correlation between the size of the diastases, the BMI, and the IAP may help us gain a better understanding of these data.

It is interesting to note the IAP reduction in all the patients on postoperative day 1. Talisman et al. [18] reported only one patient in whom IAP had increased on postoperative day 1 (from 12 to 13). Values decreased in the remaining patients. The elasticity characteristic of skin and muscle seems to be one of the reasons for the decrease in IAP values. The

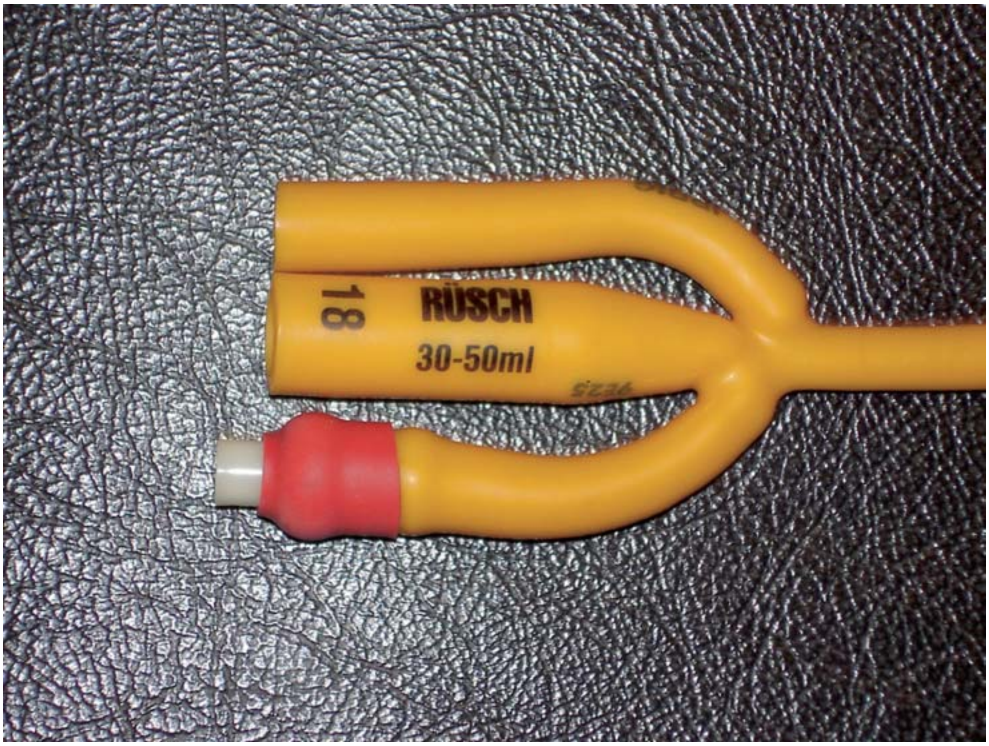

Fig. 1. A three-way Foley catheter.

Table 3. Intraabdominal pressure values

Patient	Preop	POD 0	POD 1	Complications
1	3	12	8	
2	5	13	7	
3	6	15	8	
4	4	12	7	
5	6	13	9	
6	3	11	7	
7	4	11	7	
8	5	14	8	
9	6	15	11	Mild dyspnea
10	6	16	10	
11	5	16	11	Mild dyspnea
12	3	13	8	

Preop, preoperatively; POD, postoperative day.

accommodation of the abdominal viscera and a reduced inflammatory reaction determined by the surgical trauma (metabolic and endocrine response to trauma) also could be factors in the decrease.

Complications included two cases of mild dyspnea, characterized by tachypnea without changes to radiographic or laboratory findings or at chest auscultation. These patients were fully recovered on postoperative day 2.

Talisman et al. [18] observed wound dehiscence in three cases, although they did not mention tobacco use or whether Baroudi's approach [3] was used. In the current study, there were no cases of dehiscence. Patients were required to stop smoking 1 month before surgery, and Baroudi's technique [3] was performed, using 3-0 monocryl stitches.

Although the IAP values in this study were low (between ASA 1 and 2), and despite the fact that only one other study focuses on this issue, ACS must be regarded as a threatening condition with high risks and serious consequences. Following the example of other specialties, including general, trauma, and pediatric surgery, plastic surgeons should be aware of this syndrome and understand its pathophysiology and treatment. Considering the increasing number of patients seeking abdominoplasty, especially former obese patients who have undergone bariatric surgery, it is very important to consider monitoring and maintenance of IAP at low levels to prevent a possible rise in ACS incidence. Values exceeding 20 are related to increased risks of renal and respiratory function. Further studies of plastic surgery patients, especially in teaching hospitals, may be needed to improve the knowledge concerning prevention and treatment of ACS.

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