Abdominal Compartment Syndrome: diagnostic evaluation and possible treatment

A. Maffongelli1, S. Fazzotta1, V. D. Palumbo1,2, G. Damiano1, S. Buscemi1, C. Maione1, A. I. Lo Monte1

1 Department of Surgical, Oncological and Stomatological Disciplines, University of Palermo, Palermo; 2 Euro-Mediterranean Institute of Science and Technology (IEMEST), Palermo, Italy

Abstract

Background. Abdominal compartment syndrome (ACS) is a clinical condition caused by an increase in intra-abdominal pressure. The incidence is variable, based on the type of patients taken into consideration, increasing exponentially in critical conditions, such as traumatized, burned patients in shock. The syndrome can also follow surgical procedures like transplantation of abdominal organs, for example configuring rare pictures such as RACS (post-transplant kidney syndrome).

In most cases the symptoms are non-specific and varied according to the different etiology of the ACS, therefore the diagnosis may not be immediate.

Aim. The aim of this work is to evaluate the best therapeutic approach based on the evidence in the literature.

Results. An early diagnosis, which can also identify the stages of intra-abdominal hypertension, is necessary to ensure the survival of the patient, implementing an integrated multidisciplinary treatment, especially in the early stages of the development of the ACS.


Key words: Abdomen decompression, Renal Allograft Compartment Syndrome, Surgical emergency

Introduction

Abdominal compartment syndrome (ACS) is an organ dysfunction caused by an increase in intra-abdominal pressure > 20 mmHg [with or without abdominal perfusion pressure (APP) < 60 mmHg]. (1-3)

The aim of our study is to evaluate the diagnostic classification of the pathology and the possible therapies proposed by the scientific literature. Our study group has carried out a systematic review of the literature of the last 20 years using the following keywords in the main scientific search site (pubmed, scopus, reseachgate, google scholar): “Abdomen decompression; abdominal compartment syndrome; Renal Allograft Compartment Syndrome; Surgical emergency”.

The abdominal compartment syndrome must be promptly diagnosed and treated with a multidisciplinary approach since it can cause respiratory failure, secondary to the reduction of respiratory volumes, oligo-anuria for the reduction of renal perfusion and/or other organ dysfunctions due to reduced perfusion. (4,5)

Under normal conditions, the intra-abdominal pressure (IAP) is about 5-7 mmHg (1.6) Abdominal hypertension is referred to when the pressure value exceeds 12 mmHg. The APP is calculated by subtracting the IAP from the mean arterial pressure (PAM). Increased IAP causes a reduction in visceral blood flow. Many studies have considered APP as a predictor of survival in critical patients: an APP of at least 60 mmHg appears to be correlated with an increase in survival in cases of abdominal hypertension and/or ACS. (7-9)

Epidemiology

The incidence of this condition is variable from 1% found in a study of 706 patients up to values between 9 and 14% in studies with populations of 128 and 188 patients respectively (10-13). This significant difference appears to be linked to the diversity of the populations under study with respect to the definition of ACS which is almost homogeneous. From the analysis of the data the incidence of ACS was in fact greater in critical patients (thoracic trauma, two or more abdominal lesions, severe vascular lesions, complex pelvic fractures, two or more fractures of long bones, age > 65 years, need for transfusion of six or more units of blood) compared to non-critical patients.

Aetiology

The ACS can be primary and secondary. In the primary ACS the cause of the intra-abdominal pressure increase is located in the abdominal-pelvic region as in the case of abdominal trauma, hemoperitoneum, pancreatitis, surgical and/or radiological procedures. Secondary ACS depends on factors that do not originate in the abdominal-pelvic region, but they cause fluid accumulation in this region.

ACS is defined “recurrent” when it develops again after medical or surgical treatment of a primary or secondary ACS.

The compartmental syndrome that occurs in patients with liver cirrhosis, especially in the later stages of liver disease, is defined as chronic.

Different conditions can cause ACS: (14,15)
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- trauma, for which patients need massive fluid infusions; (16,17)
- burns, especially if they affect more than 30% of the body surface; (18,19)
- transplants: Biancofere and coll. found an increase in IAP in 32% of liver transplant patients; (20,21), Damiano et al. has described how to diagnose a rare sub-type of compartment syndrome that can occur as a kidney post-transplant complication by posting to the loss of the graft: the kidney transplant compartment syndrome (RACS); (22)
- abdominal conditions such as ascites, massive hemo-peritonemone (23,24) retroperitoneal as pancreatitis (21), pelvic fractures with bleeding (25), rupture of an abdominal aortic aneurysm in which there is ACS in 8% of cases and death in half of the latter; (26-29)
- medical conditions such as septic shock and other conditions involving a massive infusion of fluids (1,31,32)
- rare diseases (superior mesenteric vein syndrome) (30).

Clinical presentation and diagnosis

The diagnosis of ACS may not be immediate due to various clinical presentations. In most cases this condition occurs in critical patients, for whom the collection of medical history and clinical symptoms is impossible; non-critical patients often report non-specific symptoms such as general malaise, fatigue, headache, dyspnea or abdominal pain. The physical examination is not decisive: the abdomen can be tense, but this condition, however, fails to predict the presence of ACS, which can be suspected in patients who come to the attention of health care professionals following trauma to the abdomen (1,33,34).

Progressive oliguria, respiratory distress with reduction of oxygen saturation and also hypotension, tachycardia, high jugular venous pressure, jugular venous distension, peripheral oedema, signs of peritonism or hypoperfusion, sensorial alteration, restlessness or metabolic acidosis may be present.

ACS can be suspected in the case of pathological findings found with thoracic and / or abdomen radiological examinations. (35) However, for a definitive diagnosis of ACS, measurement of intra-abdominal pressure is required, especially in patients with trauma, liver transplants, bowel obstruction, pancreatitis or peritonitis, conditions very related to ACS (36).

The standard method for measuring intra-abdominal pressure and therefore for screening abdominal hypertension (IAH) and ACS, is based on the use of intra-bladder catheters (37). Can also be used catheters placed in the inferior vena cava, intra-stomach or intra-rectum. In all cases, the measurement is based on the wall of the vascular structure (or the wall of the hollow organs in which the catheter is located) that acts as a membrane for pressure transduction. (38) This method is easy to perform, less invasive and precise if the patient does not make movements of the head and body during the procedure (37,39,40). In the suspicion of ACS it must be remembered that there are conditions that can interfere with a correct measurement of intra-bladder pressure, since related to alterations of the circulation of the organ wall (intraperitoneal adhesions, pelvic fractures, pelvic hematomas, neurological bladder), or conditions of chronic intra-abdominal hypertension, which tend to mask an acute increase in pressure (severe obesity, pregnancy, ascites) (38,41).

Treatment

The treatment of ACS involves the support of basic functions and abdominal decompression. The intra-abdominal volume reduction is performed with the patient in supine position as the elevation of the head of the bed could increase the abdominal pressure and falsify any measurement. (37) The compliance of the abdominal wall can be reached with adequate pain control and / or patient sedation.

The definitive treatment of the ACS is represented by the surgical decompression, although to date there are no guidelines indicating the precise timing of the decompression: some clinicians suggest to perform the treatment for IAP values> 25 mmHg; others for lower values (15-25 mmHg) claiming that the decompression performed with an IAP lower than 25 mmHg guarantees a better organ perfusion and therefore the prevention of the ACS; others still use APP as a criterion, since it has been shown that APP values <50 mmHg correlate with a lower survival (37,42-45). Analysing the literature on the subject, in the clinical suspicion of an ACS, all the authors confirm the intra-bladder pressure measurement may confirm the diagnosis. For pressure values <20 mmHg observation and subsequent re-evaluation of the patient will be proposed, while decompression will be proposed in patients with IAP ≥ 20 mmHg and with signs of organ dysfunction.

The standard technique for abdominal decompression involves the median laparotomy with opening of the abdominal cavity and the temporary closure of the wall, which prevents evisceration of the patient, minimizing the loss of domination and controlling the loss of fluid (46,47). Several techniques are available for temporary abdominal closure, the main ones being patch closure, silo closure and negative pressure systems (Barker’s VAC - sponges). The first two techniques can be used lonely or in combination with negative pressure systems. To date there is no prevailing technique over the others, but each of them has advantages and disadvantages according the ability to prevent the loss of fluids, simple use or the cost. For example, temporary closure using patches (Wittmann or PTFE patches) has the advantage of minimizing muscular band retraction, but at the same time it does not allow optimal fluid control, so it is often used in combination with negative pressure; (48) an other disadvantage consists in the patch’s excess traction on the muscle band, which can cause necrosis and reducing the probability of a future primary closure (49-52). Temporary closure by silo is a simple and low cost technique, which provides for the installation of a transparent “bag” that allows viscera inspection at any time; in this case the losses of fluids are difficult to control and a possible increase in the IAP must be solved with the positioning of a larger bag (53). The negative pressure systems, also known as VAC (Vacuum Assisted Closure) systems increase the probability of primary closure, since opposing the lateral retraction of the
muscular band (54-57). Kits that use sponges are more expensive than those using laparotomic gauzes, but at the same time they are able to guarantee a more uniform aspiration of the entire abdominal cavity, preventing the accumulation of liquids (58). The technique that involves only the closure of the skin flaps today is no longer used, since it does not allow to control loss of fluid from the wound.

In selected cases a percutaneous decompression of the abdomen can also be performed: Cheatham et al. treated 62 patients divided into two groups: patients undergoing standard treatment and patients undergoing minimally invasive treatment by percutaneous drainage. In 81% of patients subjected to minimally invasive treatment (with fluid drainage greater than 1 L or decrease in IAP> 9 mmHg in the first 4 hours) surgical decompression was not necessary, but isolated percutaneous treatment proved to be equally effective (59).

In special cases, like in RACS, different decompression techniques have been adopted to reduce the pressure on the graft: the re-allocation of the graft (intraperitoneal or subcutaneous) or the use of prostheses; (60-61) for example Maione et al. proposed the reconstruction of the abdominal wall using a PTFE prosthesis, with resolution of the compartmental syndrome and optimal recovery of the graft function (21.62).

Conclusions

Comparing data published in recent years, starting from Kron’s historical work in 1984, two elements must be underlined: the persistence of unsolved problems regarding the pathophysiology of the compartment syndrome and therefore regarding the possibility of an early diagnosis or a screening of this condition, the lack of guidelines and a standardized therapeutic behaviour both for patients at risk or patients with evident syndrome. On laparotomy treatment numerous clarifications have been made in recent years, especially in front of the high industrial interest aroused by the use of different prosthetic materials. The trauma experience of the Israelis has led to the development of the vacuum pack applied to post-traumatic laparotomy. The advantages of the method consist in the excellent drainage of the transudation fluid which allows a more rapid healing of the wound and a greater control of the water balance, the integrity of the muscle bond flaps, the reduction of thermal losses (important in the patient with multiple trauma at risk of developing the lethal triad of hypothermia, acidosis and coagulopathy) and the possibility of repeat the access in the peritoneal cavity, even in an intensive care unit, as foreseen by the damage control surgery procedures. The results of this method are promising, even for the number of patients who may be subjected to abdominal closure before discharge. The deepening knowledge of the abdominal compartment syndrome is not a mere academic exercise, because it is a widespread syndrome in critical patients (the wide range of incidence values is also attributable to the non-unambiguous nature of definitions and methods of detection of the abdominal hypertension and ACS). The patients involved suffer from a high morbidity and mortality that constitute a difficult challenge for the resuscitator and the surgeon, considering the complexity of the pathophysiological phenomena at the base of the ACS. Finally, it’s important to remind that nowadays there is an intensive growth of publications based on infusion protocols in the reanimation phase with hypertonic solutions, plasma expanders, etc., with possible resolution of iatrogenic pathology: secondary ACS.

References

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