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The Changing Face of Abdominal Compartment Syndrome

Authors

Chadwick P. Smith, *MD, FACS*
Fellow
Department of Surgical Education, Orlando Regional Medical Center
Orlando, Florida, USA
chadwick.smith@orlandohealth.com

Michael L. Cheatham, *MD, FACS, FCCM*
Director
Department of Surgical Education, Orlando Regional Medical Center
Orlando, Florida, USA
michael.cheatham@orlandohealth.com

The management of intra-abdominal hypertension and abdominal compartment syndrome has evolved resulting in significantly improved patient survival. This article discusses recent cutting-edge changes in the management of such patients.

Introduction

Intra-abdominal Hypertension (IAH) and Abdominal Compartment Syndrome (ACS) are significant causes of morbidity and mortality among critically ill medical, surgical, and paediatric patients (Ivatury et al. 1998; Malbrain et al. 2005; Ejike et al. 2007). IAH/ACS management has evolved significantly in recent years resulting in both improved survival and decreased resource utilisation (Cheatham and Safcsak 2010). Key factors in this improved strategy include earlier diagnosis, comprehensive medical management, and rapid surgical intervention for refractory ACS (Cheatham 2009; Cheatham and Safcsak 2010). The purpose of this brief review is to discuss recent cutting- edge changes in the management of patients with IAH/ACS.

Definitions

Intra-abdominal pressure (IAP) is the pressure within the abdominal cavity. It may be pathologically elevated in patients with haemoperitoneum, ascites, space occupying lesions (such as tumor or abscess), intestinal gas, viscera oedema (as occurs in severe sepsis and shock), and decreased abdominal wall compliance. Normal IAP is negative or near 0 mmHg. An IAP of 10-15 mmHg is prevalent in critically ill intensive care unit (ICU) patients (Malbrain et al. 2005). IAPs in excess of 20-30 mmHg are common in patients with an acute abdomen or sepsis and can result in significant organ dysfunction, organ failure, and even death (Cheatham and Safcsak 2010). IAP is routinely determined using intravesicular or bladder pressure (IVP) (Malbrain et al. 2006). The World Society of the Abdominal Compartment Syndrome (WSACS) consensus guidelines recommends that patients with risk factors for IAH/ACS receive serial IAP measurements throughout the duration of their critical illness (http://www.wsacs.org).

IAH is defined as an IAP $\geq$ 12 mmHg while ACS is defined as prolonged elevation of IAP > 20 mmHg with new onset organ dysfunction (Malbrain et al. 2006).

Common signs of ACS include:

• Refractory hypotension,

• Oliguria,

• Metabolic acidosis,

• Hypoxemia,

• Elevated peak inspiratory pressures,

• Hypercarbia, and

• Elevated intracranial pressure.

ACS may occur in medical, surgical, and paediatric patients as a result of sepsis, pancreatitis, trauma, burns, or critical illness. Unrecognised or untreated, ACS has a reported mortality of up to 100%.

Recent Advances

A decade ago, ACS was considered by many clinicians to be a diagnosis for which little could be done. The management of IAH/ACS has, however, changed tremendously in recent years. While emergent surgical decompression of the abdomen was previously the only treatment available, improved diagnosis and resuscitation through both non-operative and minimally invasive therapy have resulted in significant improvements in patient survival (Cheatham and Safcsak 2010).

Medical Management

Abdominal decompression, especially if performed late in the course of ACS, is associated with significant morbidity including enteroatmospheric fistula, fluid and electrolyte imbalance, accelerated protein loss, chronic ventral hernia, and increased resource utilisation, making the “open abdomen” a challenge to even the most experienced practitioner. Given the complexity of such patients, many clinicians have been reluctant to employ abdominal decompression in patients with ACS despite ample evidence that it is commonly life-saving.

Recently, a variety of less invasive methods for treating IAH/ACS have shown promise, bringing effective IAH/ACS therapies to the armamentarium of intensivists as well as surgeons. These non-operative medical interventions have been described in the management algorithm proposed by the WSACS and based upon their evi dence-based medicine consensus guidelines (Figure 1).

Directed by the results of serial IAP monitoring, this multi-modality strategy is based upon five general principles:

1) Evacuation of intraluminal contents

2) Evacuation of space occupying lesions

3) Increasing abdominal wall compliance

4) Optimising fluid administration

5) Optimising regional perfusion

These medical interventions, instituted in a staged fashion according to the patient’s severity of illness, degree of IAH, and response to less invasive therapies, have been demonstrated to decrease the progression of IAH to ACS, decrease the need for surgical intervention, and significantly improve patient survival (Cheatham and Safcsak 2010).

Peritoneal Fluid Evacuation

The peritoneal fluid of patients with sepsis, pancreatitis, and multiple organ dysfunction is filled with pro-inflammatory mediators (Souza et al. 2010; Kubiak et al. 2010). This cytokine-rich ascitic fluid may serve asa second hit phenomenon in the critically ill resulting in further organ dysfunction and failure. Peritoneal fluid removal through paracentesis, peritoneal lavage, or continuous suction from the open abdomen has been shown to significantly reduce peritoneal and/or serum tumor necrosis factoralpha, interleukin (IL)-1β, IL-6, IL-8, and IL-12 levels. More importantly, this therapy results in improved organ function in the presence of elevated IAP. Kubiak et al. demonstrated significant improvements in both renal and pulmonary dysfunction among septic pigs when peritoneal fluid was actively removed using negative pressure wound therapy (Kubiak et al. 2010).

Advances in Open Abdomen Management In the early days of surgical decompression for IAH/ACS, the open abdomen was a tool of last resort, associated with a both a high rate of entero-atmospheric fistula formation and a near ubiquitous requirement for splitthickness skin grafting of the exposed viscera and subsequent repair of the resulting massive incisional hernia. Advances in open abdomen management, supported by earlier decompression in patients with signs of IAH/ACS, have dramatically increased the rate of primary fascial closure at time of discharge to over 80% in some centres (Kimball et al. 2009). One such advance is the application of specialised vacuum assisted wound closure dressings to the open abdomen. These allow more effective removal of cytokine-rich peritoneal fluid, increased protection for the exposed viscera, and improved fascial closure rates(Batacchi et al. 2009; Cheatham and Safcsak 2010). The availability of new bioprosthetic mesh implants as well as the development of new surgical techniques have also improved the likelihood of successful abdominal closure.

Efficacy of a Multimodality Approach to IAH/ACS

The WSACS consensus recommendations are based on four principles:

1)Serial IAP monitoring;

2)Goal-directed optimisation of systemic perfusion and organ function;

3)Medical interventions to reduce IAP and IAH-induced end-organ damage; and

4)Prompt surgical decompression for IAH/ACS that is refractory to medical management.

Cheatham et al. recently published (2010) a prospective observational study of 478 patients with IAH/ACS requiring open abdominal decompression both before (2002-2004) and after (2005-2007) release of the WSACS guidelines (initially proposed in 2005).

While patient severity of illness remained unchanged throughout the study, patient survival improved significantly from 50% to 72% through adherence to the guideline ($p=0.015$).

Other improved patient factors included:

• Decreased mean days to abdominal closure (20 vs. 10 days; $p< 0.01$),

• Decreased entero-atmospheric fistula rate (8.6% vs. 3.6%; $p< 0.05$), and

• Decreased requirement for split-thickness skin grafting to close the abdomen (12% vs. 3%; $p< 0.01$).

Development of ACS, prophylactic abdominal decompression, and use of the WSACS algorithm were identified as independent predictors of survival. Kimball et al. Similarly performed a prospective study of 600 patients at risk for IAH/ACS who were managed according to a standardised protocol (Kimball et al. 2009). Reductions in ICU length of stay (14.5 vs. 10.5 days), ventilator days (12.3 vs. 8.3 days), and need for emergent abdominal decompression (23.2% vs. 13.8%) were realised.

Conclusions

IAH/ACS is commonly encountered in the critically ill. Tremendous progress has been made toward improved management of such patients with decreased morbidity and improved long-term functional outcome. An evidence-based medicine approach emphasising earlier diagnosis, multi-modality medical management, and surgical intervention for refractory ACS has been demonstrated to significantly improve patient survival.

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