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## Intra-Abdominal Hypertension:

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### Evidence that Early Detection and Management Improves Outcomes and Reduces Resource Utilisation

### Introduction

There are several important issues concerning intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS). The first is that IAH/ACS are often seen outside the trauma population. In fact this syndrome is just as common in the medical ICU as the surgical ICU, with prevalence rates over 30% in both populations (Malbrain et al. 2004). The second point is that clinically important increases of intra-abdominal pressure (IAP) are possible in just a few hours. For this reason, measurements conducted every 6-12 hours in the unstable patient are likely inadequate due to the risk of delayed diagnosis and prolonged tissue ischaemia (Balogh et al. 2003). Most importantly, however, it must be noted that intra-abdominal pressure can greatly assist the clinician in decisionmaking in the complex critically ill patient. A quickly increasing IAP in a patient could point straight to the diagnosis of abdominal compartment syndrome, rapidly identifying the underlying cause of multi-organ dysfunction. This data could allow the timely reversal of the underlying cause, reversal of organ ischaemia, prevention of permanent end organ damage and early transfer out of the ICU – freeing up an ICU bed for another patient and reducing resource consumption. The following discussion will focus on this concept – **outcome impact and resource consumption in patients with IAH/ACS.**

### Intra-abdominal Hypertension: Definitions and Risk Factors

International consensus definitions, risk factors, monitoring and interventional recommendations for intra-abdominal hypertension were published in early 2007 (Cheatham et al. 2007). Table 1 lists important definitions. Risk factors for developing elevated intra-abdominal pressure are listed in Table 2. All newly admitted ICU patients or those with new organ dysfunction who have two or more risk factors should have serial intra-abdominal pressure measurements taken to ensure IAH is not developing.

### Impact of IAH on Patient Outcome

Although multi-centre, randomised, controlled outcome trials have not been conducted for IAH management, there is an increasing body of data demonstrating that IAH worsens patients outcomes and increases resource consumption, whereas aggressive protocol driven interventions designed to treat IAH improve outcomes without increases in resource utilisation. Numerous epidemiologic studies demonstrate that patients suffering IAH/ACS have increased morbidity, mortality and ICU/hospital length of stay (LOS). Raeburn noted IAP >20 mm Hg in 36% of his damage control surgical patient population (Raeburn et al. 2001).

Compared to those that did not develop elevated IAP, this group suffered

• longer ICU lengths of stay,

• longer ventilator times,

• more multiple organ failure and

• higher mortality.

Pupelis found similar results in severe pancreatitis:

• IAP elevation predicted higher mortality (36% vs. 0%),

• more multiple organ dysfunction (64% vs. 19%) and

• longer ICU LOS (21 days vs. 9 days) (Pupelis et al. 2002).

Data on liver transplants shows association between elevated IAP and renal failure, delayed ventilator weaning and death (Biancofiore et al. 2004). Malbrain showed that an IAP≥12 mm Hg predicted higher mortality (39% vs. 22%) in adult populations while Ejike found a similar but more pronounced mortality link in children (33% vs. 2.4%) with an associated increase in ICU LOS (13d vs. 6 d) (Malbrain et al. 2005; Ejike et al. 2007). Finally, Sugrue found IAP (along with age, blood pressure and sepsis) to be an independent predictor of renal insufficiency or failure in a large surgical population (Sugrue et al. 1999).

#### Impact of IAH Interventional Management on Outcome and Resource Utilisation: Primary IAH/ACS

While epidemiologic data demonstrates a clear association between IAH/ACS and morbidity, a common question is whether IAH/ACS is simply a prognostic indicator or if it is a modifiable parameter that can be addressed to improve patient outcomes. Increasing data suggests the latter. Ten years ago, Ivatury and colleagues noted that interventions directed specifically at preventing ACS in trauma patients undergoing damage control laparotomy (i.e. using temporary abdominal closure following the initial laparotomy) resulted in marked improvement in survival (89% vs. 61%) (Ivatury et al.1998).

Since that publication other institutions have implemented temporary abdominal closure protocols with clear outcome improvements (Cipolla et al. 2005; Cheatham and Safcsak 2007). This advancement is now commonly applied in field hospitals in the ongoing Iraq war and may explain some of the dramatic improvements in survival from severe trauma in this war compared to the gulf war 15 years prior. Other surgical subspecialties caring for abdominal aortic rupture, neuro-trauma and severe pancreatitis also report outcome improvements using selected TAC as an interventional therapy for IAH (Oelschlager et al. 1997; Joseph et al. 2004; Leppaniemi et al. 2007). Most recently, Cheatham et al presented data outlining outcomes and resource utilisation in patients with ACS who were treated with temporary abdominal closure plus a standardised medical interventional protocol (Cheatham and Safcsak 2007). Utilising this protocol, the investigators noted

• a reduction in mortality (49% down to 29%),

• more rapid and more successful closure of the abdominal wall (34% vs. 61%),

• reduced total hospital LOS (29 days down to 18 days) and

• decreased resource utilisation.

The authors conclude that evidence based IAH/ACS management strategies significantly improve patient survival without an increase in resource utilisation and should be adopted by other institutions.

#### Impact of IAH Interventional Management on Outcome and Resource Utilisation: Secondary IAH/ACS

Non-surgical patients with secondary IAH/ACS also demonstrate outcome improvements with early interventional therapy. Oda established a protocol whereby all patients with severe acute pancreatitis who developed IAP >15 mm Hg underwent continuous renal replacement therapy before onset of organ dysfunction (Oda et al. 2005). The result was a rapid reduction in IAP levels to less than 10 mm Hg, along with a drop in serum cytokine levels. Compared to their traditional 30% ICU mortalities for this patient population, this interventional group had a mortality of 6%. Sun also studied severe pancreatitis patients, randomising them into a study arm that received IAP monitoring plus peritoneal drainage with a continuous indwelling catheter versus no IAP monitoring and no catheter (Sun et al. 2006). All patients were otherwise managed in the same fashion. Groups were compared for changes in APACHE II scores, hospital LOS and survival to discharge. The interventional arm fared much better – APACHE II scores dropped while hospital LOS and mortality were cut in half (15 d vs. 28 d, 10% mortality vs. 20% mortality).

#### Conclusion

Similar to compartment syndromes of the extremity or skull, prolonged elevation of pressure in the abdominal compartment leads to severe tissue ischaemia and irreversible cellular death. Without treatment, long ICU admissions, progressive organ failure and death may ensue. Current evidence suggests that early compartment pressure monitoring combined with interventional therapies can reduce morbidity and mortality while simultaneously reducing total resource consumption by the patient. Intensivists should consider intra-abdominal pressure as one piece of the physiologic picture and begin implementing an approach to managing this syndrome in the appropriate patient populations.

**Assessment and management protocols are available online at www.wsacs.org, while teaching materials and nursing management protocols can be found at www.abdominalcompartment- syndrome.org.**

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