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Review

A systematic review on intra-abdominal pressure in severely burned patients

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ABSTRACT

Objective: Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) are complications that may occur in severely burned patients. Evidenced based medicine for these patients is in its early development. The aim of this study was to provide an overview of literature regarding IAH and ACS in severely burned patients.

Methods: A systematic search was performed in Cochrane Central Register of Controlled Trials, PubMed, Embase, Web of Science and CINAHL on October 1, 2012. These databases were searched on 'burn', 'intra-abdominal hypertension', 'abdominal compartment syndrome', synonyms and abbreviations. Studies reporting original data on mortality, abdominal decompression or abdominal pressure related complications were included.

Results: Fifty publications met the criteria, reporting 1616 patients. The prevalence of ACS and IAH in severely burned patients is 4.1–16.6% and 64.7–74.5%, respectively. The mean mortality rate for ACS in burn patients is 74.8%. The use of plasma and hypertonic lactated resuscitation may prevent IAH or ACS. Despite colloids decrease resuscitation volume needs, no benefit in preventing IAH was proven. Escharotomy, peritoneal catheter drainage, and decompression laparotomy are effective intra-abdominal pressure (IAP) diminishing treatments in burn patients. Markers for IAP-related organ damage might be superior to IAP measurement itself.

Conclusion: ACS and IAH are frequently seen devastating complications in already severely injured burn patients. Prevention is challenging but can be achieved by improving fluid resuscitation strategies. Surgical decompression measures are effective and often unavoidable. Timing is essential since decompression should prevent progression to ACS rather than limit its effects. Prognosis of ACS remains poor, but options for care improvement are available in literature.

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Contents

1. Introduction

Severely burned patients are at risk for elevated intra-abdominal pressure (IAP). The World Society of Abdominal Compartment Syndrome (WSACS) defines burn as an independent risk factor for abdominal compartment syndrome (ACS). ACS is a syndrome of new organ failure resulting from a sustained or repeated IAP $>$ 20 mmHg [1]. A sustained or repeated IAP $\geq$ 12 mmHg without signs of organ failure is termed Intra-Abdominal Hypertension (IAH). IAH and ACS are detrimental complications in the critically ill, even more in severely burned patients. However, evidenced based medicine for these severely injured patients is still in its early development.

Greenhalgh et al. were the first to describe the occurrence and effects of elevated IAP among four cases of burn in children in 1994 [2]. In a prospective analysis of 30 severely burned patients they demonstrated that an IAP $\geq$ 30 mmHg is associated with a 3–4 times increased sepsis and mortality rate. This publication initiated an increase of awareness of IAP-related complications and its devastating effects. It took until 1999 before Ivy et al. [3] reported on IAH and ACS in adult burn patients. IAH and ACS are diagnosed using various IAP measuring techniques, measurements can be continuous and direct or indirect intra-vesical; this last method is included in the guidelines of WSACS and is accurate in burn patients as well [4–6].

IAH and ACS result from large fluid resuscitation volumes in combination with severe systemic inflammatory response syndrome (SIRS) [7]. Both resuscitation volume and SIRS are dependent of the burn severity [8]. Even though the most commonly used Parkland–Baxter formula states a use of 4 mL/kg/% of (burned) total body surface area (TBSA), larger volumes are often given [9,10]. This may lead to a phenomenon called 'fluid creep' which gives rise to excessive edema formation and 'third spacing' of the fluid excess [11]. This is swift process; intra-abdominal edema and ascites leading to IAH can emerge within only a few hours after sustaining the burn [12]. SIRS in these patients becomes a self-perpetuating process caused by accumulation of pro-inflammatory cytokines in the resulting ascites fluid [13].

The second main factor that leads to IAH in burn patients are compliance decreasing burns of the abdominal or thoracic wall. The compliance curve of a healthy human abdomen shows it can easily contain 3 L extra volume without a significant increase in IAP [14]. When local burn is present, the abdomal volume capacity is smaller. Truncal burn and increased intra-abdominal volume can raise IAP independently, but when an inauspicious combination of these conditions occurs, patients can deteriorate fast. In that case, IAP can be relieved rapidly by longitudinal skin incision (escharotomy) of the truncal burns or eschars [15,16].

ACS related new organ failure typically presents itself as oliguria or ventilation difficulties. They result from the body's inability to compensate and overcome the intra-abdominal pressures which gives rise to tissue ischemia. Compensatory ability is strongly patient dependent, therefore measuring IAP alone is not sufficient in determining the patient's threat. Abdominal perfusion pressure (APP) defined as the mean arterial pressure (MAP) minus the IAP, is more suitable measurement [1,17]. To restore adequate perfusion pressures in ACS patients, decompression is needed. Early ACS recognition is of decisive importance for prompting such a decompression. Even when early recognition is achieved, ACS has a poor prognosis. Mortality rates of 44% up to 100% are reported for burn patients with ACS [18,19].

Even though IAP-related complications in severely burned patients are dangerous, they occur quite common. Prevention

Table 1 – Search query.

(burn OR burns OR burning OR burnings OR burned OR burnt OR scald OR scalds OR scalding OR scorch OR scorching OR singe OR singed OR blaze OR blazed OR "blast injury" OR "blast injuries") AND ("abdominal compartment syndrome" OR ACS OR "abdominal compartment syndromes" OR "abdominal compartmental syndrome" OR "abdominal compartmental syndromes" OR "abdominal hypertension" OR "intra-abdominal hypertension" OR "IAH" OR "intra abdominal hypertension" OR "abdominal pressure" OR "intra-abdominal pressure" OR "intra abdominal pressure" OR "IAP")