

## Under pressure... Pressure pushing down on me

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A 70-year-old male without significant medical history, presented to the hospital after having been trapped under a piece of industrial equipment for several hours. In addition to multiple orthopedic fractures and compartment syndrome requiring left upper extremity fasciotomies, he was found to have rhabdomyolysis and renal failure. The patient was aggressively resuscitated with crystalloid fluids. He arrived to the Surgical Intensive Care Unit (SICU) intubated and was ultimately started on continuous veno-venous hemodialysis (CVVHD) for metabolic derangements including hyperkalemia. Tube feeds were started on hospital day 1 and the patient was noted to have been having good bowel function.

He required low dose single vasopressor therapy support to maintain his blood pressure during this time, prompting the team to refrain from volume removal while on CVVHD. Consequently, his net fluid balance was 21 liters positive by the end of hospital day 2. Upon chart review, it was noted that the patient had received 14 liters of crystalloid solution. Physical exam at that time demonstrated a distended but soft abdomen. Serial exams demonstrated worsening of his abdominal tension and on hospital day 4, a bladder pressure was checked. It was found to be elevated to 30 mmHg. The patient was paralyzed in an emergent effort to treat his in-

traabdominal hypertension, but his pressures only decreased to 21 mmHg. At this time, he was approximately 30 liters positive. The patient subsequently underwent emergent definitive management with a bedside decompressive laparotomy.

Abdominal compartment syndrome is most often seen after over-resuscitation, more commonly in trauma patients but also in conditions like septic shock. **Figure 1** demonstrates the bulging intraabdominal contents encountered upon entering the abdomen of this patient with release of his intraabdominal hypertension. The patient was found to have a significant amount of necrotic small bowel, as seen in **Figure 2**, resulting in resection of ~100 cm of his bowel.

Abdominal compartment syndrome is an increase in intra-abdominal pressure, typically above 20 mmHg, compromising blood flow and resulting in organ failure. (1) One study estimated the incidence at 1% in general trauma patients admitted to an ICU, while smaller studies demonstrated higher incidences in sicker trauma patients. (2) One theory behind the pathogenesis is the abdominal perfusion pressure (APP), defined as difference between the mean arterial pressure (MAP) and the intra-abdominal pressure (IAP). (2)

$APP = MAP - IAP$  (goal >60 mmHg)

Expert opinion recommends that an APP less than 60 mmHg may compromise perfusion of intra-abdominal organs. (1) The IAP is measured via the bladder during end-exhalation and while the patient's abdominal muscles are relaxed. Clinical features of abdominal compartment syndrome often include a tense abdomen, decreased respiratory compliance, and oliguria. (2) A major risk factor, as in this patient, is volume overload. As fluid increasingly third-spaces, it contributes to worsening visceral edema and increasing IAP. These patients may be intravascularly depleted but additional volume is likely to be harmful.

The management algorithm for intra-abdominal hypertension in the absence of organ dysfunction includes maintaining an APP greater than 60 mmHg; removing volume if the patient's hemody-

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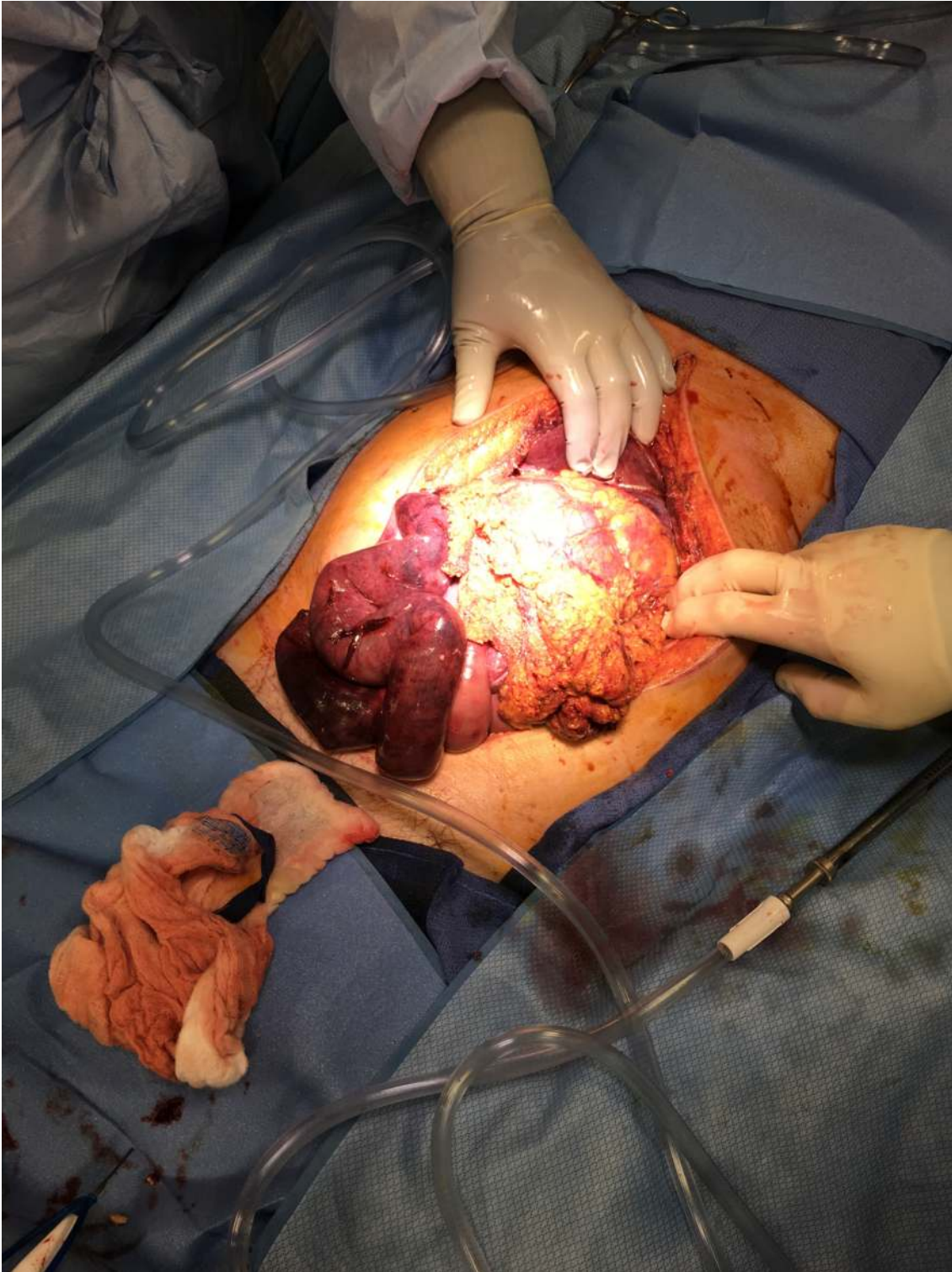
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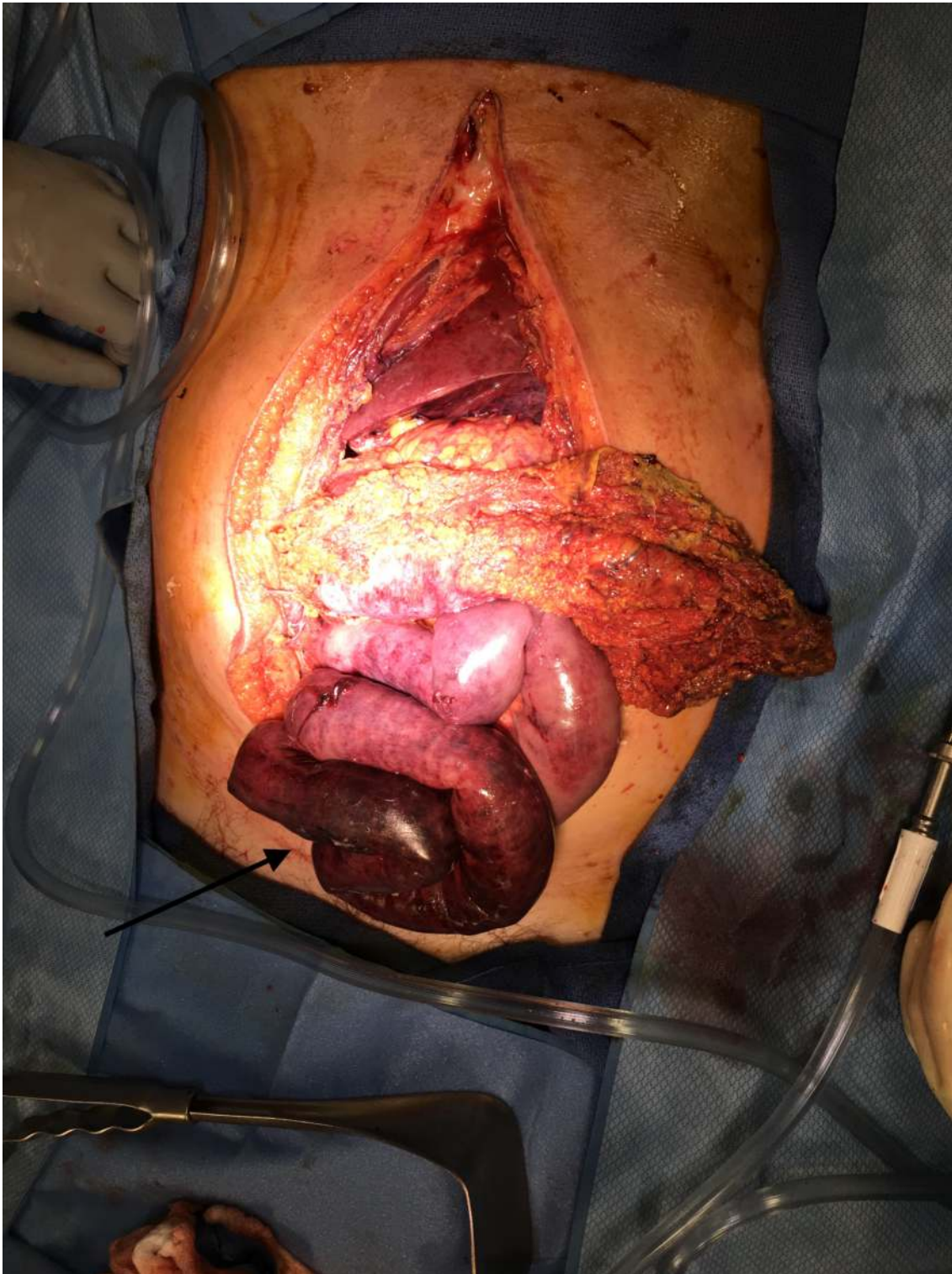
namics are favorable; decompressing the abdominal compartment via a nasogastric tube, evacuating the bowels, and draining any ascites; reducing intrathoracic pressures by draining pleural effusions and avoiding positive pressure systems; and paralyzing the patient. (3) Evidence supporting the efficacy of most of these interventions is limited. (3) Ultimately, it is recommended that patients with signs of organ dysfunction undergo a decompressive laparotomy for definitive management. (3)

Subsequently our patient developed worsening hemodynamic instability. On hospital day 5, the bowel was reexamined intraoperatively and found to have extensive necrosis (including hepatic necrosis). The family then elected to withdraw care and the patient expired. An autopsy demonstrated extensive pulmonary and hepatic congestion consistent with the large volumes of fluid administered and likely over-resuscitation of the patient prior to developing abdominal compartment syndrome.

**Figure 1.** Bulging intraabdominal contents upon decompressive laparotomy



**Figure 2.** Edematous and necrotic small bowel (arrow); note necrotic hepatic edge



## References

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