

COMMENTARY

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Non operative management of liver and spleen traumatic injuries: a giant with clay feet

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After years of initial aggressive surgical intervention and a subsequent shift to damage control surgery (DCS), non operative management (NOM) has been shown to be safe and effective.

In fact trauma surgeons realized that in liver trauma, it was safer to pack livers [1] than do finger fracture [2] or resection, and this represented a tangential issue to nonoperative approach.

Damage control was not the paradigm shift for spleen and liver, but rather to address coagulopathy that was more commonly associated with penetrating major abdominal vascular injuries [3].

The shift to nonoperative care was largely motivated by intraoperative observations that many minor liver [4] and splenic injuries [5] were found no longer bleeding.

Then CT arrived in the early 1980s and confirmed that many moderate liver and spleen injuries did not require OR intervention. Pediatric surgeons first lead the shift to nonoperative management for splenic trauma [6,7].

In the 90's it became the gold standard for liver injuries in hemodynamically stable patients, regardless of injury grade and degree of hemoperitoneum [8], allowing better outcomes with fewer complications and lesser transfusions [9]. Nevertheless concerns have been raised regarding continuous monitoring required [10], safety in higher grades of injury [11] and general applicability of NOM to all haemodynamically stable patients [12]. Similarly, in the same period and following promising results obtained with splenic salvage [13] with several surgical techniques [14] such as splenorraphy, high intensity ultrasound, haemostatic wraps and staplers [15], NOM became the treatment of choice for blunt splenic injuries [5]. However it was immediately clear that NOM failure in adults was

significantly higher than that observed in children (17% vs 2%). The incidence of immune system sequelae, coupled with Overwhelming Post Surgical Infection (OPSI) and their real clinical impact, is difficult to establish in the overall population including children [16].

Although recent reports [17] showed that despite a similar incidence and severity of solid organ injuries, Trauma centers with higher risk-adjusted mortality rates are more likely to undertake operative interventions for solid organ injuries. Data from The American College of Surgeons' National Trauma Data Bank including 87,237 solid abdominal organ injuries showed that, despite a strongly significant increase in percentage of NOM for hepatic and splenic trauma, mortality has remained unchanged [18].

More recently several authors have highlighted an excessive use of NOM, which for some high grade liver injuries is pushed far beyond the reasonable limits, carrying increased morbidity at short and long term, such as bilomas, biliary fistulae, early or late haemorrhage, false aneurysm, arteriovenous fistulae, haemobilia, liver abscess, and liver necrosis [19]. Incidence of complications attributed to NOM increases in concert with the grade of injury. In a series of 337 patients with liver injury grades III-V treated non-operatively, those with grade III had a complication rate of 1%, grade IV 21%, and grade V 63% [20]. Patients with grades IV and V injuries are more likely to require operation, and to have complications of non-operative treatment. Therefore, although it is not essential to perform liver resection at the first laparotomy, if bleeding has been effectively controlled [21], increasing evidence suggests that liver resection should be considered as a surgical option in patients with complex liver injury, as an initial or delayed strategy, which can be accomplished with low mortality and liver related morbidity in experienced hands [22].

Liver resection in hepatic trauma should be considered when (1) massive bleeding related to a hepatic venous injury, (2) massive destruction and devitalized hepatic tissue is present, often partially resected by the injury itself,

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or (3) a major bile leak coming from a proximal, main intrahepatic biliary duct are found.

NOM of liver injuries grade ≥ 3 , especially when treated with combined AngioEmbolization (AE), is not without risks (mainly biliary leaks, liver necrosis and severe sepsis) and may lead to significant morbidity and possible mortality in up to 11% of cases due to liver-related complications [23].

Although AE has been defined the logical augmentation of damage control techniques for controlling hemorrhage, the overall liver-related complication rate can be as high as 60.6% with 42.2% incidence of Major Hepatic Necrosis [24]. Early liver lobectomy in such cases required lesser number of procedures and achieved lower complication rate and lower mortality compared to less aggressive approaches such as serial operative debridements and/or percutaneous drainage [25].

Further concerns for both liver and spleen NOM, arise when associated hepatic and splenic injuries coexist and/or potentially missed injuries can be suspected. Patients with associated liver and spleen injuries are twice as likely to fail non-operative therapy as those with only a single organ injured [26]. Missing associated intra-abdominal injury and delayed treatment, significantly affects the outcome. This occurs more often in conjunction with liver than with splenic injury, especially pancreas and bowel injury are significantly associated with liver injury in blunt trauma [27].

NOM is actually used blunt splenic as the initial standard of care for blunt splenic injuries, not only in children (rates above 90-95%) but also in adults (60-77% [28]). Even in Grade IV-V splenic injuries NOM attempt has been pushed up to in 40.5% but it ultimately failed in 55% of these high-grade injuries [29]. This is despite the fact that, already in the late 90's, it became clear that significant numbers of delayed splenic complications occurred with nonoperative management of splenic injuries which were potentially life-threatening [30].

A significantly higher failure rate (38%) has been observed in grade IV-V Blunt Splenic injury(BSI) patients and above all, mortality of patients for whom NOM failed was almost 7-fold higher than those with successful NOM in this series (4.7% vs 0.7%; $p = .07$) [31]. Furthermore, multivariate analysis identified 2 independent predictors of f-NOM: grade V BSI and the presence of a brain injury. Other authors identified age > 55 years, ISS > 25 and lower level trauma centers admission as predictors of splenic NOM failure [32]. That means NOM should be carefully initiated in severe grade of BSI and careful selection of candidates for NOM is advisable for a safe conservative management choice.

In the most recent years a liberal and more aggressive use of angiography has often been observed and is associated with higher rates of NOM (80%) and lower rates of

failure (2-5%); nonetheless several concerns raise because it is labour intensive and there have been several reports reporting a surprisingly high rate of complications [33]. In WTA multi-institutional experience, among 140 patients underwent AE, 27 (20%) suffered major complications including 16 (11%) failure to control bleeding (requiring 9 splenectomies and 7 repeat AE), 4 (3%) missed injuries, 6 (4%) splenic abscesses, and 1 iatrogenic vascular injury [34]. Additionally, proximal splenic artery embolization (SAE), has been introduced in an attempt to increase overall success rates of NOM in high grade BSI, but the following has been observed: (1) high failure rates of proximal SAE in all patients with grade V injuries and the majority of grade IV injuries, (2) the immunologic consequences of proximal SAE are unclear, and whether its use provides true salvage of splenic function versus simple avoidance of operative splenectomy, (3) an increased incidence of Adult Respiratory Distress Syndrome (ARDS). This was 4-fold higher in those patients that underwent proximal SAE compared with those that underwent operative splenectomy (22% vs. 5%, $p = 0.002$). Higher rates of septic complications including splenic abscess, septicemia, and pneumonia have also been recorded, and lastly (4) a non significant trend to higher amount of PRBC (packed red blood cell) transfusions, higher mortality and longer Length Of Stay [35].

Splenic preservation can also have deleterious side effects in otherwise salvageable patients. A review of 78 patients who failed NOM revealed a mortality rate of 12.6%. The authors concluded that the majority of their deaths were a result of delayed treatment of intra-abdominal injuries, and suggested that 70% of deaths after failing NOM were potentially preventable [36]. When extrapolated to a large series like the EAST trial, this means that 33 unnecessary deaths occurred or 0.5% of all patients treated non-operatively. Compared to a death rate from OPSI of 1/10,000 adult splenectomised patients, the odds are 20 times greater that a patient would die from failure of NOMSI than from OPSI [37].

Thus we surgeons must keep in our minds that post-splenectomy sepsis is rare and can be minimized with polyvalent vaccines of encapsulated bacteria, whilst operative mortality of splenectomy in the otherwise normal patient is $< 1\%$ [38].

Whereas Non Operative Management of Liver Injury (NOMLI) has not been shown to increase mortality rates for those that fail, the same cannot be said for the NOMSI and the balance between concerns with bleeding and infection has in the most recent years shifted illogically to favour infection. As Richardson highlighted, it should be made clear that these delayed bleeding and late failures of NOM are not harmful. "Anecdotally, I have been impressed in private discussions about deaths or "near misses" from bleeding occurring in NOM

failures. These are rarely reported in the literature. Additionally, many reports list multiple organ failure as a leading cause of death. Does unrecognized shock play a role in these deaths?" [39].

In conclusion, at the beginning of the 21st century, when NOM for liver and spleen injuries is often advocated beyond the limits of a reasonable safety and the need for surgery is considered as a defeat or "failure". We should not forget in making the best treatment choice, to keep in mind not only the predictors of NOM failure, such as the injury grade, the presence of associated intra-abdominal injuries and the risk of missing injuries with the subsequent sequelae, of a failed NOM and of delayed surgical treatment, but we must also consider the potential drawbacks of angioembolization, the environmental setting and factors, i.e. the level of the hospital (trauma center), availability of Angio Suite and ICU for continuous monitoring, the initiation of NOM during night shift, the need of an eventual time consuming spine surgery in a prone position for a concomitant vertebral fracture, and last but not least, the time needed for complete and safe resumption of normal life (work and physical activity).

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