



# Blunt abdominal trauma: watch and wait

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## Purpose of review

This review examines recent advancements in nonoperative management (NOM) of hemodynamically stable blunt abdominal trauma, focusing on expanding patient selection for observation-first strategies, particularly for high-grade solid organ injuries.

## Recent findings

Advances include a more deliberate nonoperative approach, allowing for broader patient inclusion in diagnostic and interventional angiography. Strict clinical monitoring and appropriate follow-up strategies are crucial to identify early signs of clinical progression and complications. Repeated contrast-enhanced CT (CECT) scan can be used for close observation of high-risk injuries, while the repetition of CECTs may be avoided for lower-risk cases, such as specific high-grade kidney injuries. The role of contrast-enhanced ultrasound (CEUS) in detecting sequelae of nonoperative approaches is still debated and has lot of potential, with ongoing trials exploring possible advantages.

## Summary

Multidisciplinary trauma teams play a crucial role in nonoperative management, particularly for high-grade injuries. A careful selection of patients is essential to minimize failure rates. Complications of nonoperative and angiographic approaches should be managed according to local expertise.

## Keywords

abdominal trauma, blunt, follow-up, high grade abdominal injury, nonoperative management, watch and wait

## INTRODUCTION

Blunt abdominal trauma remains a significant challenge. Traditionally, the management of such injuries involved immediate exploratory laparotomy, to identify and address internal injuries. However, the paradigm of care has shifted with the advent of watch and wait strategies, emphasizing a more conservative approach while ensuring optimal patient outcomes.

The concept of watchful waiting in blunt abdominal trauma gained traction over the past decades, fuelled by advances in imaging techniques, knowledge of injury patterns, and improved patient selection criteria. This evolving approach acknowledges that not all patients require immediate surgical intervention, and that selected individuals can be closely monitored for signs of internal bleeding or organ injury before deciding on further interventions and others can be amenable to less invasive and effective procedures such as angioembolization (AE) [1<sup>\*\*\*</sup>].

This review aims to explore the most recent advances in watch and wait strategies for blunt abdominal trauma, focusing on most frequent solid organ injuries, shedding light on the emerging evidence, diagnostic modalities, patient selection criteria, and clinical outcomes associated with this evolving approach.

## TEXT OF THE REVIEW

The principles of evidence-based surgery dictate that the right patient should receive the appropriate treatment in the correct location, administered by the suitable medical team. The nonoperative management (NOM) applies to hemodynamically stable patients with blunt abdominal trauma as well.

### Patient selection

Recent evidence suggests expanding the criteria for NOM of solid organ injuries after blunt abdominal trauma. It is now accepted that hemodynamically stable patients with high-grade injuries and no other

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## KEY POINTS

- Optimal nonoperative management of blunt abdominal trauma requires careful patient selection and a precision medicine approach. Physiology, clinical evaluation, and contrast-enhanced CT (CECT) patterns of injury are essential for determining the appropriate approach for each patient.
- Observation-first strategies can be used in stable patients with high-grade solid organ injuries, even with active contrast extravasation, offering advantages in terms of complications compared to angioembolization.
- Expanded criteria for endovascular approaches in blunt abdominal trauma lead to better outcomes compared to surgery, but require a comprehensive understanding of potential complications for long-term multidisciplinary management.
- The optimal follow-up strategy is still under debate. For high-grade spleen injuries, routine imaging after 48–72 h is recommended, considering the potential occurrence of delayed PSA up to 15 days after trauma. High-grade liver and kidney injuries may be managed through observation, with a low clinical threshold for performing CECT.
- Contrast-enhanced ultrasound shows promise as a tool, particularly in pediatric and pregnant patients, but its precise role still needs to be defined.

indications for surgery should not undergo immediate interventions [1<sup>\*\*</sup>]. Consequently, the selection criteria for NOM have been refined to reduce failure rates and optimize resource allocation. The severity of the anatomical injury, according to AAST injury scale, is no longer considered the sole criterion [2]. Patients' selection and implementation of nonsurgical strategies are crucial, as the failure of NOM can lead to worse outcomes. The acceptable failure rates average around 8–10% [2].

Recent studies have identified useful criteria, taking into account the increased failure rates of NOM in cases of high-grade injuries, considering patient physiology, which was previously overlooked in prediction models. The admission shock index (SI) has been found to be an independent predictor of NOM failure in cases of blunt splenic trauma, with a three-fold risk increase. A prediction model incorporating patient age, high-grade injuries (III–V), and an SI > 0.9 has demonstrated good accuracy in aiding patient selection [3<sup>\*\*</sup>].

A Turkish analysis emphasized the importance of accurate clinical evaluation upon admission. Patients with worse clinical and laboratory parameters (heart rate, haemoglobin, hematocrit, overall trauma severity) and an early need for blood

transfusion were more likely to experience NOM failure [4].

Another prediction model was developed from a retrospective cohort study of blunt liver trauma. It identified high-grade injuries (IV–V), the presence of hemoperitoneum, and the necessity for upfront AE as independent risk factors for NOM failure. The combination of high-grade injuries and the requirement for AE, due to contrast extravasation or pseudoaneurysm (PSA), yielded a positive predictive value of 83.3% and a specificity of 99.3% [5<sup>\*\*</sup>].

The widespread use of new-generation CECT with intravenous contrast has provided reliable information for patient management. An analysis of over 1000 cases of blunt abdominal trauma has determined that isolated abdominal fluid in small amounts only requires clinical observation, as it poses minimal risk of progression and should not impact the patient's management. These patients have very low odds of requiring subsequent surgical exploration [6].

In addition to specific solid organ injuries, recent evidence has examined the impact of pre-trauma anticoagulant intake on NOM failure rates. Patients on anticoagulants are at a significantly higher risk of undergoing delayed interventional procedures and experiencing clinical complications [7].

Recent prediction models and clinical studies have highlighted the critical role of laboratory biomarkers. An analysis focusing on the most frequent solid organ injuries revealed that admission lactate levels, along with the delta neutrophil index were associated with the need for surgical or angiographic intervention [8].

When considering the selection of patients for watchful waiting strategies in cases of risk of mesenteric and bowel injuries, it is crucial to conduct a careful clinical evaluation and utilize specific CECT signs based on the most recent clinical practice guidelines and studies [9–11].

### Full watch and wait strategy

The evolution of NOM has expanded the debate and interest in the possibility of implementing a pure watch and wait strategy, avoiding any invasive procedure.

In recent decades, the management of splenic injuries has undergone significant advancements [12]. The latest evidence suggests that grade I–II–III injuries can be observed, but grade III injuries in patients older than 55 years with multiple high-grade associated injuries, early need for blood transfusion within the first 24 h, patients under anticoagulant therapy, or with risk factors such as

cirrhosis, HIV, and drug addiction, should have a low threshold for interventional procedures [13<sup>11</sup>].

Exciting progress has been reported in implementing a full watch and wait strategy for liver injuries with active contrast extravasation at CECT, in hemodynamically stable patients. A prospective multicenter observational study was published reporting a propensity score matching analysis to compare patients who underwent AE with those who did not. The matching covered liver injury severity, mechanism of trauma, vital signs, and blood transfusion within the first 4 h. Despite the relatively small number of patients available for comparison (34 vs. 34), the nonembolization group experienced lower rates of clinically relevant complications requiring percutaneous drainage, such as abscesses or biloma, and had shorter hospitalizations, without differences in mortality rates, intensive care unit (ICU) stay, days on ventilation, and other liver-specific complications. These findings should spark a debate on whether an upfront full watch and wait strategy should be implemented in all hemodynamically stable patients with liver injury and active blush [14].

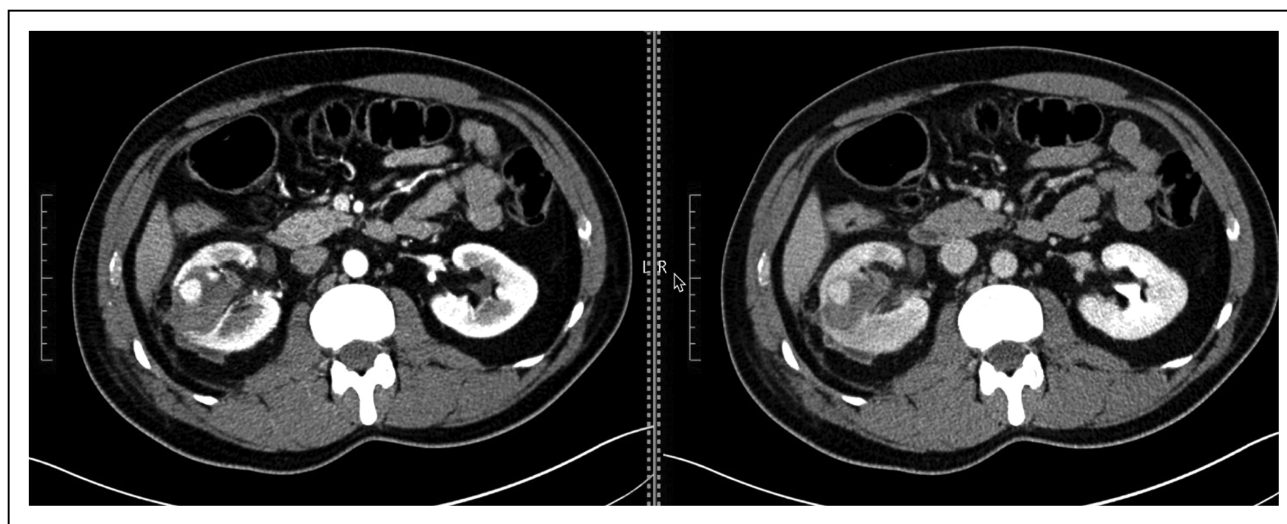
This evidence is supported by a recent systematic review, which reported lower complication rates in NOM without AE. However, it should be noted that the available studies have high heterogeneity and a small number of recruited patients [15<sup>12</sup>].

Regarding renal trauma, the latest advancements focus on the possibility of implementing NOM in grade V renal trauma. Patients who have a low transfusion requirement within the first 24 h, smaller peri-renal hematoma, and a reduced depth of renal laceration can undergo these strategies. This

report demonstrates how CECT pattern evaluation can guide successful NOM [16].

An interesting finding related to high-grade renal injuries has emerged from CECT analysis. A recent paper revealed an inverse relationship between the thickness of the peri-renal fat and the occurrence of high-grade renal injuries. This relationship was not influenced by patients' Body Mass Index and may be associated with their nutritional status [17].

In 2023, the Eastern Association for the Surgery of Trauma published an evidence-based guideline using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) methodology. The guideline attempts to address four open questions regarding the management of blunt renal injuries. One of the focal points is the possibility of avoiding upfront AE in blunt renal trauma with active contrast extravasation up to the secondary branches of the renal vessels. Figure 1. Currently, the available studies do not provide sufficient evidence-based recommendations to determine whether AE is superior to close clinical monitoring in terms of mortality, nephrectomy rates, renal complications, and the need for renal replacement therapy in hemodynamically stable patients. Current evidence suggests that patients may undergo AE or receive close hemodynamic monitoring with regular blood tests and urine output assessments depending on various factors, such as the patient's hemodynamic stability, injury severity, blood transfusion requirements, presence of other injuries, availability of a surgical team, ICU availability, preexisting renal failure, contrast load on the initial scan, and the presence of active



**FIGURE 1.** A case of a high grade right kidney injury (organ injury severity IV) with two actively bleeding PSA in which an initial watch and wait strategy was chosen until the patient developed flank pain and persistent hematuria. The patient underwent AE on day 5 posttrauma, after 3 days the patient was discharged without further symptoms.

extravasation in the secondary branches of the renal vessels observed on CT. CECT or upfront angiography should be considered if any parameter is deteriorating [18<sup>••</sup>].

The debate is ongoing supporting upfront non-angiographic approaches, even in high-grade renal injuries with contrast extravasation and hemodynamic stability

### Interventional radiology and clinical complications of nonoperative management

The extension of implementing operative angiography for high-grade solid organ injuries represents the most significant advancement in the NOM of blunt abdominal trauma. Recent studies have shown a growing trend towards using AE as an adjunct to NOM, resulting in higher success rates and better outcomes in terms of mortality, length of hospital stay, and related complications, particularly for high-grade injuries. AE has revolutionized the NOM of blunt abdominal trauma, especially for spleen and liver injuries, offering a safe and feasible approach using established interventional techniques [19–23].

While the endovascular management of blunt abdominal trauma as an adjunct to NOM has shown promise, it is currently limited to hemodynamically stable patients. However, a recent meta-analysis explored the possibility of extending this approach to hemodynamically unstable patients, demonstrating high success rates in liver, spleen, and renal injuries. However, it is important to reserve this approach for a selected population of unstable patients who respond to fluid resuscitation and can access timely interventional radiology services [24<sup>•</sup>].

One aspect that still requires further investigation is the magnitude of posttrauma and postangiography complications and their management. In a comprehensive meta-analysis with meta-regression analysis on the risk of PSA after liver trauma, it was found that the overall risk, regardless of trauma severity, was around 2% to 2.5% in cases managed nonoperatively. The risk of PSA increased progressively with the severity of trauma, ranging from 0.4% for grade I injuries to 10.6% for grade V injuries. AE was successful in treating PSAs in 56% of cases, while observation and surgical repair were used in 24% and 20% of cases, respectively, resulting in an overall success rate of 90% [25<sup>••</sup>].

The risk of clinically relevant biliary complications after NOM in high-grade liver trauma without AE is reported to be low or absent. The development of delayed PSAs is the most significant complication, which can be primarily managed through repeated AE for lesions larger than 1 cm [15<sup>••</sup>,26].

A rare but potentially devastating consequence of hepatic embolization for blunt trauma is the development of parenchymal necrosis. This phenomenon has been extensively studied, and a recent review provides the latest evidence and understanding of this complication. The most common complications after liver AE for actively bleeding patients include hepatic abscesses, biloma, and hepatic necrosis. Interventional radiology procedures and endoscopic solutions are typically the first-line approaches for managing purulent or biliary post-embolization collections, while surgery is reserved for nonresolving cases [1<sup>••</sup>].

Major hepatic necrosis can occur in up to 40% of high-grade liver injuries treated with embolization, with a higher incidence seen in nonselective or nonsuper selective approaches. Around 74% of patients with hepatic necrosis require operative treatment due to the extent of the necrosis, which is not amenable to antimicrobial therapy and percutaneous drainage. The related mortality rate is approximately 11% [1<sup>••</sup>,27<sup>•</sup>].

In splenic injuries, NOM is already well established. However, it is important to understand the extent of expected complications. Clinically significant complications include splenic bleeding, infarction, splenic abscesses, and contrast-induced nephropathy, while minor complications include ipsilateral pleural effusion, fever, and coil migration. The most frequently reported complication is ipsilateral pleural effusion, requiring thoracentesis in 10% of cases, while splenic infarction and abscesses occur in 8% and 5% of cases, respectively. Abscesses tend to occur more frequently in patients with at least 50% of parenchymal necrosis. Regular follow-up is crucial to monitor the clinical evolution of patients with splenic infarction, as complications can arise between 16 and 21 days postembolization [28,29].

Similar to liver and spleen injuries, expanding the boundaries of observational and AE strategies for high-grade renal injuries requires a deep understanding of potential complications. The most common complications following nonoperative management of high-grade traumatic renal injuries include hematuria, fever, acute kidney injury, urinoma, and a moderate risk of abscesses. Most of these conditions can be safely managed with close monitoring and percutaneous drainage, reserving nephrectomy as a salvage approach for unresolved cases [30].

Injuries to the renal blood vessels, often associated with high-grade kidney trauma, require heightened attention due to the significantly higher rate of kidney-related complications, regardless of the chosen management approach [31].



## Follow up strategies: summary of most recent evidences

The current topic of debate regarding NOM in solid organ injuries is the appropriate follow-up strategy. Existing guidelines, which are comprehensive and widely cited, provide conditional recommendations based on low-quality evidence. These guidelines suggest that high-grade splenic injuries (grade III to V) should undergo a follow-up with a CECT or CEUS within 48–72 h [1<sup>■</sup>,13<sup>■</sup>].

However, a recent publication highlights a potential drawback of this approach. It reveals that most clinically significant PSA resulting from blunt splenic trauma occur after 15 days from the initial trauma [32]. Despite the severity of liver injuries, the current suggested strategy does not advocate for the standardized repetition of CECT [1<sup>■</sup>,33].

A significant issue raised by Duncan *et al.* is the occurrence of posttraumatic PSA in high-grade liver injuries, with an average detection time of 6 days. The authors recommend routine follow-up for high-grade injuries [25<sup>■</sup>]. This trend is supported by two recent reports which identified significant rates of PSA with potential clinical impact, emphasizing the need for delayed CECT and universal screening in high-grade blunt solid organ injuries [34,35<sup>■</sup>].

Another unresolved question pertains to the optimal follow-up for high-grade kidney injuries. Recent qualitative guidelines have failed to provide a recommendation on whether routine follow-up CECT of the abdomen or symptom-based CECT are superior in reducing the incidence of clinically

relevant complications. The available evidence analyzed using the GRADE methodology were insufficient to draw a conclusion [18<sup>■</sup>].

A retrospective 11-year series of blunt renal traumas published in January 2023 sheds some light on this matter. The authors report that routine surveillance has a limited impact on the clinical management, as clinical deterioration is the main determining factor. They suggest that routine follow-up should only be considered for patients with high-grade injuries to the collecting system, where the persistence or evolution of the lesion after 72 h may require an interventional approach [1<sup>■</sup>,36].

One potentially impactful practice is the use of CEUS as a follow-up strategy for blunt abdominal solid organ injuries. This approach offers easy availability, absence of radiation exposure, and the ability to repeat the exam multiple times. However, its potential needs further clarification since it is underutilized in most settings. Limitations include operator skills, limited exploration of other abdominal organs, and challenges posed by patient habitus and gas interposition. Despite these limitations, CEUS is beneficial in special cases such as pediatric and pregnant trauma patients [37].

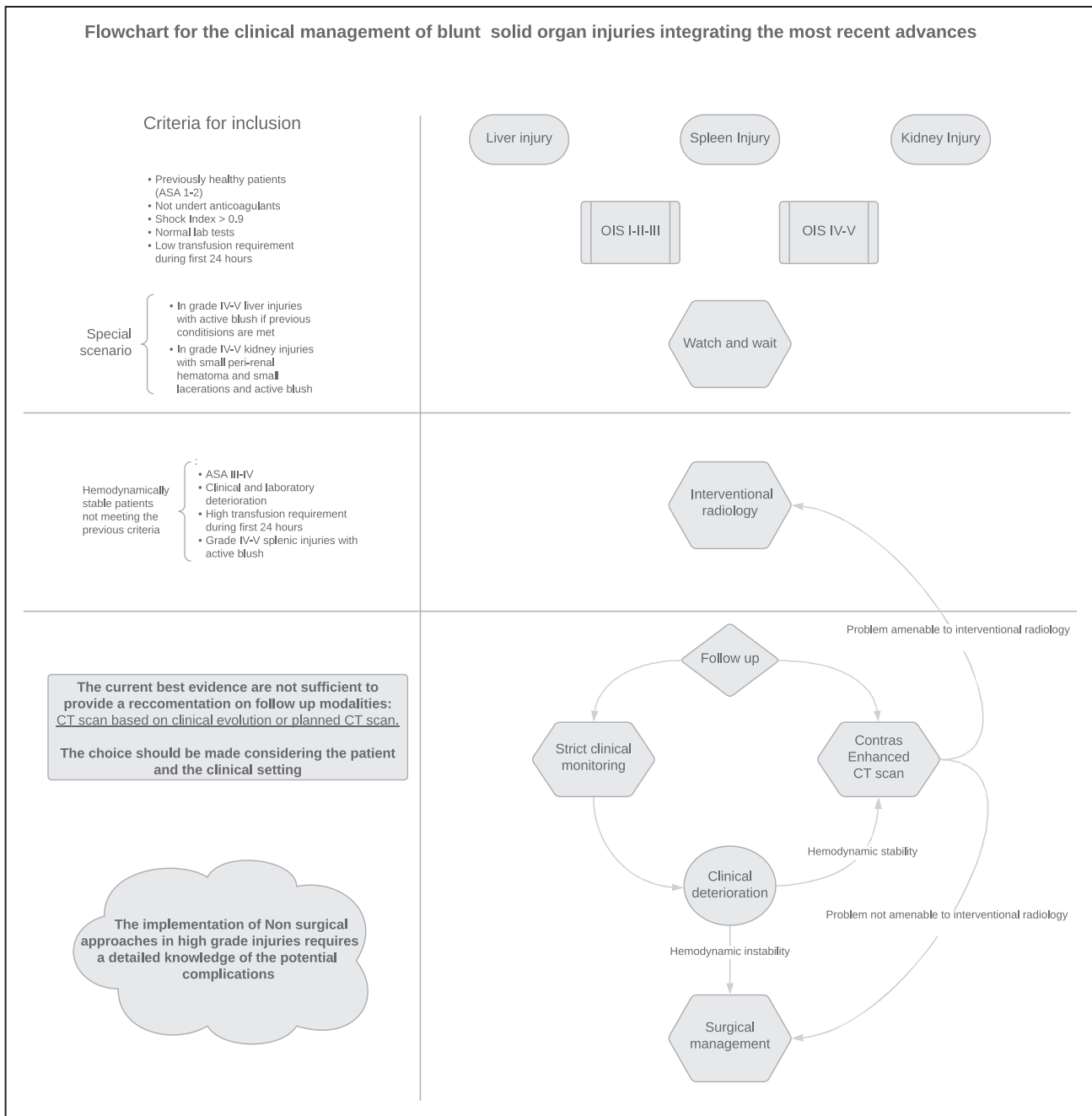
Ongoing trials aim to define its role in the management of blunt abdominal trauma in both adults and children [38,39].

In Table 1, detailed recommendation of specific organ injuries follow up are depicted, considering the most recent published evidence.

**Table 1.** Follow up strategies for high grade solid organ injuries

High grade liver injuries		
Best strategy	Potential pitfalls and recent evidences	Complications and solutions
Close clinical monitoring with serial blood test including hemoglobin and liver function tests	Up to 10% risk of PSA within the first 6 days Consider routine CECT at 7 days post trauma	Biloma, abscesses or hepatic necrosis with small collections -> interventional radiology or endoscopy. Surgical approaches -> unresolving or bigger collections.
High grade splenic injuries		
Best strategy	Potential pitfalls and recent evidences	Complications and solutions
Routine CECT on day 3 posttrauma in high risk grade III and all grade IV and V injuries	A negative 3 days CECT does not exclude delayed PSA Beware that clinically relevant PSA can occur up to 15 days post trauma	Small to medium splenic abscesses or infarction -> clinical observation + antibiotics. Large unresolving collections, persistent bleeding or primary/recurrent PSA -> AE or splenectomy if unstable or too big
High grade kidney injuries		
Best strategy	Potential pitfalls and recent evidences	Complications and solutions
Close clinical monitoring with serial blood test including hemoglobin in nonurinary injuries Routine CECT on day 3 post trauma for collecting system injuries	Low threshold for CECT in nonurinary injuries Non resolving urinary injuries after CECT at 3 days should lower the threshold for interventions	Persistent urinary leak -> interventional urology Abscesses, primary/recurrent PSA -> interventional radiology Nephrectomy for unresolving conditions or unstable patients

Organ specific recommendation for the follow up of high grade solid organ injuries undergoing NOM. Potential pitfalls, complications and approaches are depicted. CECT, contrast enhanced CT scan; PSA, pseudoaneurysm.



**FIGURE 2.** Comprehensive decision making flow chart integrating the most recent evidences on the NOM of blunt solid organ injuries, from patients selection to follow up. NOM, nonoperative management; OIS, Organ Injury Scale.

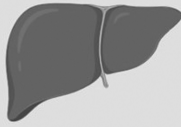
**CONCLUSION**

In conclusion, NOM of blunt abdominal trauma represents a significant advancement in acute care surgery in recent decades. Its scope continues to expand, incorporating nonsurgical angiographic approaches and leading to improved outcomes. We included a comprehensive workflow including patients selection criteria and clinical pathways to support the decision making considering the most updated advances, Fig. 2.

The current evidence prompts the question of whether ‘less is more’ in the management and follow-up of these patients. In Fig. 3 we resumed the most impactful evidence for the three most frequently injured organs.

In 2023, accurate clinical and laboratory monitoring are still guiding the utilization of diagnostic and interventional procedures. The advances and updates discussed in this review also highlight the need for trauma surgeons to expand their skills to

## Expanding the boundaries of NOM in high grade solid organ injuries



### Avoid upfront angioembolization in high grade liver trauma?!

Selected high grades liver injuries with active contrast extravasation in hemodynamically stable patients can be treated without angioembolization



### Can we safely discharge high grade splenic injury with negative 3-5 days follow-up after NOM and angioembolization?

Be aware that pseudoaneurysm can occur up to 15 days after trauma!



### Raise the threshold for nephrectomies!

NOM in grade V renal trauma can be safely implemented in case of low transfusion requirement within the first 24 hours, smaller peri-renal hematoma, and a reduced depth of renal laceration

**FIGURE 3.** Most impactful and debated advances in the nonsurgical management of liver, spleen and kidney blunt injuries.

encompass endovascular management of trauma patients, thus becoming hybrid surgeons.

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### Conflicts of interest

There are no conflicts of interest.

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- of special interest
- ■ of outstanding interest

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