



## Initial Approach to Liver Injuries

In patients with suspected intra-abdominal injuries after blunt trauma, immediate operation is indicated in the setting of refractory shock with hemoperitoneum demonstrated on ultrasound or diagnostic peritoneal lavage. Otherwise computerized tomographic (CT) scanning should almost always be done if possible. If a liver injury is identified on CT, the decision to pursue nonoperative management (NOM) hinges on the severity of the physiologic derangement, and the presence or absence of peritonitis. CT characteristics of the liver injury such as grade of liver injury, presence of a vascular “blush” or contrast extravasation, the degree of hemoperitoneum, and presence of associated injuries should also be considered in the decision to pursue NOM.

Angioembolization is an important modality which can be utilized as the primary therapeutic intervention when NOM is pursued, or as an adjunct to operative management where hemostasis is less than satisfactory. The decision to proceed with angiography in the latter scenario is usually made on the basis of operative findings and clinical course although a recent study has also demonstrated some value in postoperative CT scanning to guide the need for angiography [1].

In most (70–90%) of the patients presenting with blunt liver injuries, NOM can be attempted with a high success rate [2, 3]. Despite the fact that higher grade (American Association for the Surgery of Trauma [AAST] Organ injury Scale grades 3–5) liver injuries are more likely to require operative intervention, the failure rate is low (about 6–8%) for NOM when properly selected [4, 5].

For patients with penetrating abdominal injuries, urgent operation is largely necessary in gunshot wounds, and less so for stab wounds. In the stable patient with a documented trajectory through the liver on CT and a very low suspicion of hollow viscus injury by examination and CT findings, NOM is an acceptable strategy [6]. In one series, NOM was attempted in only 15% of patients with penetrating liver injuries, with a low (3%) failure rate [7]. Another study found that of 36 penetrating liver injuries selected for NOM, the success rate was 86% [8].

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## The Geriatric Patient: Initial Approach

In elderly patients with blunt liver injuries, there is no available evidence demonstrating that NOM is detrimental or that the NOM strategy should be somehow modified. In a multicenter study of severe (AAST OIS grades 4 and 5) blunt liver injuries undergoing NOM, where NOM was defined by “a clear note in the medical record committing the patient to NOM or by the fact that an operation was booked later than 3 hours after the diagnosis,” there was no difference in mean age as to who underwent immediate operation as opposed to a trial of NOM. Out of 262 patients, 23 (8.8%) failed NOM. Patients 55 years and older formed 10.3% ( $n = 27$ ) of the entire cohort and only 1 of 27 (4.3%) failed NOM [4]. Recent guidelines by prominent societies [9, 10] have not considered age an important factor in the decision to pursue NOM of blunt liver injuries (Fig. 19.1).

In the largest recent study of isolated severe (AIS of 4 or greater) blunt liver injuries from the National Trauma Data Bank, attempted NOM (defined as no surgery in the first 6 hours) occurred in 73% of 3267 patients with a failure rate of 6.5% [11]. Failed NOM was independently associated with 30-day in-hospital mortality after controlling for confounders (crude survival rate 78.8% vs. 92.9%, hazard rate, 1.7; 95% confidence interval [C.I.] 1.1–2.6). Age (odds ratio 1.02, [95% C.I. 1.01–1.03]) was a predictor of NOM failure, others being male sex, systolic blood pressure <90 mmHg, Injury Severity Score, Glasgow Coma Scale score, and need for hepatic angioembolization. Putting this into practical terms, for every 10 years of age, the odds of failure of NOM changed by  $1.02^{10}$  or 1.22. If the NOM failure rate was 6.5% at age 30, the corresponding rates would be 11% at age 60 and 13.3% at age 70 with the other variables in the study being equal. These hypothetical figures give some reassurance to clinicians that although age is associated with failure of NOM, NOM is still an acceptable strategy in the elderly with severe blunt liver injuries.

There is no available evidence to suggest that age is a contraindication to NOM of selected patients with penetrating injuries. In recent published guidelines [6, 10] there is no mention of age as a contraindication for this strategy. The decision to manage patients nonoperatively for penetrating injuries should be made by an experienced surgeon with the ability to provide vigilant follow-up.

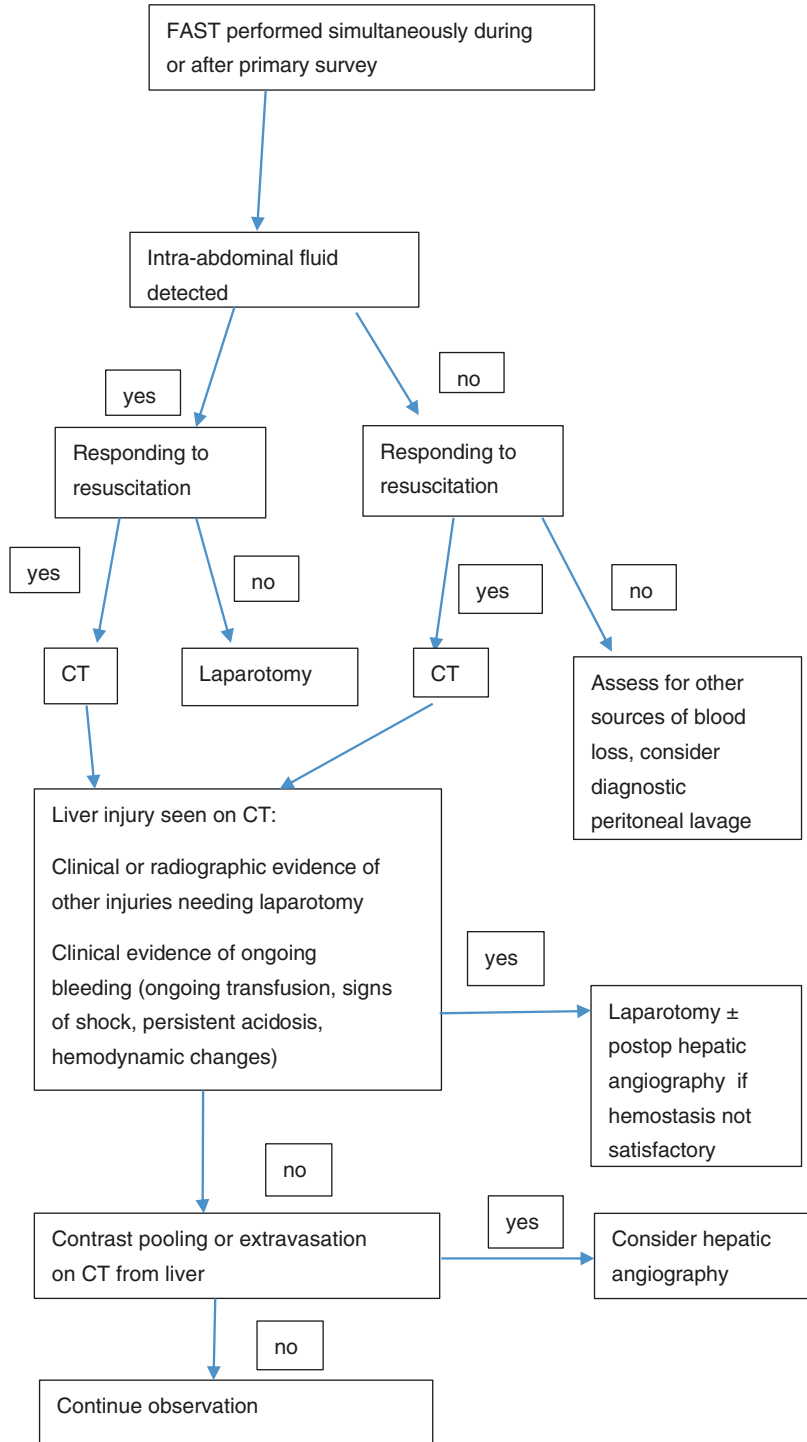
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## The Geriatric Patient: Operative Management of Liver Injury

There is no available evidence to suggest that different operative techniques should be used in elderly patients as opposed to younger patients to control bleeding from the injured liver. However, in general, the elderly have a poorer outcome when operative management is necessary compared to younger patients. Lustenberger et al. [12] compared 34 patients  $\geq 55$  years of age to 124 younger patients with head-Abbreviated Injury Score (AIS) of  $\leq 2$  who received initial damage control laparotomy for predominantly blunt (>90%) injuries: in-hospital mortality rate was significantly higher for elderly patients (29% vs. 4.8%) with the main causes of death being hemorrhagic shock and multi-organ system failure.

Studies comparing younger to older patients in terms of techniques of liver hemostasis in trauma are also lacking. Liver resection, an uncommon technique in trauma, has been evaluated in one study: Tsugawa et al. [13] compared 29 patients >70 years of age and 71 younger patients undergoing anatomic liver resection. The older patients were more severely injured and had a lower mean GCS. The majority of the resections involved right hepatectomy (52% in the older patients vs. 63% in younger patients). Survival was significantly lower in the older group (66% vs. 80%). There were no intraoperative deaths or deaths related to exsanguination in either group. The authors concluded that anatomic resection might still be a viable option in the elderly with blunt liver trauma. This study,

**Fig. 19.1** Blunt liver injury: initial management



however, was notable for its frequent utilization of anatomic liver resection (100/487 or 21%) for blunt liver trauma and poorer outcomes in the elderly.

In contrast, there is more data on elective liver resections. In general, studies show a higher but still acceptable postoperative mortality rate for the elderly compared to younger patients [14–17]. However, in major liver resections ( $\geq 3$  liver segments), the elderly may have poorer outcomes. Reddy et al. [18] found that for major resections, postoperative mortality rates were 8.4% for patients  $\geq 65$  years old and 1.5% in patient 50 years and younger. Age was an independent predictor of postoperative mortality (odds ratio of 1.43 for every 10 years' increase in age). Other predictors included male sex, simultaneous procedure, diagnosis of malignancy, and American Society of Anesthesiologists (ASA) grade. On the other hand, Menon et al. [19] similarly evaluated patients 70 years and older compared to younger patients who underwent major resections with similar 30-day mortality rates (7.9% vs. 5.4%), ICU length of stay, and postoperative complication rates. In this study, ASA grade III and intraoperative transfusion of more than 3 units of blood were predictive of overall survival, not age. Studies of elective liver resection need to be interpreted with caution because of selection bias: details of selection of elderly patients for these major liver procedures are not always available.

## Complications of Hepatic Trauma

There are several well-described complications of liver trauma: delayed hemorrhage [4, 5], bile leak manifesting as bile ascites or biloma [4, 20], hepatic necrosis [21], hepatic failure [5, 19], abscess [5, 22–24], and hemobilia [25, 26]. These complications are more likely to be associated with higher grade liver injuries, whether operatively or nonoperatively managed. Studies comparing hepatic-related complication rates and outcomes of management of these complications between the elderly and younger patients are lacking.

## Summary

The approach to the geriatric patient with liver injury should follow the same principles as that for younger patients. It is important to recognize that although age is associated with failure of NOM in blunt liver injuries NOM is still an acceptable strategy in elderly patients with low NOM failure rates. When operative intervention is necessary, the elderly have poorer outcomes in general. There is very scant evidence available comparing elderly and younger patients in terms of operative techniques, except perhaps liver resection. There is very scant evidence comparing elderly to younger patients in terms of liver-related complications after liver trauma.

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