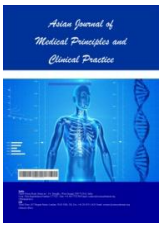

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Mean Arterial Pressure 65 mmHg as A Cut-Off Point for Successful Non-Operative Management of AAST Grade III Liver Injury Associated with Stable Hemodynamic on Blunt Abdominal Trauma Patients (A Serial Case Report)

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Authors' contributions

This work was carried out in collaboration between both authors. Author DAK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DAK and IBB managed the analyses of the study. Author IBB managed the literature searches. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Aims: To report 2 cases of blunt abdominal trauma with AAST Grade III liver injury and the mean arterial pressure as a cut-off point for successful non-operative management of AAST Grade III liver injury associated with stable hemodynamic.

Case Description: 2 cases of blunt abdominal trauma with AAST Grade III liver injury treated in Dr. Moewardi General Hospital Surakarta. The patients performed with stable hemodynamic. The patients were treated conservatively (non-operative). They got resuscitation and their vital signs were monitored strictly. The Mean Arterial Pressure was maintained in 65 mmHg with fluid resuscitation and blood transfusion.

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Discussion: The decision to manage operatively or conservatively was made by evaluating hemodynamic state, not from the result of CT scan. CT scan can be useful for predicting the result of conservative treatment. Mean Arterial Pressure ≥ 65 mmHg can secure the macrocirculation functioning well. Prolonged arterial hypotension can make hypovolemic shock irreversible and increase mortality. In the other side, permissive hypotension during the acute phase of trauma is needed as a part of *Damage Control Resuscitation* to achieve hemostatic condition as soon as possible. We should keep cautious when we choose non-operative management, especially monitor the late complications such as delayed bleeding, DIC, sepsis and the sign of peritonitis that can be the indications to surgery.

Conclusions: The recommended initial target MAP for successful non-operative management of AAST Grade III liver injury associated with stable hemodynamic on blunt abdominal trauma patients is 65 mmHg to avoid prolonged arterial hypotension that can lead to irreversible shock and increase mortality.

Keywords: Non-operative management; liver blunt injury; stable-hemodynamic; mean arterial pressure; permissive hypotension.

1. INTRODUCTION

Approximately 86% of hepatic injuries are treated by laparotomy. At the time of surgery, it is found that bleeding has stopped, and only about 33% of laparotomies are performed on blunt abdominal trauma with suspicion of hepatic injury of therapeutic significance [1]. In addition, the advantages of non-operative therapy, such as lower hospital costs, shorter length of hospital stay, low intra-abdominal complications, and reduced need for transfusion, are the reasons why operative procedure for hepatic injury is become rare [2]. In this article, we will discuss 2 cases of grade 3 liver laceration due to blunt abdominal trauma which were handled nonoperatively at the Dr. Moewardi General Hospital Surakarta between August and September 2019.

2. PRESENTATION OF CASE

2.1 Case 1

A 24-year-old male was brought to the Emergency Department of Dr. Moewardi General Hospital after traffic accident 2 hours before. The patient fell when the motor he was driving collided with another motorbike from the opposite direction. He fell with his chest hitting the pavement. The patient was fully conscious and the history of fainting, vomiting and seizures were denied.

The patient complained of chest pain and a little tightness (*tachypneu*) with a pulse of 110 x/minute and a blood pressure of 100/60 mmHg. On the examination of abdomen, there were lesions and pain in the epigastrium, the abdominal wall was supple, and there were no involuntary muscle rigidity. There were no signs of fracture in the ribs and clavicula. There were no neurological deteriorations.

An Intravenous access and an urinary catheter were placed to assess signs of shock. The blood laboratory examination found a hemoglobin level of 10.6 gr/dl with a leukocyte count of 5.2 thousand/ul and a platelet count of 180 thousand/ul. From chest X-rays and FAST (Focused Assessment with Sonography in Trauma) performed free fluid (+) in the Morrison Pouch and in Cavum Douglas. After that, an Hb examination evaluation was carried out for 3 hours, and then the Hb value was 10.2 gr/dl. A contrast-enhanced abdominal CT scan was performed. A subcapsular hematoma of the liver presented (> 50% of the surface area) and an intraparenchymal hematoma of 11.5 cm in the 4B segment of the right lobe of the liver (according to the stage 3 AAST liver trauma classification). Free fluid was obtained in the abdominal cavity. The distribution of intestinal gas and fecal material was normal.

The patient was managed conservatively (non-operatively) with total bedrest and monitoring the hemodynamic in the High Care Surgical Unit. His vital pulse was monitored, and his blood pressure was maintain with a Mean Arterial Pressure (MAP) at 65 mmHg. Resuscitation and monitoring for signs of acute abdomen were performed. Laboratory test was conducted to evaluate the value of stable hemoglobin levels. The patient was hospitalized for 10 days. He had started the diet at day 2 of treatment and went home at day 10.

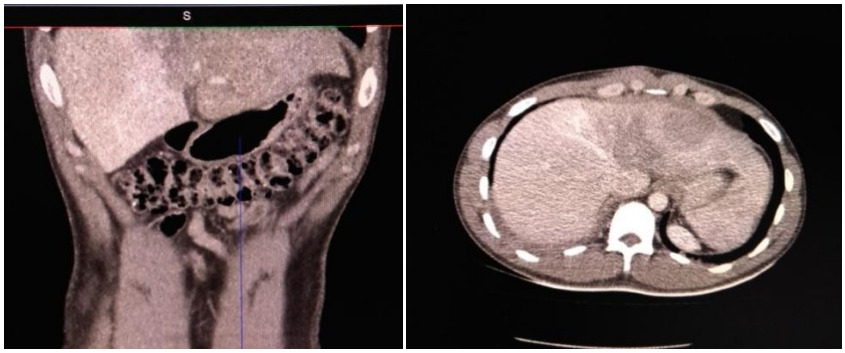


Fig. 1. Subcapsular hematoma > 50% of surface area and 11.5 cm-length intraparenchymal hematoma in segment 4B of the right lobe of the liver (AAST Grade 3)

2.2 Case 2

A 55-year-old woman was referred to Dr. Moewardi General Hospital from Suwondo General Hospital, Pati, Central Java, after having a traffic accident 12 hours before. The patient fell while riding a motorcycle and was hit by a car from the left. The patient fell in an unknown position. There was a history of fainting but no history of vomiting and seizures. After the incident, the patient complained of pain in the head and pelvis. At Suwondo General Hospital, she got infusion, checked in the laboratory (Hb value 9.8 gr/dl), and had chest and pelvic x-rays. Due to limited facilities, she was referred to Dr. Moewardi General Hospital.

At Dr. Moewardi General Hospital, intravenous access and urinary catheter are placed. From the examination, it** 2ndry survey was done **patient was fully conscious, and there was no airway or breathing problem with a pulse of 104 x/minute and a blood pressure of 127/70 mmHg. From X-rays carried out at Suwondo General Hospital, a closed * fracture of the four-ramus pubis was found was found. Abdominal examination revealed lesions in the right hypochondriac region, supple abdominal wall, (no involuntary muscle rigidity,) and tenderness around the lesion. The FAST examination indicated the impression of free fluid in the Morrison Pouch and in Cavum Douglas. In the next laboratory test, the hemoglobin is decreased (8.3 gr/dl). An gr/dl. Then, a contrast abdominal contrast enhancement CT scan was performed. The liver laceration was 3 cm in size 4B and at least 1 cm laceration in segment 5 and hemoperitoneum, and a fracture of the right anterior rib 11 and four ramus pubis fracture was obtained was obtained.

Fractures of the 11th costae and four ramus pubis fractures were managed conservatively by thoracic and cardiovascular and orthopedics department by maintaining the pelvic slings during treatment. Management of blunt abdominal trauma was carried out conservatively (non-operatively) by closely monitoring vital pulse signs and blood pressure by maintaining Mean Arterial Pressure (MAP) at 65 mmHg, resuscitation, and monitoring for signs of acute

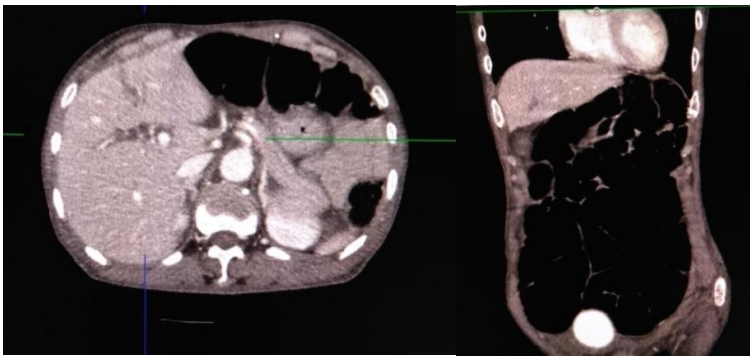


Fig. 2. 3 cm deep laceration in segment 4B (AAST Grade 3) and laceration of at least 1 cm in the 5th segment

abdomen. In the patient transfused with 2 bags (200 ccs) of red cells, the post-correction Hb result was 9.6 gr/dl. The patient was treated for 14 days and was able to go home in a good condition.

3. DISCUSSION

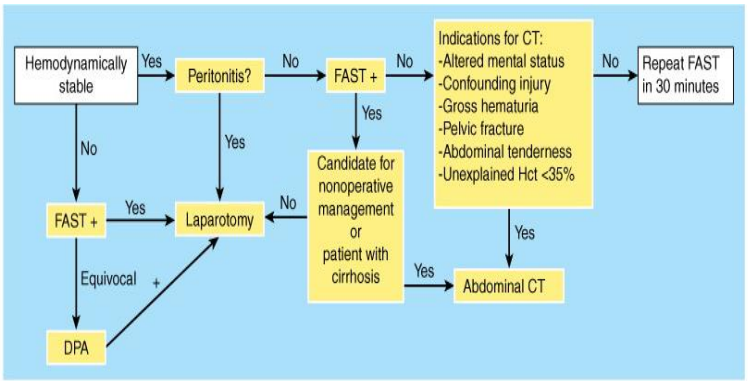
The most common cause of blunt abdominal trauma is accidents. Patients with a history of blunt abdominal trauma, the Surgeons should suspect the possibility of injury to solid or hollow organs. Injury to the liver and spleen is the most common condition (nearly 75%) of solid organ injuries resulting from blunt abdominal trauma [1]. However, compared to injury to the spleen, the management of liver injury still leaves much debate in various study centers. The large size of the liver, the fragile parenchyma, the capsule and the relatively fixed position in the pronation position make liver injury common in blunt abdominal trauma. The right lobe is most injured due to its pronated position and closeness to the ribs. Compression of the ribs, spine, or retroperitoneal wall often results in injury to the segments 6, 7 and 8 of the liver (> 85%) [2].

Pressure on the right hemithorax can also cause contusions in the dome of the liver. The hepatic ligaments that attach to the diaphragm and retroperitoneal wall are also frequently torn in the mechanism of deceleration injury. Trauma to the liver can cause subcapsular/intrahepatic hematomas, lacerations, contusions, hepatic vascular injury and biliary duct injury [3].

Liver injury is common, especially if there is injury to the lower right chest or upper right abdomen. Signs and symptoms that are often encountered in liver injury include signs of blood loss (decreased hemoglobin value) and involuntary muscle rigidity in the upper right abdomen. Peritonismus can appear in some cases such as bile leakage. An increase in the transaminase enzyme can be a marker of injury to the liver although other diseases, such as fatty liver and cirrhosis, can also be found [4].

Patients* patients with blunt abdominal trauma and stable hemodynamics, a more complete radiological examination can be performed. CT scan has become the gold standard in the diagnosis of solid organ injury in blunt abdominal trauma. CT scan can also detect injuries to hollow organs such as the pancreas and gastrointestinal tract and is quite accurate in determining the degree of injury to the liver and surrounding tissue damage that has occurred. The American Association for Surgery of Trauma (AAST) has divided the criteria for liver injury based on the severity assessed from the CT scan [5].

Knudson et al. [4] examined that there was a significant increase in the number of non-operative managements of blunt abdominal trauma with hepatic injury in adult patients. From this study, it was also stated that conservative management of hepatic injury due to blunt abdominal trauma resulted in fewer intraabdominal complications and decreased mortality compared to operative management [6]. In non-operative therapy, there was also less use of blood transfusions. The success rate of non-operative therapy in blunt abdominal trauma patients with liver injury reaches 95% [7].



Source: Brunicardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE: *Schwartz's Principles of Surgery, 9th Edition*: http://www.accessmedicine.com

Algorithm for the initial evaluation of a patient with suspected blunt abdominal trauma. CT = computed tomography; DPA = diagnostic peritoneal aspiration; FAST = focused abdominal sonography for trauma; Hct = hematocrit.

Fig. 3. Algorithm for the initial evaluation of a patient with suspected blunt abdominal trauma

Table 1. CT scan criteria for liver injury based on AAST

Grade	Description
Grade 1	Subcapsular hematoma less than 1 cm in maximal thickness, capsular avulsion, superficial parenchymal laceration less than 1 cm deep, and isolated periportal blood tracking
Grade 2	Parenchymal laceration 1-3 cm deep and parenchymal/subcapsular hematomas 1-3 cm thick
Grade 3	Parenchymal laceration more than 3 cm deep and parenchymal or subcapsular hematoma more than 3 cm in diameter
Grade 4	Parenchymal/subcapsular hematoma more than 10 cm in diameter, lobar destruction, or devascularization
Grade 5	Global destruction or devascularization of the liver
Grade 6	Hepatic avulsion

In both cases, it was found that both patients were in stable hemodynamic status so that even though liver laceration obtained grade 3. Conservative management was carried out, evaluating hemodynamic signs and acute abdomen, and maintaining the Mean Arterial Pressure (MAP) at 65 mmHg. The target MAP ≥ 65 mmHg is a macrocirculation parameter that should generally be reached as soon as possible. MAP is the driving pressure for tissue or organ perfusion. The perfusion of critical organs, such as brain, heart, liver, and kidney, is highly protected from systemic hypotension through regional perfusion autoregulation. However, at certain MAP limits, tissue perfusion becomes linearly dependent on arterial pressure. The recommended initial target MAP in shock patients is 65 mmHg. Prolonged arterial hypotension can cause irreversible shock and increase mortality [8]. In this case, fluid resuscitation and transfusion both play a role in maintaining MAP ≥ 65.

However, permissive hypotension in fluid resuscitation of traumatic patients with hemodynamically stable signs can reduce mortality and increase output when compared to patients receiving aggressive fluid resuscitation [9]. The concept of permissive hypotension is a limitation of the amount of fluid administered during the resuscitation process to bleeding trauma patients of maintaining blood pressure below normal [10]. This is maintained during the acute phase of trauma. Resuscitation with permissive hypotension is also a part of Damage Control Resuscitation which aims to prevent iatrogenic lesions, worsening shock and achieve immediate hemostasis [11]. The European Guidelines for Management of Major Bleeding recommend a limited fluid administration strategy to achieve a systolic blood pressure of 70-90 mmHg with the target of MAP 50-65 mmHg until the acute phase is over [12].

High systolic pressure as a result of aggressive resuscitation in the acute phase can run the risk of increasing thrombus release (blood clot) which helps control further bleeding [13]. Aggressive resuscitation will also dilute the coagulation factor which makes the clot formed unstable. In addition, this can trigger hypothermia which also aggravates the patient's systemic condition [14]. However, the management of permissive hypotension in patients with a history of high blood pressure and* patients with advanced trauma has a higher risk of death, associated with decreased coronary artery prefusion and ischemic conditions in the heart, thereby increasing the risk of myocardial infarction [12].

It should also be realized that with the choice of conservative therapy, it is still necessary to evaluate the possible risk of cavity organ injury and the risk of delayed hemorrhage. Patients who are initially treated with conservative measures, when it is found that there is no sign of improvement, need to immediately do a deeper analysis for the possibility of operative action [15,16,6].

Operative management is performed for liver injury where there is an unstable hemodynamic status despite adequate resuscitation.

Laparotomy is the preferred procedure [17] Liver bleeding can be controlled by direct pressure using a pack. Additional techniques can be performed such as Pringle manoeuvre, bimanual compression of the liver, or manual compression of the aorta over the coeliacus trunk. Intravascular volume replacement and correction of coagulopathy with PRC, platelets, FFP and cryoprecipitate are crucial [18]. If definitive control of bleeding from hepatic injury cannot be stopped, perform perihepatic packing immediately, close the surgical incision and refer to a higher type of hospital [19].

The use of primary sutures and ligation with a liver needle is also quite effective in obtaining hemostasis. Stone and Lamb (1975) reported the use of omentum as a pedicle flap to fill in defects in torn hepatic parenchyma [19]. Selective ligation of the hepatic artery is performed if other techniques have failed. When the Pringle manoeuvremaneuver fails to stop bleeding, total vascular exclusion clamping IVC (suprahepatic cava), venovenous bypass, or atriocaval shunting can be performed [20,8].

Further complications of hepatic trauma are often missed on initial examination and may arise later. Sepsis complications, such as intraabdominal abscess and bile leakage, often appear as a follow-up complication. Bleeding, blood coagulation disorders including DIC, arterioportal fistula and sepsis due to biliary infection, bile peritonitis, necrotic hepatic tissue are examples of further complications [8,12].

4. CONCLUSION

The advancement of radiology as both a diagnostic tool and an intervention has made conservative therapy the main choice in the management of liver injury today. The decision to manage operatively or non-operatively is made based on the patient's hemodynamic status, not the severity detected by CT scan. The use of CT scanning is quite helpful in predicting the success of non-operative management. The recommended initial target MAP for successful non-operative management of AAST Grade III liver injury associated with stable hemodynamic on blunt abdominal trauma patients is 65 mmHg to avoid prolonged arterial hypotension that can lead to irreversible shock and increase mortality. However, permissive hypotension with the target of MAP 50-65 mmHg in acute-phase trauma patients can reduce mortality and increase outcomes when compared with patients receiving aggressive fluid resuscitation.

CONSENT AND ETHICAL APPROVAL

As per university standard guidelines, participant consent and ethical approval have been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Morales Uribe CH, López CA, Cote JCC, Franco ST, Saldarriaga MF, Mosquera J, et al. Tratamiento del traumatismo cerrado de hígado, indicaciones de cirugía y desenlaces. Cir. Esp. 2014;92:23–9.
2. Negoi I, Paun S, Stoica B, Tanase I, Vartic M, Negoi RI, et al. Latest progress of research on acute abdominal injuries. J. Acute Dis. 2016;5:16–21.
3. Chastang L, Bège T, Prudhomme M, Simonnet AC, Herrero A, Guillon F, et al. Le traitement non opératoire des traumatismes spléniques sévères fermés est-il le moins morbide ? Résultats d'une étude prospective multicentrique. J. Chir. Viscerale 2015;152:86–92.
4. Duron V, Stylianos S. Strategies in liver trauma. Semin. Pediatr. Surg. 2020;29:150949.
5. Saqib Y. A systematic review of the safety and efficacy of non-operative management in patients with high grade liver injury. Surgeon. 2020;18:165–77.
6. Edwards A, Hammer M, Artunduaga M, Peters C, Jacobs M, Schlomer B. Renal ultrasound to evaluate for blunt renal trauma in children: A retrospective comparison to contrast enhanced CT imaging. J. Pediatr. Urol. 2020;16:557.e1-557.e7.
7. Sorour MA, Kassem MI, Ghazal AH, Azzam A, El-Khashab E-SI, Shehata GM. Conservative approach in the management of isolated penetrating liver trauma. Alexandria J. Med. 2013;49:125–32.
8. Kumar V, Mishra B, Joshi MK, Purushothaman V, Agarwal H, Anwer M, et al. Early hospital discharge following non-operative management of blunt liver and

splenic trauma: A pilot randomized controlled trial. Injury. 2021;52:260–5.
9. Selim YARM, Albroumi SA. Initial multidetector computed tomography of blunt splenic injury: Impact on management. Egypt. J. Radiol. Nucl. Med. 2015;46:573–80.
10. Azzam AZ, Gazal AH, Kassem MI, Souror MA. The role of non-operative management (NOM) in blunt hepatic trauma. Alexandria J. Med. 2013;49:223–7.
11. Koganti SB, Kongara R, Boddepalli S, Mohammad NS, Thumma V, Nagari B, et al. Predictors of successful non-operative management of grade III & IV blunt pancreatic trauma. Ann. Med. Surg. 2016;10:103–9.
12. Kopljar M, Ivandić S, Mesić M, Bakota B, Žiger T, Kondža G, et al. Operative versus non-operative management of blunt pancreatic trauma in children: Systematic review and meta-analysis. Injury; 2020.
13. Mancini A, Duramé A, Barbois S, Abba J, Ageron FX, Arvieux C. Relevance of early CT scan diagnosis of blunt diaphragmatic injury: A retrospective analysis from the Northern French Alps Emergency Network. J. Visc. Surg. 2019;156:3–9.
14. Shimizu D, Yamano T, Kudo Y, Kuroda M, Takagi S, Ikeda E, et al. Diagnostic and therapeutic role of endoscopic retrograde pancreatography and stent placement for grade IV blunt pancreatic trauma: A case report. Trauma Case Reports. 2020;28:100319.
15. Kong Y, Zhang H, He X, Liu C, Piao L, Zhao G, et al. Endoscopic management for pancreatic injuries due to blunt abdominal trauma decreases failure of nonoperative management and incidence of pancreatic-related complications. Injury. 2014;45:134–40.
16. Zakaria HM, Oteem A, Gaballa NK, Hegazy O, Nada A, Zakareya T, et al. Risk factors and management of different types of biliary injuries in blunt abdominal trauma: Single-center retrospective cohort study. Ann. Med. Surg. 2020;52:36–43.
17. Liechti R, Fourie L, Stickel M, Schrading S, Link BC, Fischer H, et al. Routine follow-up imaging has limited advantage in the non-operative management of blunt splenic injury in adult patients. Injury. 2020;51:863–70.
18. El-Matbouly M, Jabbour G, El-Menyar A, Peralta R, Abdelrahman H, Zarour A, et al. Blunt splenic trauma: Assessment, management and outcomes. Surgeon. 2016;14:52–8.
19. Kunhivalappil FT, Hefny AF, Abu-Zidan FM. Management of blunt adrenal gland injury in a community-based hospital. Injury. 2019;50:1049–52.
20. Notrica DM, Linnaus ME. Nonoperative management of blunt solid organ injury in pediatric surgery. Surg. Clin. North Am. 2017;97:1–20.

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