Letter to Editor

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Avoidance of 'Mishra Phenomenon' Prevents Technical Failure of Hepatic Artery Angioembolization following Failed Perihepatic Packing in Traumatic Liver Injury

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Dear Editor

Ours is a level I Trauma Center. During the initial phase of our angiography facility around seven years ago, we encountered two adult male patients (patient 1: 50yr/male, May 2009, and patient 2: 18yr/male, January 2010) with hemorrhagic shock secondary to road traffic injury (RTI) and they underwent exploratory laparotomy. Damage control surgery (DCS) was done in the form of perihepatic packing (PHP) for bleeding liver (grade IV injury). Both patients continued to bleed and therefore were taken to angiography suit for hepatic angiography and angioembolization (HAAE). Despite repeated efforts by our experienced interventional radiologists, the angiography catheter could not be negotiated through the coeliac trunk and beyond (Figure 1 and 2) and hence HAAE were abandoned. Interestingly blood flow through the common hepatic artery (CHA) and contrast blush were demonstrated in the angiography images. The cause for the technical failure of negotiation of the tip of angiography catheter through the coeliac trunk and CHA could not be ascertained at the time. These cases were retrospectively analyzed by one of the authors (BM), and he suggested the cause to be 'extrinsic compression of lesser omentum (hepatoduodenal, HD and hepatogastric, HG ligaments) by sponges/packs used during PHP for liver hemorrhage leading to difficult or unsuccessful maneuvering of angiography catheter through coeliac trunk or common hepatic artery (CHA) or hepatic artery (HA)' and named it as 'Mishra phenomenon'. The compressing sponges were also seen in the angiographic images around the coeliac trunk and CHA (Figure 1B and 2B). Thereafter we adopted the management policy of avoidance of packing surgical sponges around the porta or lesser omentum.

In the last seven years we have performed 152 HAAE out of which 62 were done after PHP and 90 were done without PHP i.e. in vitally stable patients, mostly prophylactically. Fortunately no such technical failure was observed for the next seven years. Unfortunately we observed another such failure recently in a 20yr/male with blunt trauma and grade III liver injury with packing of surgical sponges around the lesser omentum – another example of Mishra phenomenon (Figure 3).

General Principles of MANAGEMENT of Liver Injuries

The management protocol of abdominal/liver injury followed in our center is robust and evidence

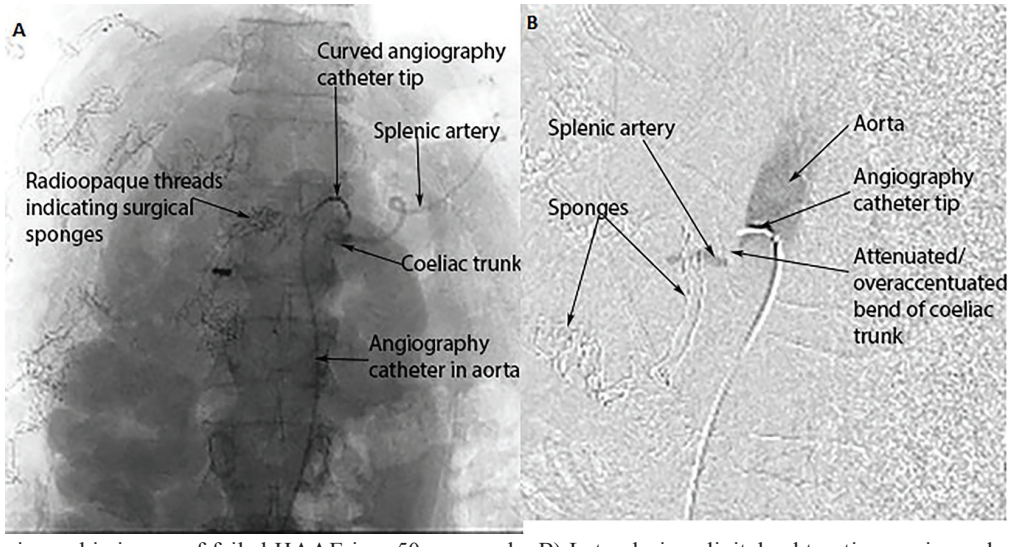

Fig. 1. A) Angiographic image of failed HAAE in a 50 year male; B) Lateral view digital subtraction angiography (DSA) of the same patient.

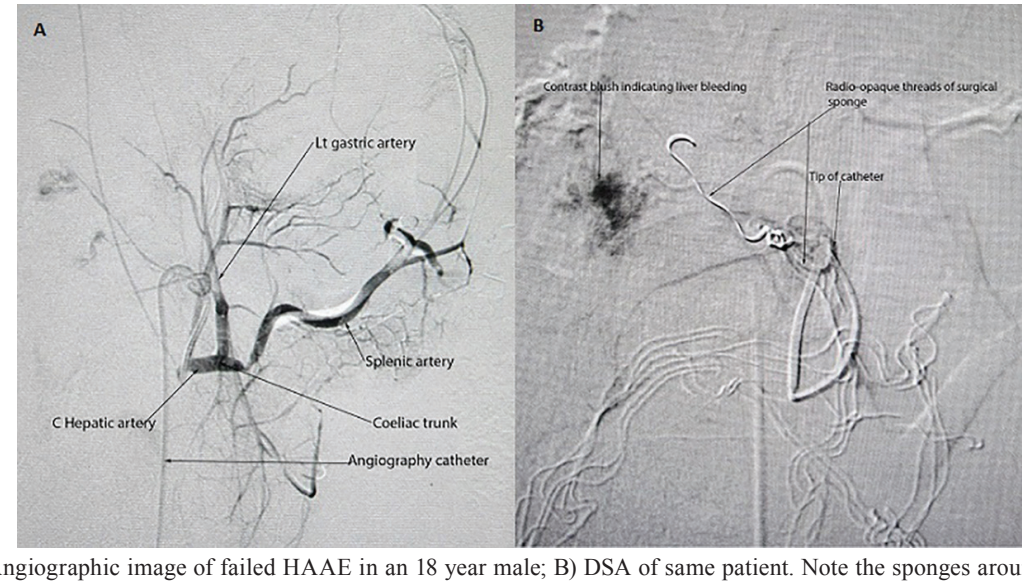

Fig. 2. A) Angiographic image of failed HAAE in an 18 year male; B) DSA of same patient. Note the sponges around the coeliac trunk and contrast extravasation from right HA.

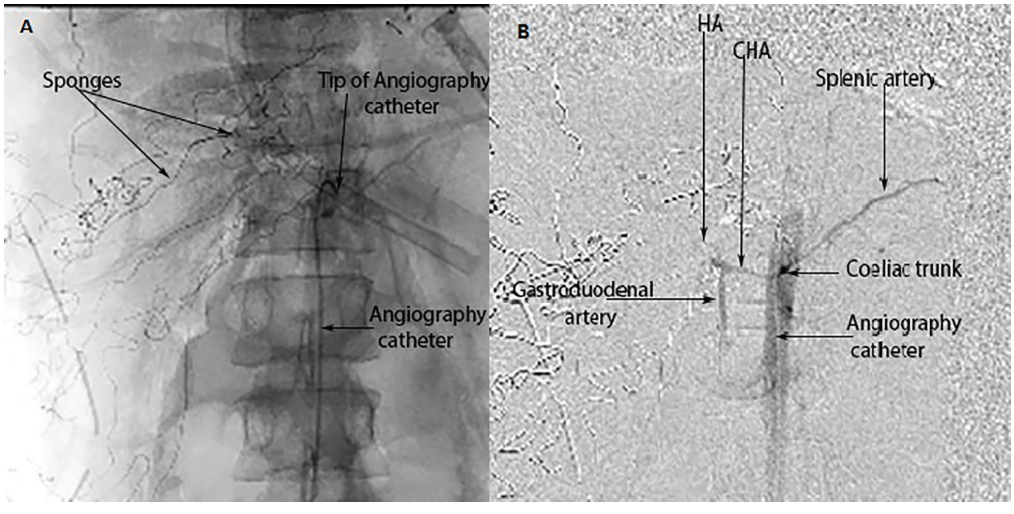

Fig. 3. A) Angiographic image of failed HAAE in 20 year male; B) DSA of same patient showing attenuated and compressed CHA and HA.

based (Figure 4). The initial management is based on primary survey of 'Advanced Trauma Life Support' (ATLS) rather than 'liver injury'. If FAST (Focused Assessment Sonography in Trauma) is positive (for abdominal windows) with unstable vitals even after resuscitation, patient is shifted to Operating

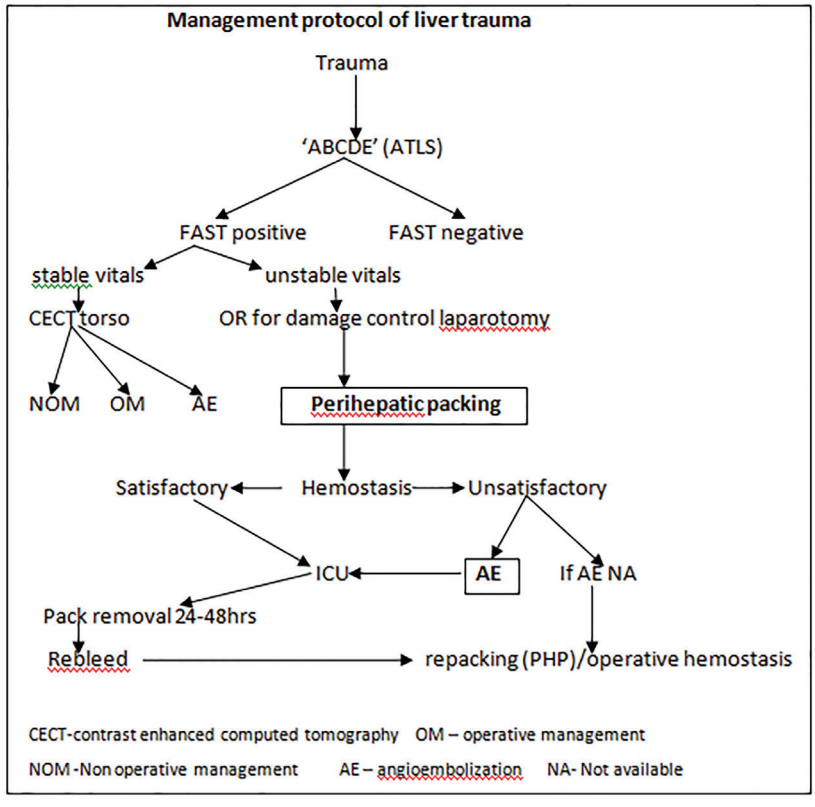

Fig. 4. Flowchart showing management protocol of liver trauma in JPN Apex Trauma Center, AIIMS, New Delhi.

Room (OR) for exploratory laparotomy, thus if liver injuries are present, they are diagnosed intra-operatively. If liver injury is significant PHP is done (after other maneuvers like bimanual compression of liver, Pringle maneuver and temporary sponge packing) based on DCS principles and subsequently patient is shifted to intensive care unit(ICU) with continuation of resuscitation including transfusion of blood and blood products as required. These sponges are removed in OR after 24-48 hours following optimization of hypothermia, coagulopathy and acidosis.

The goal of PHP is to compress the liver especially the injured part after its 'fracture reduction' in such a way that tamponade is maintained to effect hemostasis, at the same time not to compromise the blood flow (especially the micro-circulation) to its tissue by excessive pressure which may lead to hepatic necrosis (It is highly probable that this fact is under-reported in literature and many cases of hepatic necrosis may have been wrongly attributed solely to HAAE only [1-3]. We believe that hepatic necrosis occurs mostly due to combination of factors like liver trauma itself, shock, tight PHP, HAAE and vasoconstriction secondary to ionotropes if used). The technique involves systematic placement of folded surgical sponges around the liver from multiple directions: between diaphragm & liver, between anterior and lateral abdominal walls and liver, between hepatic flexure of colon and inferior surface of liver [4]. Some use modified versions of PHP like complete mobilization of right lobe and sponge placement all around the posterior paracaval surface avoiding IVC compression [5].

We discourage exploration of liver fracture and intra-hepatic packing. Most of the packed liver will achieve hemostasis in time but there is a subgroup of patients who will continue to bleed in spite of adequate PHP. Managing this group of patients is a nightmare for surgeons. One of the best strategies in such situations is HAAE [2, 3, 6]. But this option may be compromised if lesser omentum is compressed by surgical sponges during PHP.

The Procedure of Angiography

It is done by the Interventional Radiologist. The patient is shifted to the angiography suit or to angiography compatible OR. The femoral artery is cannulated by 5F angiography catheter (reverse curve 1) (Figure 5) followed by catheterization of the external iliac artery (EIA) →common iliac artery (CIA)→aorta→coeliac trunk→common hepatic artery →hepatic artery→'selective' branch of hepatic artery (Figure 6A).

The Most Plausible Cause for Failure of Catheter Negotiation

The coeliac trunk, CHA and HA are draped by the lesser omentum (Figure 6B). Therefore during PHP, sponges may easily compress upon the lesser omentum especially if packed too tightly and this may also accentuate the bends of these arteries. The compression is usually 'mild enough' not to compromise the arterial blood flow to the liver

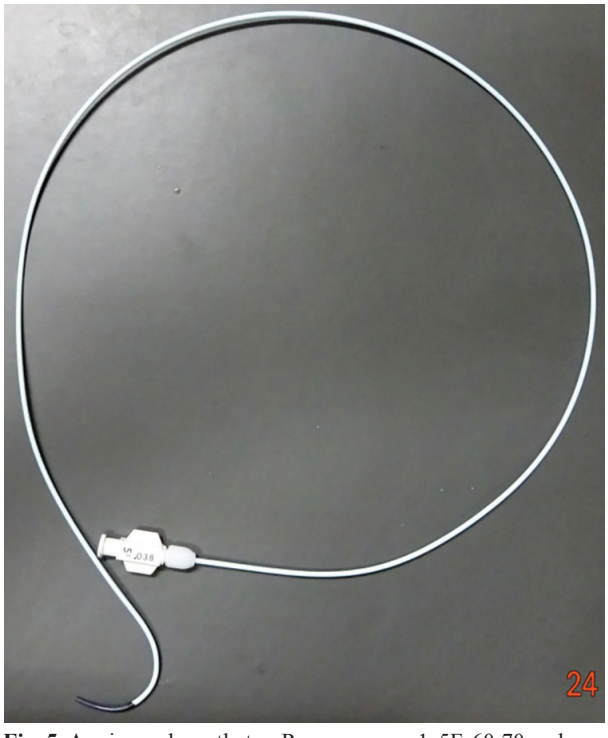

Fig. 5. Angiography catheter: Reverse curve 1, 5F, 60-70cm long.

but 'just enough' to cause failure of negotiation of angiography catheter tip through them and through their bends which needs delicate maneuvering.

Need for Further Research and Education

To the best of our knowledge and after detailed search of the internet, we could not find appropriate literature on 'causes of abandonment/technical failure of HAAE/ pitfalls of HAAE'[2, 3, 7-10]. We sincerely hope that such cases may be looked for both retrospectively and prospectively as this phenomenon is probably being under-reported and unrecognized. We also feel that there should be appropriate collaboration between surgeons and interventional radiologists.

Conclusion and Recommendation

HAAE is one of the best management strategies for patients who continue to bleed from liver even after PHP. Therefore the technical success of HAAE itself plays an important role but this option can be compromised if 'Mishra phenomenon' is not taken care of by the surgeons. There is an urgent need to recognize this phenomenon and prevent it by avoiding PHP around the lesser omentum (which is unwarranted and easily avoidable) and disseminate this knowledge without which incidence of these cases may even increase with the increase in popularity of HAAE with time.

Conflict of Interest: None declared.

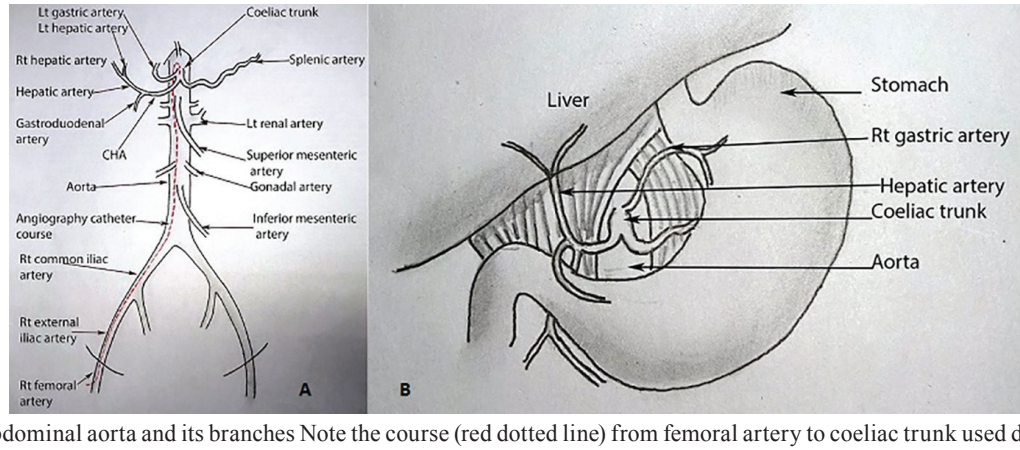

Fig. 6. A) Abdominal aorta and its branches Note the course (red dotted line) from femoral artery to coeliac trunk used during HAAE; B) Coeliac trunk and its branches in relation to liver and stomach as seen after removal of lesser omentum

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