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Angio Embolisation In Traumatic and Non-Traumatic Indications - A Case Series Analysis

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Abstract

Background

Surgery has been primary modality of treatment for various conditions. However over past few decades less radical and less invasive techniques have gained significant role in management.

Patients & Methods

Data regarding patients who underwent Non-Operative Interventions (NOI) or Non-Operative Management (NOM) in Safdarjung hospital, New Delhi, India over past 3 years was collected retrospectively from hospital database. A Case series analysis of the historical patient records was done.

Results

A total of 15 patients had undergone angio-embolisation, of which 80 % were splenic artery embolisation and 20% had hepatic artery embolization (HAE). Three patients underwent SAE for non-traumatic causes. Among splenic injuries grade IV injuries were more common (44.4%) whereas grade III was most common (60%) among liver injuries.

Conclusions

Non operative Interventions have revolutionized management of several entities for which surgery was sole resort until few decades back. However, these facilities come with their own set of limitations. Availability of embolisation in developing nations is of concern. There is a paucity in literature in the developing world regarding outcome of embolisation in traumatic and non-traumatic patients.

Keywords
surgery, intervention radiology, Non-operative-management, Non- operative-interventions

Background

Surgery has been primary modality of treatment for various conditions. However over past few decades less radical and less invasive techniques have gained significant role in management.

Spleen is the most common organ injured during blunt trauma to abdomen. Blunt Splenic Injury (BSI) is one of most common entity encountered in trauma centers and emergencies around the globe. Whilst the management of the same has remained surgical, improved radiological amenities have abled us to take less radical course during past few decades.[1] Classically all splenic injury patients underwent surgery, in the form of exploratory laparotomy. [2] Splenic injury was assessed intraoperatively and depending upon severity of injury it was either preserved, partially removed, or removed in toto. It also provides an opportunity to address any other visceral injury associated with the trauma.

Removal of spleen was done liberally in patients with BSI previously. Splenectomy was however associated with complications like subphrenic abscess, pancreatic fistulas and OPSI (Overwhelming Post Splenectomy Infections). OPSI is common in asplenia, more commonly following splenectomy in patients with hematological disorders. High mortality and morbidity conferred by these complications have prompted us to manage BSI patients expectantly. [3,4,5]

Expectant management in trauma patients have evolved into what is now known as non-operative management (NOM). NOM developed in late 20th century with better understanding regarding immunological function of spleen and its correlation with OPSI. It was initially limited to children. Patients were admitted, strict vital monitoring and bed rest was followed. Deteriorating general condition and vitals would be end points of conservative management and patient would be taken up for surgery. [6,7]

However, with introduction of Contrast Enhanced CT scan, angiography, and embolization, it became possible for trauma surgeons to manage these patients with interventions that prevented surgery. [8] These procedures are known as Non-Operative Interventions (NOIs) and are essential part of NOM. Studies have shown that addition of NOI to NOM have reduced its failure rates. They have also proved their role in other solid organ injuries of abdomen like hepatic and renal injuries. They also come in handy in management of non-traumatic rupture of spleen and pseudoaneurysms of splenic vessels because of chronic pancreatitis. [9,10,11] Laparotomies are independently associated with postop morbidity in the form of lung atelectasis, wound dehiscence, anesthesia related complications and increased hospital stay. [3,12] Apart from NOIs done to replace surgical procedures, some are done as an adjunct to add to therapeutic advantage. This includes embolization of feeder vessels to malignancy or Superior mesenteric artery stenting in patients with gangrenous bowel. [3,13]

Methods

Data regarding patients who underwent NOI or NOM in VMMC and Safdarjung hospital, New Delhi, India over past 3 years was collected retrospectively from hospital database. Data regarding patients who underwent embolisation for both traumatic and non-traumatic causes was included. A Case series analysis of the historical patient records was done.

Embolization:

Among patients with blunt trauma abdomen only those who were hemodynamically stable Mean Arterial Pressure (MAP) >65mm of Hg and pulse rate < 90/ min) are opted for Non operative management. All blunt trauma patients underwent Focused Assessment Sonography for Trauma (FAST) in emergency regardless of hemodynamic status. Hemodynamically stable patients underwent Contrast Enhanced CT scan of abdomen coupled with CT angiography. AAST grading of patients coupled with hemodynamic status and hematocrit levels determines whether patient goes for surgery or NOM.

Arterial Embolization: Right femoral artery is commonly used for arterial access in these patients. Celiac axis was cannulated using 5 French catheter under fluoroscopic guidance. Splenic or hepatic artery was visualized depending on the site of interest. Vessel wall is then observed for pseudoaneurysms and active contrast extravasation with the help of an angiogram. Embolization of the desired vessel was subsequently done with gelfoam, coil or both. Post procedure, angiogram is done look for any leaks, sheath is removed, and hemostasis is ensured.

Collected data included Demographic details, Physiological parameters, Radiological images and reports (e.g., AAST severity of injury), NOI done and Failure of procedure. Transfusion of blood products was not considered as failure of procedure. Data collected was analyzed in Microsoft Excel.

Results

Over 3 years from 2018-2021, a total of 15 patients had undergone NOI with the help of arterial embolization. Mean age of patients who underwent NOI was 30.8 SD 11.8 (range 18-60). It is worthwhile noting that extremes of age <18 years and >60 years are absent. This could be correlated with lower incidence of trauma and early onset of hemodynamic instability due to poor reserves in these age groups. 14 out of 15 (93.33%) study subjects were gentlemen.

Out of 15, 12 patients (80 %) had undergone embolization of splenic artery and 3 patients (20%) had Hepatic Artery Embolization (HAE). 3 patients who underwent SAE (20% of total) had indications like pseudoaneurysm following chronic pancreatitis for the procedure. (**Figure 1, Table 1**) Since they were hemodynamically stable, they underwent CECT whole abdomen with CT angiography. Seven patients had isolated splenic injury, 3 patients had isolated liver injury and 2 patients had isolated both liver and splenic injury. AAST grading of solid organ injuries were assessed in these patients. Distribution of AAST grades in these patients is shown in **figure 2** and **table 2**. Among splenic injuries grade IV injuries were more common (44.4%) followed by grade III (33.33%). Among liver injuries grade III was most common (60%). It is notable

that Grade V injuries are not seen in either group, owing to hemodynamic instability by the time these patients present to emergencies.

Embolization of arteries were achieved with help of Coils, Gelatin foams or both. Coils were more commonly used (53.33%). (**Figure 3**) Both coils and gelfoams are placed under fluoroscopic guidance and post procedure angiogram done in these showed coils and no active extravasation of contrast. (**Figures 4,5,6**) 83.33% of SAE was done proximally.

Three patients underwent hepatic artery embolization, which was 20% of total arterial embolizations done in the institute. All these patients sustained injury post Motor Vehicular Accident (MVA). Documented complications post embolization of hepatic artery includes hepatic necrosis, abscess, and bile leak. [13] These were however not encountered in our setting.

None of these patients developed any distress or hemodynamic instability during the procedure. Post procedure extravasation of contrast or rebleeding never occurred in any of these patients. None of the patients required exploration post procedure.

Other instances where intervention radiology came in handy:

- Forty year old gentleman came to emergency with complaints of pain abdomen associated with non-passage of stool and flatus. As part of workup, he underwent CECT of abdomen which revealed thrombus occluding coeliac axis. Dilated small bowel loops and a segment of non-enhancing bowel was present suggestive of bowel gangrene. Patient was taken up for exploratory laparotomy which revealed a foot of jejunum which was gangrenous. Gangrenous bowel was resected, and division loop ileostomy was made. On postoperative day 1, patient underwent angiography and catheter directed thrombolysis. **Figure 7** shows the fluoroscopic image in which normal blood supply of bowel in restored.

- Twenty four year old gentleman presented with swelling in lower back which turned out as malignant connective tissue tumor. On presentation the tumor was oozing blood through ulceration. (**Figure 8**) Initially it was managed by compression dressing. Preoperatively angioembolization of arterial feeders was done to minimize intra operative bleeding.

Discussion

Arterial embolization has been around for the past few decades. Their availability in trauma centers around the globe has supported conservation of spleen in both traumatic and non-traumatic settings, where splenectomy would have been done earlier. However only few studies could be found, especially from the developing world regarding its use and efficacy. [14,15]

A study done in 2012, revealed secondary splenectomy rate of 4% among BSI patients managed with SAE as compared to 15% among those who underwent NOM without SAE.[16] Some studies have shown secondary splenectomy rates up to 25% among patients who were managed with NOM without any NOI. [17] The present

study is comparable to above mentioned study, with no patients requiring secondary splenectomy following SAE. Lower incidence of failure could be attributed to lack of grade V solid organ injuries in study group. Patients with Grade V injuries of spleen did not meet inclusion criteria for arterial embolization due to hemodynamic instability.

Multi Centre review had revealed 3 % incidence of splenic abscess post SAE. Other documented complications of arterial embolization are migration of coil and arterial dissection. None of these were encountered in any of these patients. Which is comparable to study mentioned before. [17]

Though in lower numbers SMA stenting (for thrombus) and embolization of feeder vessels of malignancy were also done in the study period. All these procedures have proved to be an efficient adjunct to surgical options and helped in reducing morbidity of patients that would have occurred otherwise.

Conclusions

Non-Operative Interventions have revolutionized management of several entities for which surgery was sole resort until few decades back. Present study with its own limitation in terms of its study design. However, it shows that embolisation has limited or close to null failure rate when done in hemodynamically stable patients. Complication rates of embolisation in trauma patients were also not encountered in this study.

However, these facilities come with their own set of limitations. Expectant management of trauma patients mandates round the clock availability of Operation theatre, blood bank, surgeon, and laboratory. There is always risk of mortality in delaying operative decisions in patients requiring surgical intervention. Hence identifying patients who need either modality of management is of paramount importance. Availability of embolisation in developing nations is of concern. In places where the facility maybe present, round the clock availability maybe an issue. There is a paucity in literature in the developing world regarding outcome of embolisation in traumatic and non-traumatic patients.

List of abbreviations:

Abbreviation	Expansion
NOI	Non-Operative Interventions
NOM	Non-Operative Management
SAE	Splenic Artery Embolisation
BSI	Blunt Splenic Injury
OPSI	Overwhelming Post Splenectomy Infections
MAP	Mean Arterial Pressure
FAST	Focused Assessment Sonography for Trauma
HAE	Hepatic Artery Embolization
MVA	Motor Vehicular Accident
AAST	American Association of Surgery for Trauma

Declarations

Ethics approval and consent to participate:

Not applicable

Consent for publication:

Not applicable

Availability of data and material:

Materials and data not uploaded in any online portal due to fear breech of patients data.

Competing interests:

No competing interests.

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Authors' contributions:

First, second, third and fourth authors were involved in analysis of data and incites in to the problem statement. Fifth, sixth, seventh and eighth authors were involved in data collection and data entry.

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FIGURES & TABLES

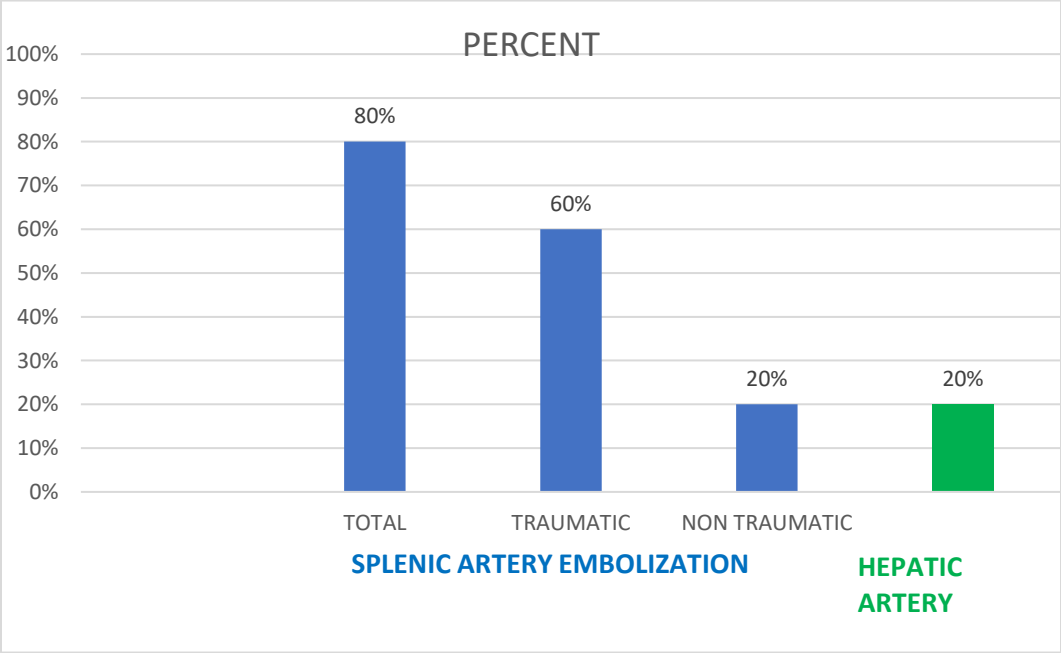

Figure 1: Distribution of arterial embolization

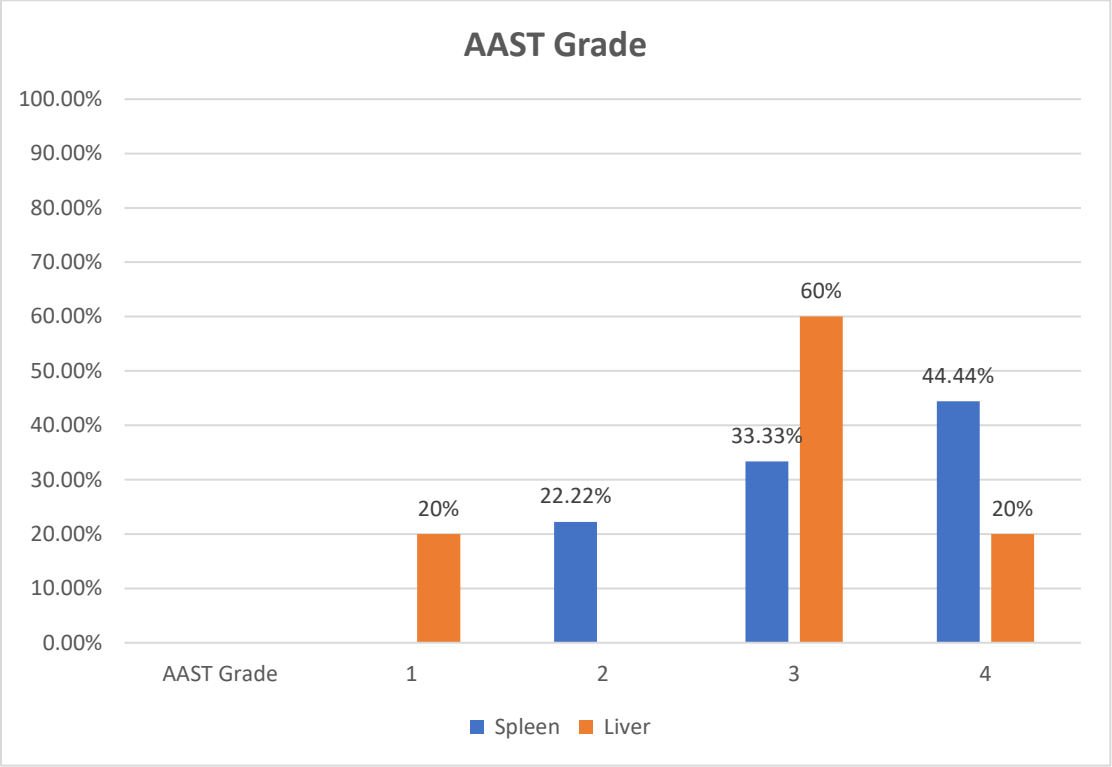

Figure 2: Distribution of AAST Grade of injury to spleen and liver

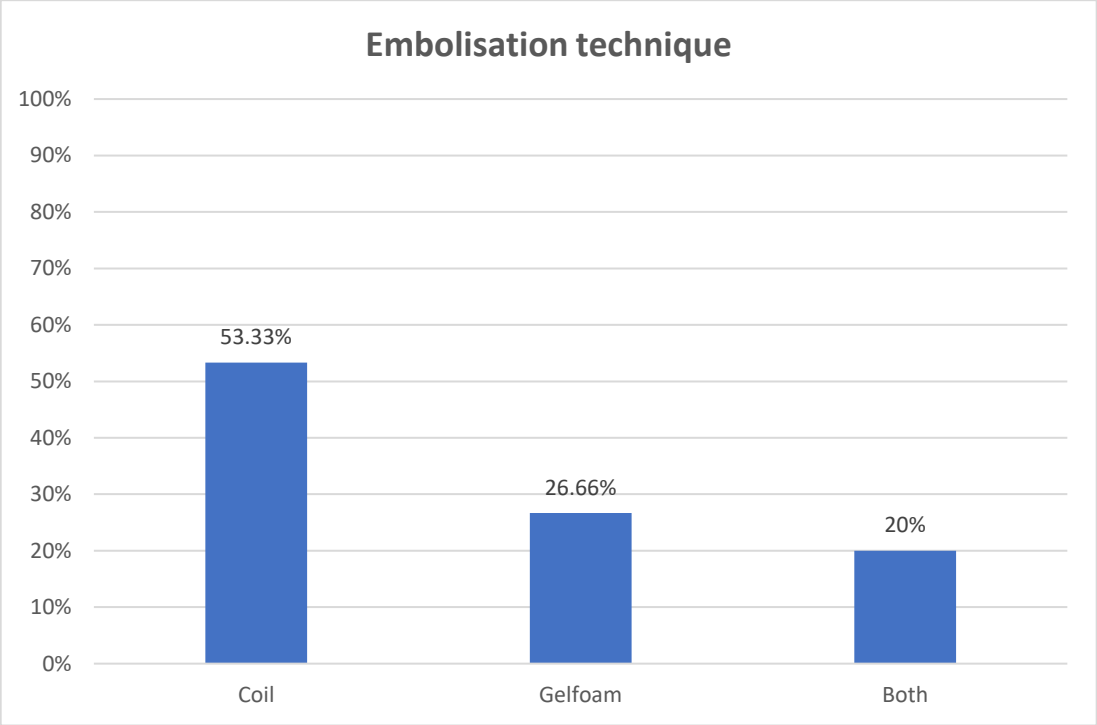

Figure 3: Embolization agent used

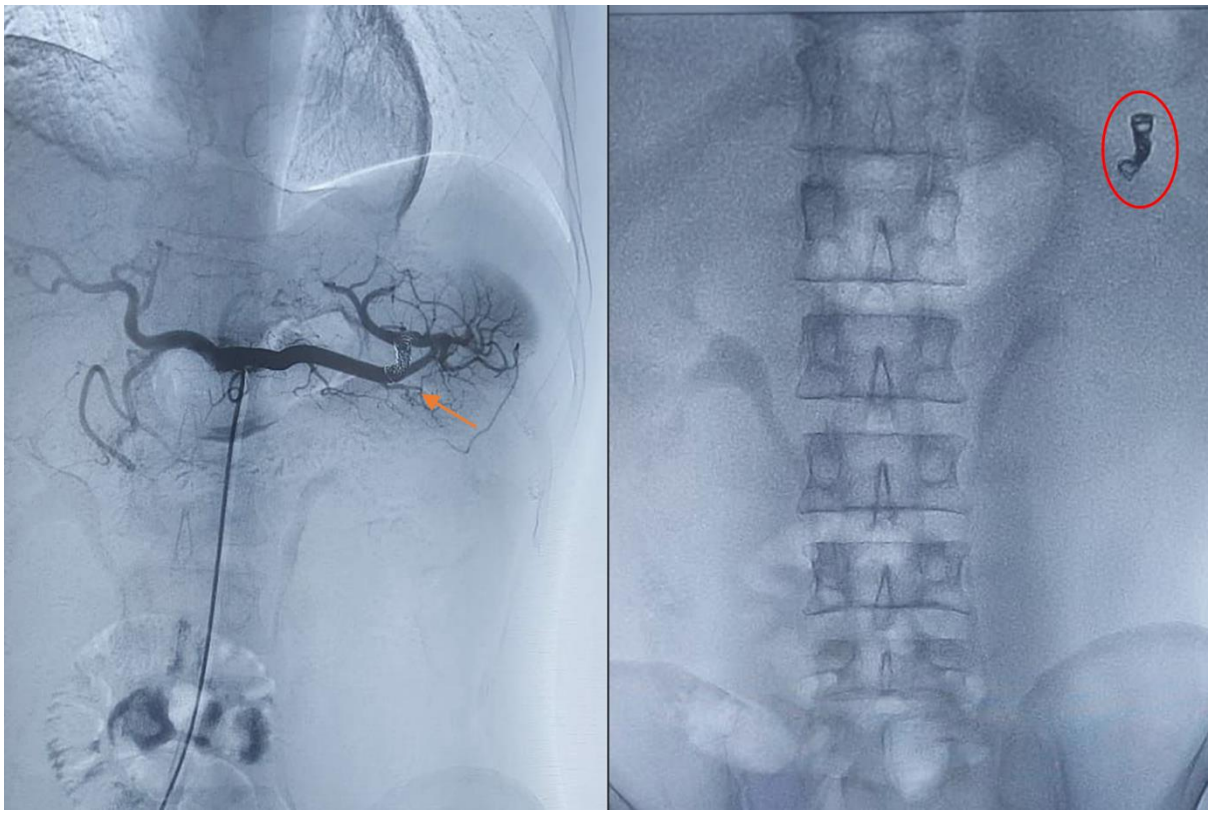

Figure 4: angiography followed by coil placement (left, arrow mark), fluoroscopy image following coil placement in follow-up (right, circled)

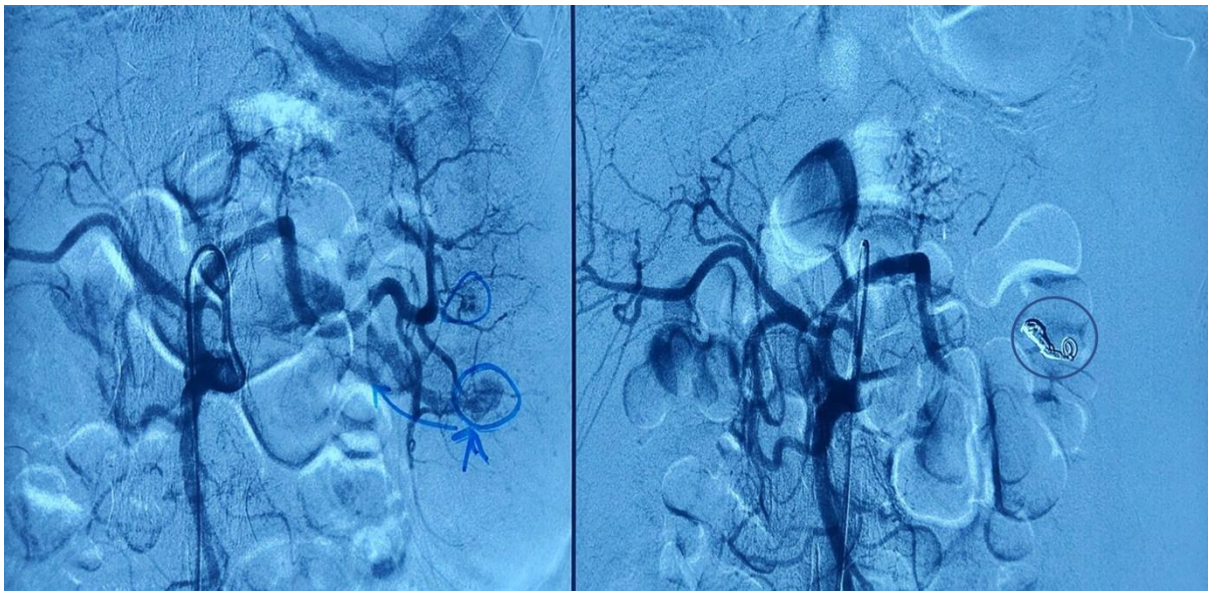

Figure 5: Splenic artery is dilated and tortuous with multiple pseudo aneurysms (marked blue): left, proximal splenic artery embolization done with coil placement: right (circled)

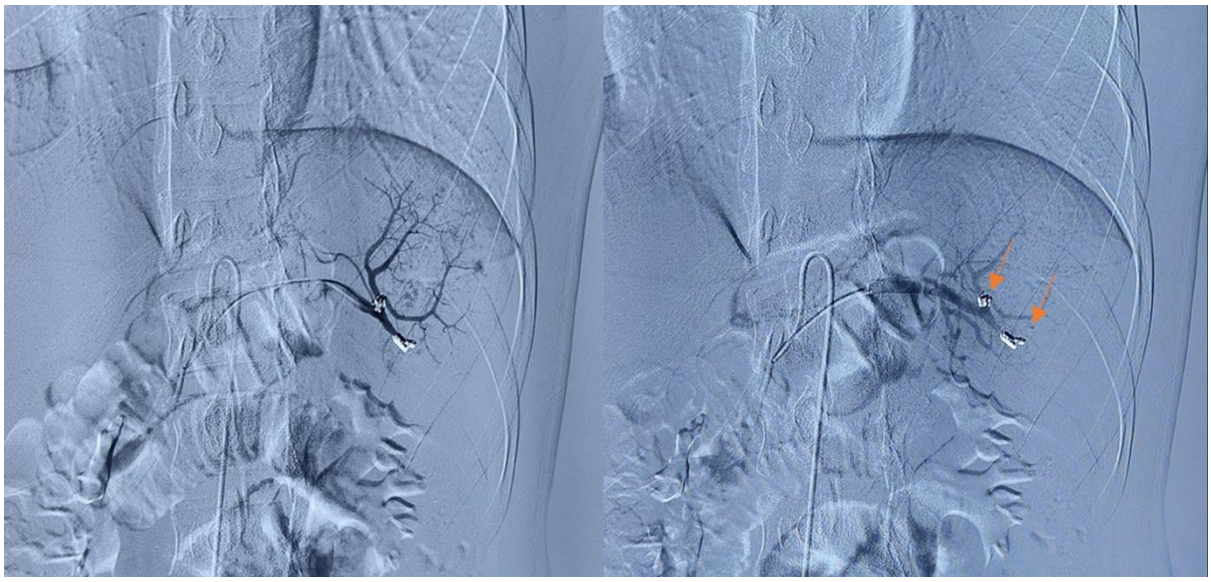

Figure 6: Angiography with partial embolization of branches: left, post embolization fluoroscopy image with coil in situ: right (arrow marked)

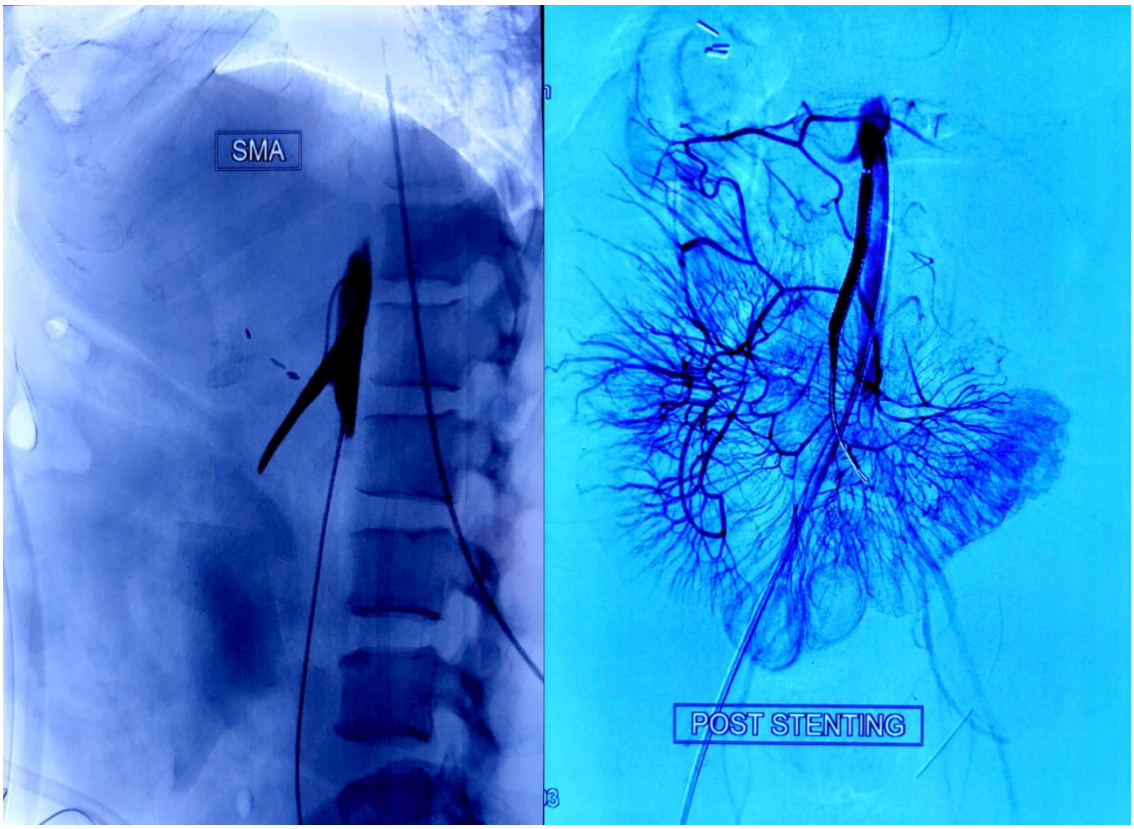

Figure 7: fluoroscopic image of Superior mesenteric artery, before and after stenting

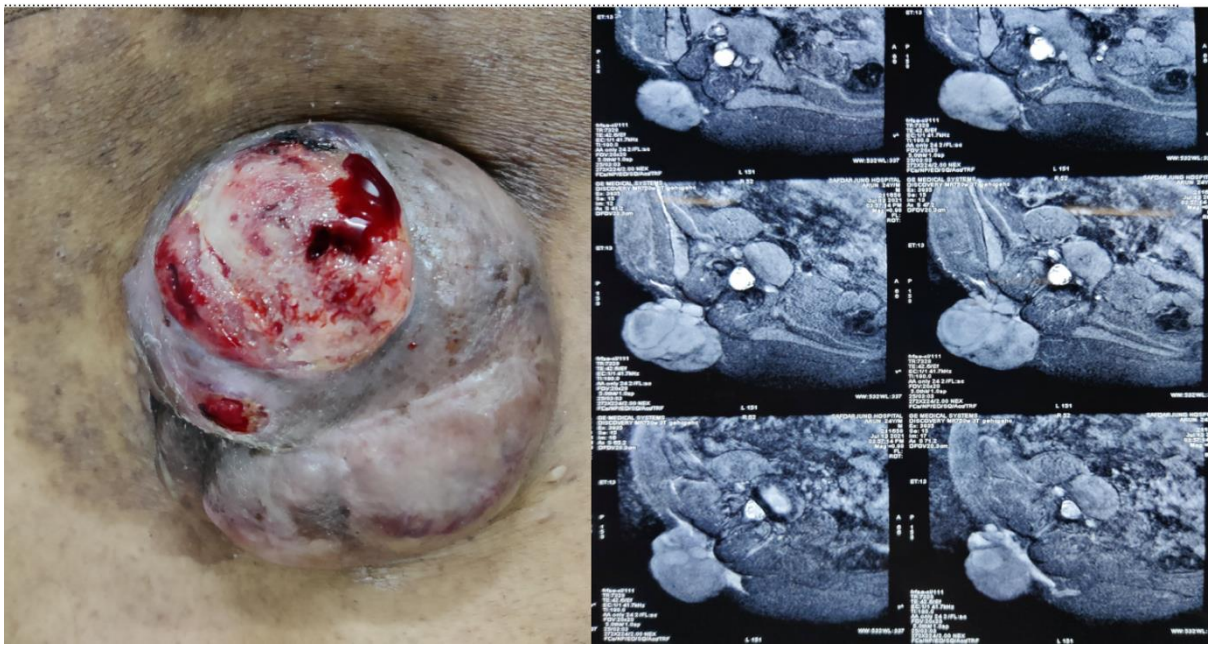

Figure 8: soft tissue sarcoma of lower back with active bleeding (left), MR imaging of the same (right)

Table 1: Distribution of arterial embolization

ARTERIAL EMBOLISATION	PERCENT
Splenic artery	
TOTAL	**80%**
TRAUMATIC	**60%**
NON TRAUMATIC	**20%**
Hepatic artery	**20%**

Table 2: Distribution of injuries according AAST Grade of trauma

AAST Grade	Spleen	Liver
I	0%	**20%**
II	22.22%	0%
III	33.33%	60%
IV	44.44%	20%
V	0%	0%