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Potential role for the conservative management of warfare penetrating Shrapnel and bullets to the abdomen: an observational study

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ABSTRACT

Background: the conservative management of selected cases of penetrating Shrapnel and bullet injuries to the abdomen, inflicted in the warzone, has not been previously reported.

Material and methods: Patients, who sustained penetrating bullets or Shrapnel abdominal injuries in the battle field, were included in the study.

Results: 39 consecutive patients were included in the study. They were all males with a mean age of 31 years. 4 (10.3%) patients had bullet injury, while 35 (89.7%) had Shrapnel injury. The injury was localized to the abdomen in only two cases (5%), while it involved the abdomen as well as other sites in the remaining 37 patients (95%). 13 patients (33.3%) underwent laparotomy in the first line hospital, while 26 (66.7%) were referred to our hospital without laparotomy. Out of these 13 laparotomies, 10 (77%) were positive therapeutic, while 3 (23%) were positive non therapeutic. In our hospital, 10 (77%) out of these 13 patients needed only continued post operative care while 3(23%) needed relaparotomy. In the 26 patients who were referred to our hospital without laparotomy, 4 (15.4%) needed laparotomy, while conservative management was followed in 22(84.6%) with only one failure. All laparotomies performed in our hospital were positive therapeutic ones. At the end of the study, patients were contacted by phone. 23 patients, were found in good health, two patients had minor complaints, while. 14 could not be contacted.

Conclusion: a subset of patients with penetrating Shrapnel and bullet injury to the abdomen, who show no frank indication for laparotomy, could be treated conservatively. The clinical evaluation should be augmented with contrast enhanced abdominal CT scan. Preparedness to operate if conditions change, should be an indispensable part of the treatment plan. By adopting this policy, a reduction in the rates of positive non therapeutic or negative laparotomy, could be anticipated.

Keywords: *Shrapnel-bullet-conservative-non operative-warfare-warzone*

INTRODUCTION

Although not universally accepted, conservative, or non operative, management of selected cases of civilian gunshot injuries to the abdomen, has been previously reported[1]. The essence of this concept depends on allowing the patient to recollect from the initial horror of being shot, while resuscitating and evaluating him. Those who are haemydyanmically stable or remain so after the initial resuscitation, show little or equivocal signs of peritoneal irritation on evaluation and show no evidence of bowel leak or much fluid collection on abdominal computerized axial tomography scan (CT)may be potential candidates for conservative treatment. Additionally, this policy should be coupled with vigilant periodic clinical reassessment with the preparedness to operate once new signs or deterioration of the condition appears[2].

The potential advantage of this management strategy is to avoid an unnecessary negative or positive non therapeutic laparotomy, with their attended complications and prolongation of the hospital stay.

However, this concept has not been evaluated in the management of patients with penetrating fragments, Shrapnel and bullet, to the abdomen, sustained in the battle field.

MATERIALS AND METHODS

War casualties were received initially in first line hospitals (hospitals in the immediate vicinity to the battle field) for initial emergency management, then referred to our hospital. Cases with history or bullet injury to the abdomen, were the focus of the study. Data were collected from the hospital registries and retrospectively analysed.

Upon arrival to our hospital and providing the necessary resuscitation, a decision for laparotomy or continued observation was taken, depending on the clinical and radiological assessment of the patient. If laparotomy was done in the referring hospital, continued post operative care was provided, unless the patient needed relaparotomy.

As a part of the radiological assessment, CT scan was done once the patient became haemodynamically stable. Its major objectives were to assess for the presence of intra abdominal Shrapnel/bullets, its location, number and size, internal organ injuries, intra abdominal fluid collections and its amount and the presence of bowel leak of oral or rectal contrast.

Conservative treatment consisted of nil by mouth, intravenous fluids, antibiotics and vigilant clinical evaluation at intervals, the frequency of which was dictated by the haemodynamic status and magnitude of abdominal signs. This was aided by repeat CT scan when indicated. All patients were carefully observed over the 24 hours of the day and the conservative treatment was abandoned once the patient's condition declared the need for laparotomy.

RESULTS

39 patients who sustained penetrating abdominal injury,by bullets or Shrapnel, in the battle field, were included in the study. They were all males with a mean age of 31 years (SD 7.3, minimum 22, maximum 47).

4 (10.3%) patients had bullet injury, while 35 (89.7%) had Shrapnel injury. In 37(95%) patients, the injury involved the abdomen as well as other sites of the body, while it was localized to the abdomen in 2 (5%).

13 patients (33.3%) underwent laparotomy in the first line hospital, while 26 (66.7%) were referred to our hospital without laparotomy. Out of these 13 laparotomies, 10(77%) were positive therapeutic, while 3 (23%) were positive non therapeutic. In our hospital, 10(77%) out of these 13 patients needed only continued post operative care while 3(23%) needed relaparotomy.

In the 26 patients who were referred to our hospital without laparotomy, initial evaluation revealed the need for laparotomy in 4 (15.4%) of them, while 22(84.6) were found suitable for conservative management. Out of these 22 patients, one patient failed to respond to conservative treatment due to increasing abdominal signs and laparotomy was performed. All laparotomies and relaparotomies performed in our hospital were positive therapeutic ones. The management of patients in our hospital, the indications for laparotomy or relaparotomy and operative findings are shown in tables 1, 2 and 3. They type of fragment in the whole group and subgroups is shown in table 4

Due to the scattered nature of the Shrapnel injury, 27 (69%) patients needed interventions by other specialities.

The number of Shrapnel ranged from 1 to 3 mm in those who were treated conservatively, and 1 to 15 mm in those who received laparotomy, while the maximum size of the Shrapnel did not differ between the two groups (Tables 5 and 6).

Among those who were treated conservatively, fragments were abutting a hollow viscus in 6 cases. Despite that a successful outcome was obtained. Hollow viscera which were at risk of injury in the conservative group are shown in table 7, and the management of solid organ injury is shown in table 8, Figures 1-11.

At the end of the study, all patients were contacted by phone to enquire about their general condition. 23 patients, were found in good health, two patients had minor complaints, while.14 could not be contacted. The mean time between the discharge and phone enquiry was 451 days (minimum 12, maximum 810, SD 231).

DISCUSSION

The concept of non operative management of penetrating abdominal trauma is old and, over the years, the management of this type of injury has seen few fundamental conceptual changes. Before the 19thcentury, it was observed that patients whose abdomen had to be opened, were doomed to die. For that reason, surgeons believed in leaving the patient to heal his wounds without laparotomy, to give him a chance, albeit slim, to survive. However, in the nineteenth century, this concept was challenged by the military surgeons, who believed in performing laparotomy for all penetrating abdominal injuries. This paradigm shift from mandatory conservatism to mandatory exploration, certainly saved many lives, though at the expense of several unnecessary laparotomies[3,4,5,6].In a review of 227 patients treated by mandatory laparotomy for gunshot injuries to the abdomen, no intra abdominal injury was found in 40 patients[6]. In another review, on 273 war casualties, 6% had negative laparotomy[5].For that reason, this dogma was again questioned and selective conservatism for penetrating abdominal trauma was introduced, first by Shaftan [7, 8]in the sixties of last century, to be followed by others for both stab injuries[9], and later bullet injuries[10,11]of the abdomen.

This selective conservative approach was further supported by several reports[2, 12]and prospective studies[10,13]. In prospective study involving 111 patients, 22 patients (20%) were treated conservatively, with no incidence of delayed laparotomy or death. In this study, 11% of patients with peritoneal penetration had no serious intraabdominal injury[10]. In another prospective study on 88 patients, 14 patient who presented with equivocal or minimal abdominal signs were chosen for conservative treatment. Two of them required delayed laparotomy which was negative in one[13].

Surprisingly, little is written in the literature about Shrapnel injuries to the abdomen and the concept of conservative management for selected cases of warzone abdominal penetrating fragments is almost unknown. Our PubMed search for articles in English or with English abstract for Shrapnel injury, yielded only 14 relevant reports. Utilizing the search terms “Shrapnel” and “abdomen” and “conservative” yielded one relevant result[14]. Adding the term “warzone” or “warfare” or “war” yielded no results. Substituting the term “Shrapnel” with “bullet” yielded also no results. However, in the scanty reports found, a selective conservative management was advocated for penetrating Shrapnel to the abdomen from low powered explosions[15]. In another report, the incidence of negative laparotomy was higher in Shrapnel than in bullet injuries[16].

The conservative management of penetrating fragments to the abdomen, is based on thorough initial assessment, followed by vigilant and continuous observation for the development of new signs, signifying hollow viscus perforation, and/or continuing haemorrhage. This should be coupled with the liberal use of abdominal CT scan. Preparedness to operate once the condition changes, completes the pillars for the conservative management protocol.

In our series, 21 (53%) patients with penetrating abdominal fragments were treated conservatively. In 6 (15.4%) of them, the Shrapnel appeared intimately related to a hollow vsicus. This clearly demonstrates that the mere presence of intraabdominal fragment is not by itself an indication for laparotomy. When surgery was not performed in the first line hospital, the patient arrived to our hospital around 24 hours after the injury. This period was enough to

determine about the need for laparotomy or the possibility of conservative treatment. In only one case, conservative treatment was followed initially, but failed and laparotomy was performed due to increasing abdominal pain. In the recent study, we observed that the higher the number of intraabdominal Shrapnel, the more chances for visceral injury to be present. While the Shrapnel number was less in those who were treated conservatively, than those who were treated operatively, the maximum Shrapnel size was similar in both groups. In this regard and as expected, solid organ injuries had a higher chance to respond to conservative treatment (table 8).

While the concept of selective conservative management of civilian gunshot injuries to the abdomen has been accepted by some, the same doesn't hold true for wartime gunshot as well as Shrapnel injuries. However, in a study on wartime bullet and Shrapnel injuries to the abdomen, a negative laparotomy of 10% and 5% was seen in Shrapnel and bullet injuries respectively[16]. This highlights the potential for the conservative approach in a selected set of patients with warfare Shrapnel and bullet injuries to the abdomen.

Traditionally, indications for laparotomy in warfare injuries includes the presence of peritoneal violation or the radiographic evidence of intrabdominal air or Shrapnel[17]. While this holds true in many cases, there are exceptions. First and foremost, the mere presence of peritoneal violation is not synonymous with solid organ or hollow viscus injury. Secondly, the presence of intraabdominal Shrapnel or air, which might have been dragged with it, does not necessary mean damage to internal organs and the need for laparotomy. As we observed in several of our patients, peritoneal violation and small intraabdominal Shrapnel, with or without small air blebs, were seen in 21 of our patients who were successfully managed conservatively. It is these events, namely continuing haemorrhage or bowel perforation with its resultant peritoneal signs, which count and dictate the need for laparotomy.

In an effort to aid in selecting patients for laparotomy or non operative management, diagnostic peritoneal lavage (DPL) was employed. Klaue et al [18]. published their report on 40 patients with warfare shrapnel and high velocity missile injuries to the torso in the early 80s. The decision to operate was based on the results of DPL. In 17 cases, the indications for laparotomy were evident from the start. In the remaining 23 with less obvious indications, laparotomy was performed based on the results of paracenthesis or diagnostic peritoneal lavage. 12 patients had positive results and laparotomy was performed to find significant intraabdominal injuries. 10 patients had negative or weekly positive results and were treated conservatively. Out of them, only one patient had to be explored to find a retroperitoneal haematoma not requiring surgery. Although DPL has been largely abandoned in the stable trauma patient, this study clearly indicates that a conservative approach could be followed for selected patients with these type of injury.

Previously, we reported our experience with selective conservative management of gunshot injuries to the abdomen[19], to be followed few years later by what could be the first report on the selective conservative treatment of penetrating Shrapnel to the abdomen[20], depending on the clinical and radiological assessment.

The time passed between the injury and arrival to our hospital, including the time spent in the first line hospital, allowed the patient's initial anxiety and apprehension to diminish, and this in turn allowed a more factual assessment to be made. In addition, the initial mild and equivocal abdominal signs had the time to either ameliorate or worsen. This situation may be likened to another situation with obvious differences. In one of the early and large series on the topic, Demetriades et al from South Africa, reported their experience with gunshot injuries to the abdomen[11]. In this country, reaching the hospital after being shot was much delayed, and this inadvertent delay created the conditions previously mentioned. This of course might have happened at the expense of increased motility and morbidity, as the patients were unmonitored during the delay. These authors observed that performing laparotomy for all gunshot injuries to the abdomen in their series may have resulted in 27% of negative or unnecessary laparotomy[11].

Although the estimated missile trajectory may indicate the presence of severe injuries, this may be misleading at times, even in anatomical regions condensed with organs. In a previous report, we successfully followed the conservative

approach to treat a patient with transpelvic bullet trajectory, who presented several hours after the injury and showed no signs indicative of immediate laparotomy[19].This has also been reported by others. Velmahos et al [1] reported their experience on transpelvic gunshot injuries in 37 patients. In their report,19 patients (51.3%) were operated upon immediately due to the presence of clinical findings. Only 16 of these laparotomies were therapeutic. The remaining 18 patients (48.6%) were treated conservatively with a successful outcome in 15 patients (40.5%). The remaining three patients underwent laparotomy due to worsening tenderness and all the three laparotomies were non therapeutic.

Interestingly, we received two patients, with Shrapnel in the interventricular septum in addition to the abdomen and other organs (figures 12, 13). Upon the discretion of the cardiac surgeon, one patient required open heart surgery for Shrapnel removal and repair of the tricuspid valve. The same patient underwent laparotomy and right hemicolectomy for a penetrating Shrapnel to the caecum. The other patient was successfully treated conservatively for both his cardiac and abdominal injuries.

In this study, we were only able to recognize the injury type, as a bullet or Shrapnel injury, but we couldn't elaborate further on its velocity, ie low or high velocity injury, obviously due to turbulent atmosphere of the battlefield.

CONCLUSION

Conclusion: Our data suggest that a subset of patients with penetrating Shrapnel and bullet injury to the abdomen, who show no frank evidence of peritonitis and/or continuing haemorrhage on initial and subsequent clinical evaluation, could be treated conservatively, even in the presence of intimate contact between the fragment and a hollow viscus. The clinical evaluation should be augmented with contrast enhanced abdominal CT scan. Preparedness to operate over the 24 hours period of the day, if conditions change, should be an indispensable part of the treatment plan. By adopting this management policy, a reduction in the rates of positive non therapeutic or negative laparotomy, should be anticipated.

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TABLE 1: Management in our hospital (table 1)

Management	Count (%)
Conservative treatment	21 (53.8%)
Conservative treatment failure followed by laparotomy	1 (2.6%)
Laparotomy from the start	4 (10.3%)
Continued post operative care	10 (25.6%)
*Re laparotomy	3 (7.7%)

*Laparotomy done in the referring first line hospital.

TABLE 2: Indications for laparotomy or relaparotomy in our hospital.

Indications	Count
To clear the situation before cardiac surgery in a patient with intracardiac and right iliac fossa Shrapnel	1
Haemodyanamic instability with free intraabdominal air on CT scan	1
Marked abdominal signs	2
Conservative treatment failure: Increasing abdominal signs:	1
*Relaparotomy: Marked abdominal signs with expanding central abdominal haematoma	1
*Relaparotomy: wound dehiscence with suspected bowel leak	1
*Relaparotomy: damage controlled laparotomy was performed in the referring hospital	1
Total	8

*Laparotomy was done in the referring hospital.

TABLE 3: Findings of laparotomy/relaparotomy done in our hospital

Finding	Count
Caecal perforation	2
Caecal and multiple small bowel perforations	1
Gastric and transverse colon perforation Haematoma in gastrocolic omentum and mesentry Haematoma in tail of pancraes	1
Shattered spleen with injury in the tail of pancreas	1
* Relaparotomy: Intact previous anastomosis Expanding retroperitoneal haematoma Shattered Rt kidney with renal aneurysm	1
*Relaparotomy: leak from a repaired small bowel perforation. Other repaired perforations were found intact	1
*Relaparotomy: two closed ends of the resected sigmoid colon and pelvic retroperitoneal haematoma (damage control laparotomy was performed in the referring hospital)	1

* Laparotomy was done in the referring hospital, followed by relaparotomy in our hospital

TABLE 4: Type of fragments in the whole group as well as the subgroups.

Type of fragment	Conservative	laparotomy	Total
Shrapnel	19	16	35
Bullet	2	2	4
Total	21	18	39

TABLE 5: Number of intraabdominal fragments in the subgroups in CT scan*.

		Conservative	Laparotomy	Total
Number of fragments	1	16	8	23
	2	2	0	2
	3	2	2	4
	4	0	1	1
	10	0	1	1
	15	0	1	1
Total		20	13	33

*In 6 patients, no fragments were seen, due to either removal in a laparotomy done in the first line hospital, fragment exit through the exit wound or omitting CT scan in our hospital.

TABLE 6: largest Shrapnel size in each patient in the subgroups*.

		Conservative	Laparotomy	Total
Largest fragment size	< 3 mm	1	0	1
	3-5 mm	5	4	9
	5-10mm	8	4	11
	> 10 mm	6	5	11
Total		20	13	33

*In 6 patients, no fragments were seen, due to either removal in a laparotomy done in the first line hospital, fragment exit through the exit wound or omitting CT scan in our hospital.

TABLE 7: hollow organs at risk in patients who were treated conservatively. Some patients had more than one organ involved.

Organ	Count
Intra abdominal shrapnel. No specified organ	1
Small bowel	3
Centre of mesentery	1
Splenic flexure	1
Right colon	1
Rectum	1
Anal canal	1

TABLE 8: Solid organ injury and their management.

Organ	Injury	Management	Count
Liver	Liver laceration and contusion	Conservative treatment	4
	Liver laceration	Repair *	1
	Intrahepatic Shrapnel	Removal *	1
	Intrahepatic Shrapnel ± laceration	Conservative treatment	3
spleen	Grade III-IV	Conservative	1
	Shattered spleen with pancreatic tail contusion	Distal pancreatectomy with splenectomy	1
	Splenic tear with pancreatic contusion	Splenectomy	1
kidney	Shattered kidney	Nephrectomy	1
	Shrapnel in kidney	Conservative	1
	Grade II injury	Conservative	1

*Done in the referring hospital, of doubtful therapeutic value.

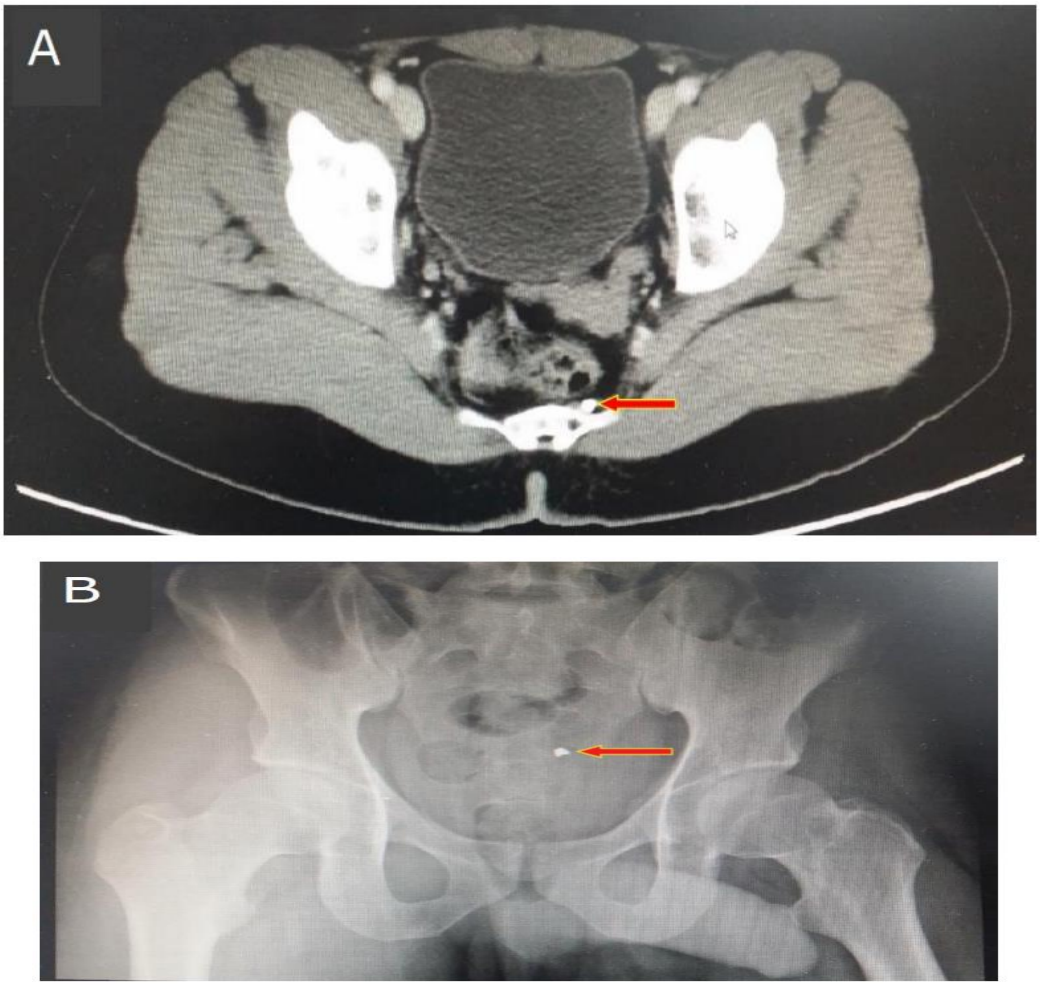

FIGURE 1: Shrapnel abutting the rectum (red arrow). A:CT scan,axial view, B:X ray. Treated conservatively.

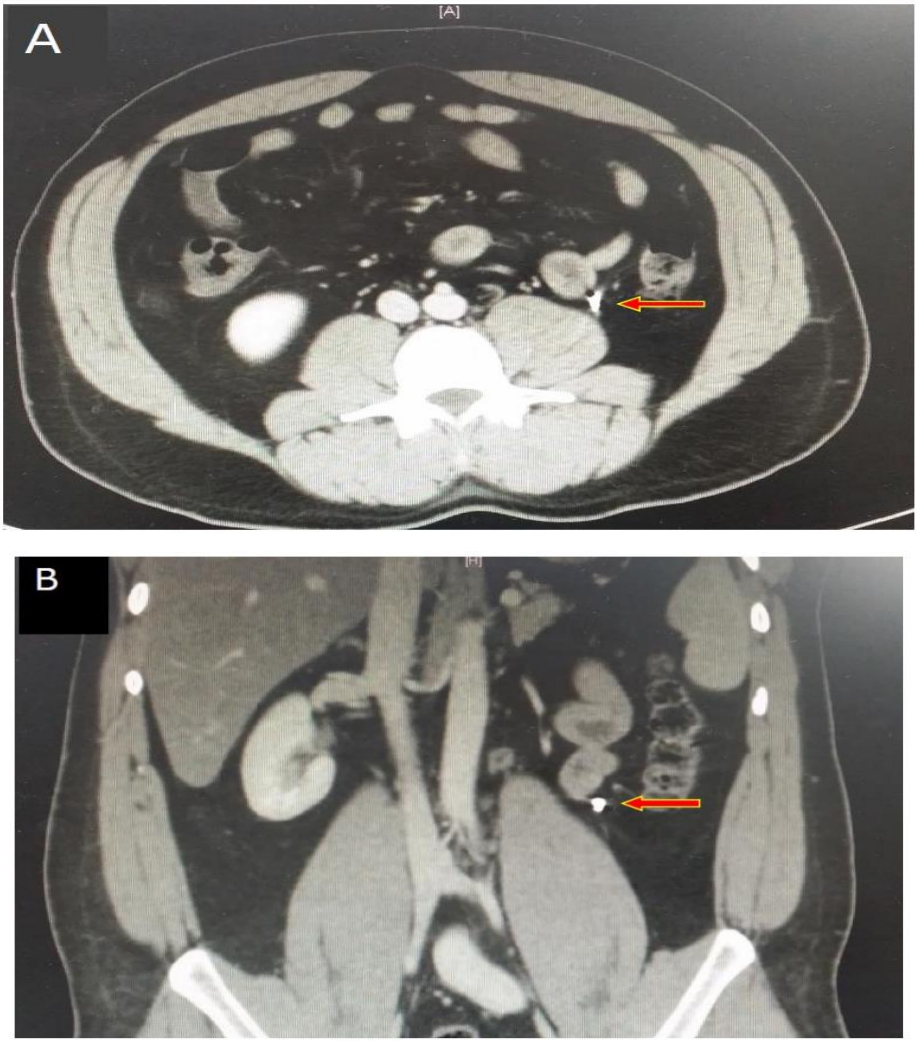

FIGURE 2: CT of the abdomen showing Shrapnel (red arrow) in close proximity to bowel loops. A: axial view, B: coronal view. Treated conservatively.

FIGURE 3: Shrapnel in the middle of the mesentery (red arrow). Treated conservatively.

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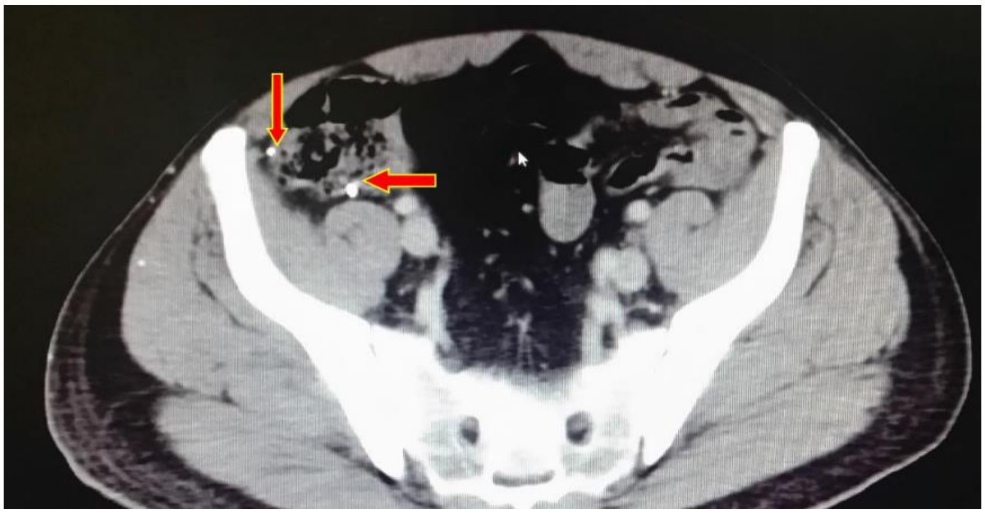

FIGURE 4: two Shrapnel abutting the right colon, in addition to subcutaneous and intramuscular Shrapnel in the right flank (red arrows). Treated conservatively.

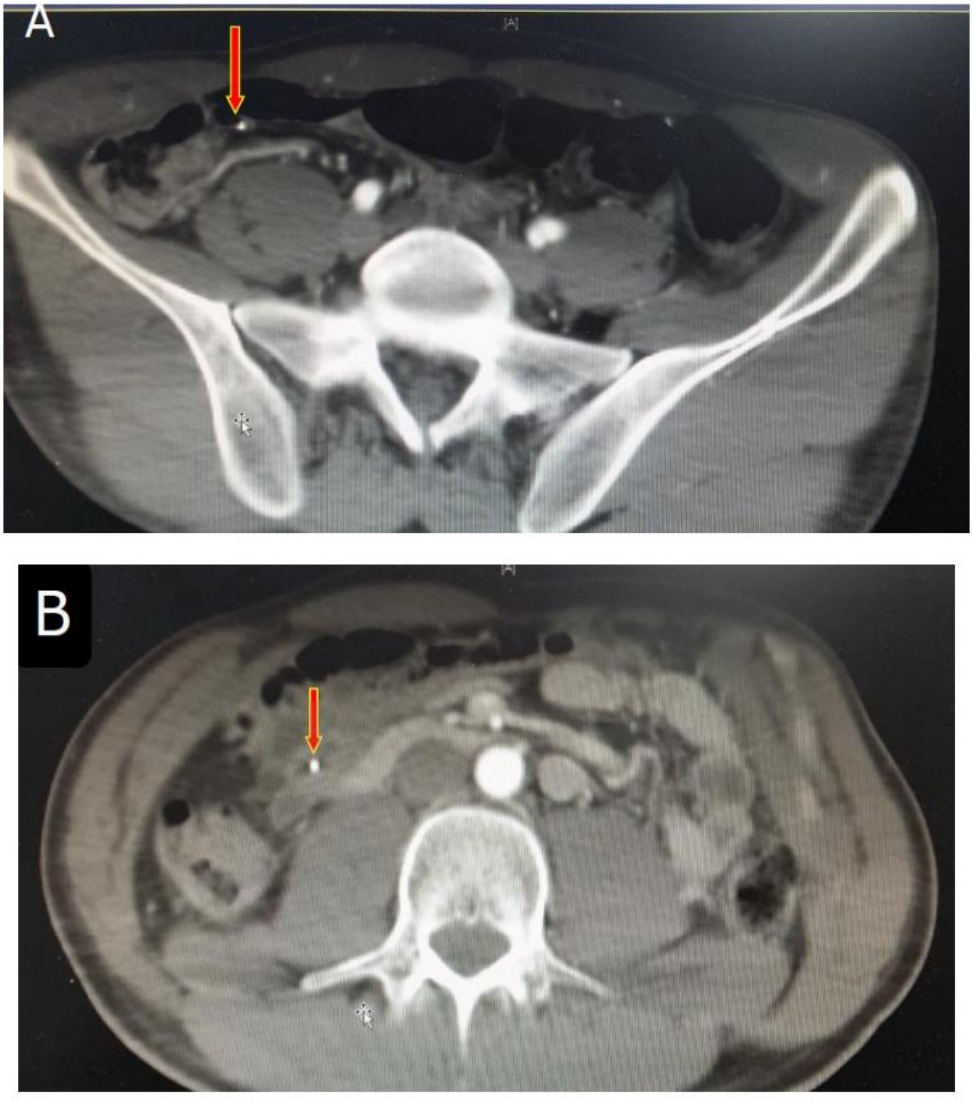

FIGURE 5 (A and B): two small Shrapnel seen inside the abdomen abutting small bowel loops (red arrow). Treated conservatively.

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FIGURE 6: Shrapnel seen inside the abdomen, abutting the wall of the jejunum (red arrow). Treated conservatively.

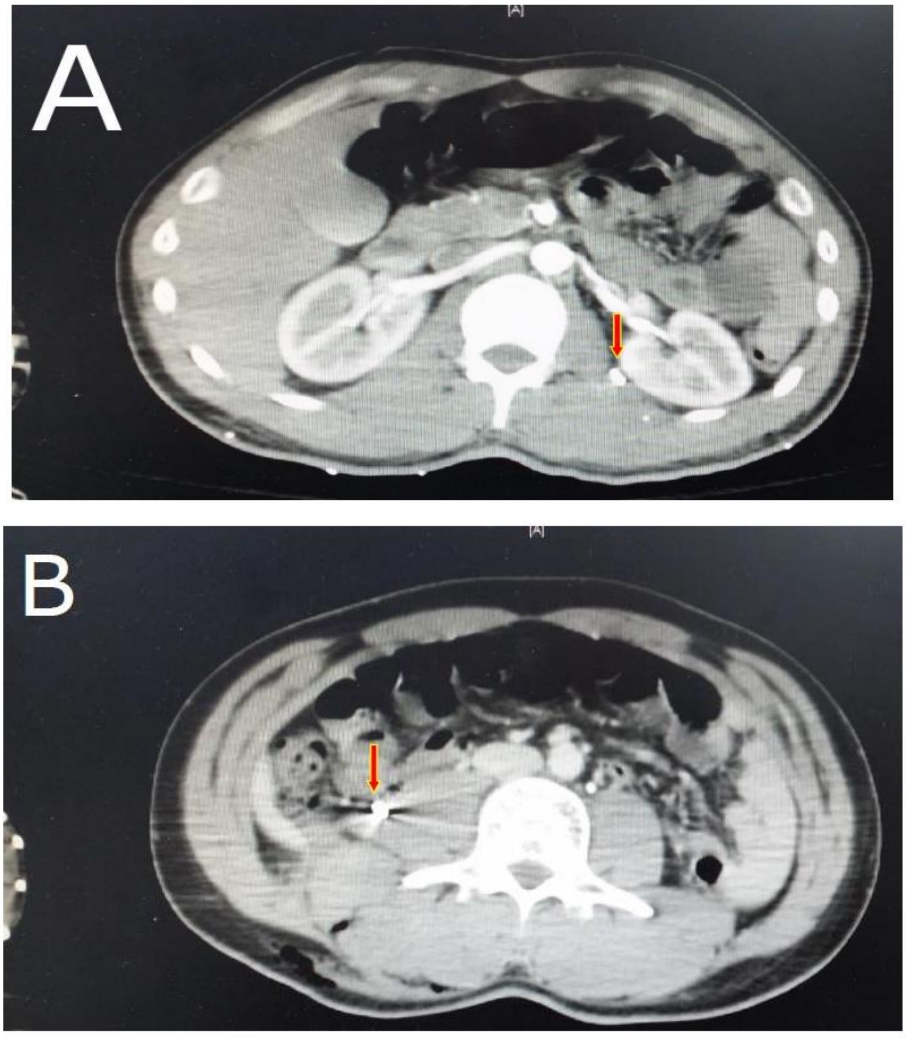

FIGURE 7: multiple posterior subcutaneous Shrapnel with Shrapnel abutting the medial aspect of the left kidney (A) and another abutting bowel loops on the right side (B), red arrows. Treated conservatively

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FIGURE 8: Shrapnel abutting the splenic flexure. Patient was treated conservatively (red arrow).

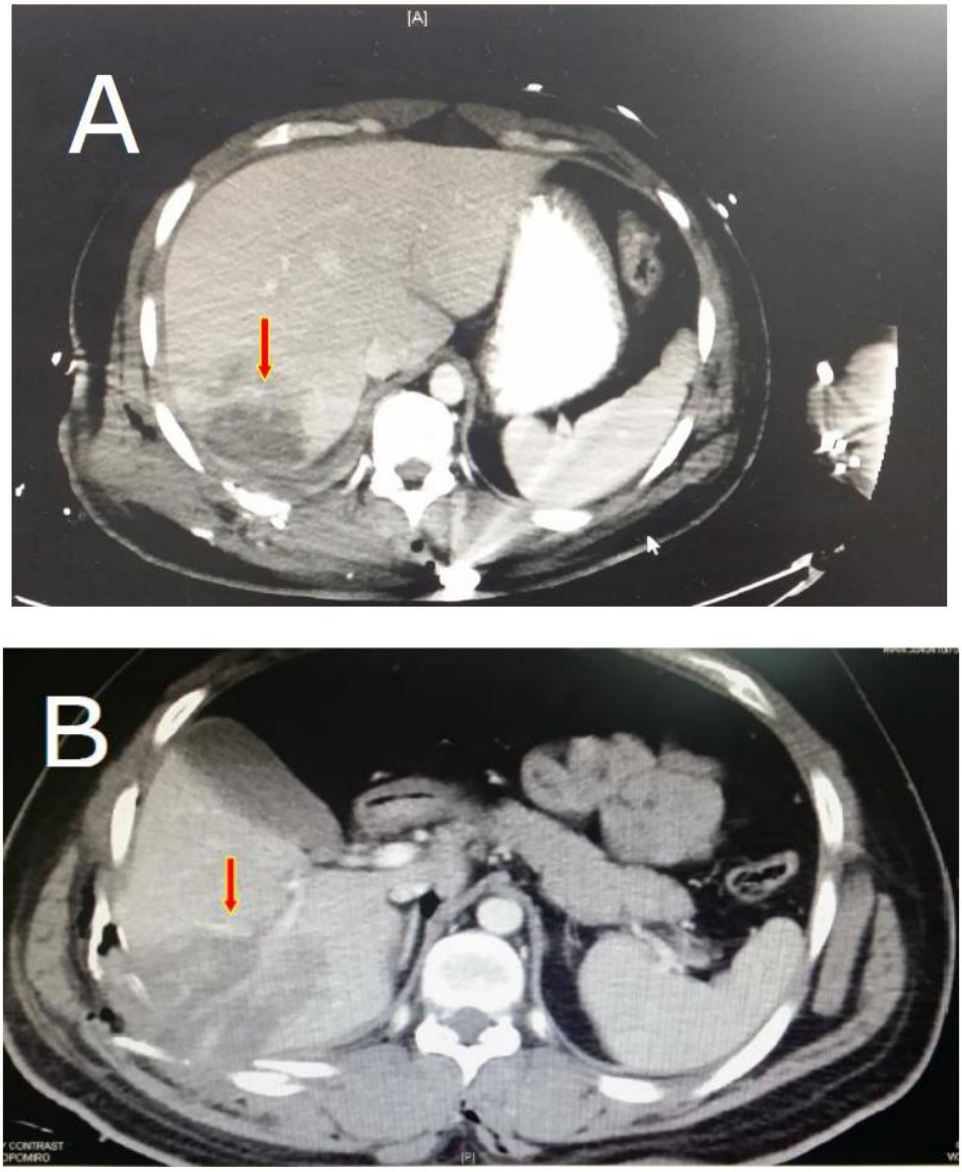

FIGURE 9 (A and B): liver contusion and laceration in segment 6 in two patients (red arrow).Treated conservatively.

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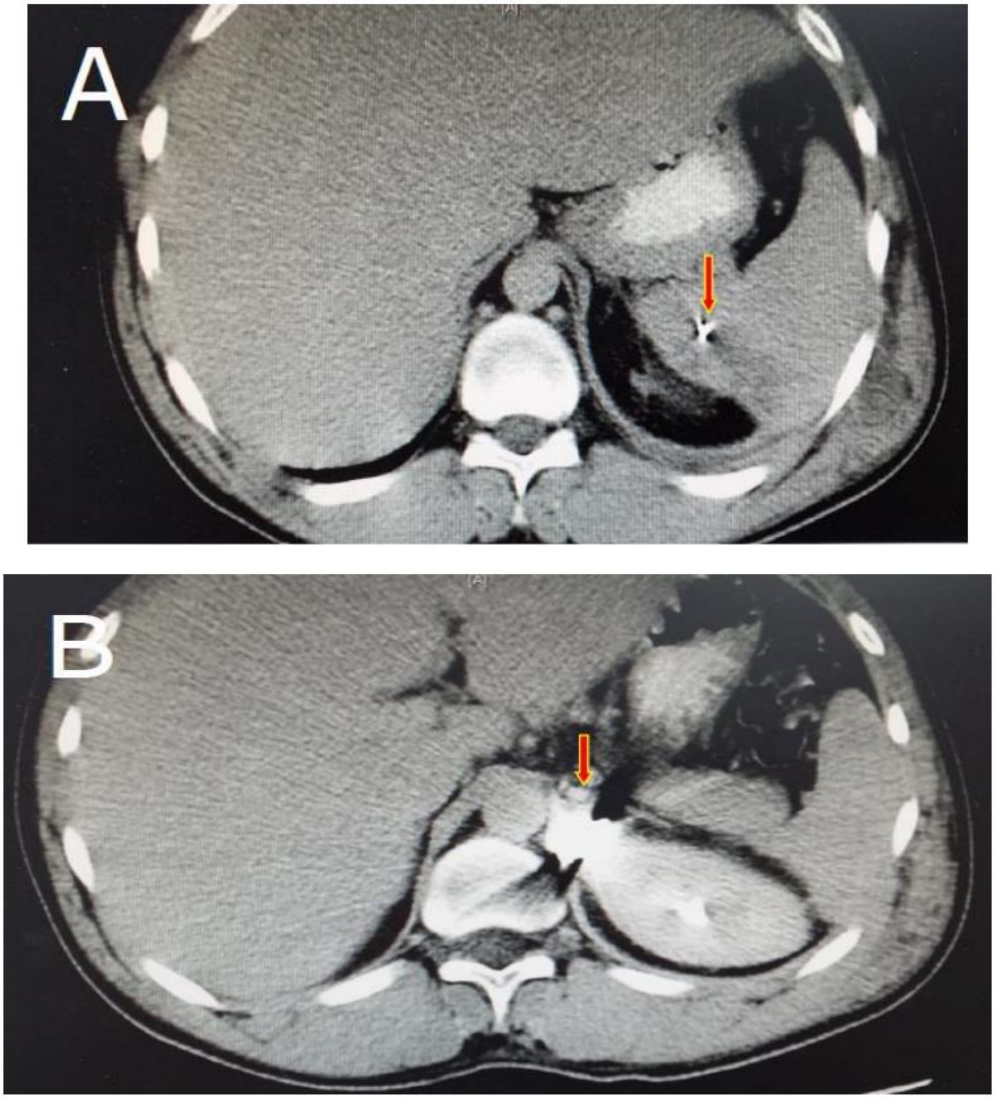
FIGURE 10: Shrapnel inside the liver, segment VII, with liver laceration (red arrow).Treated conservatively.



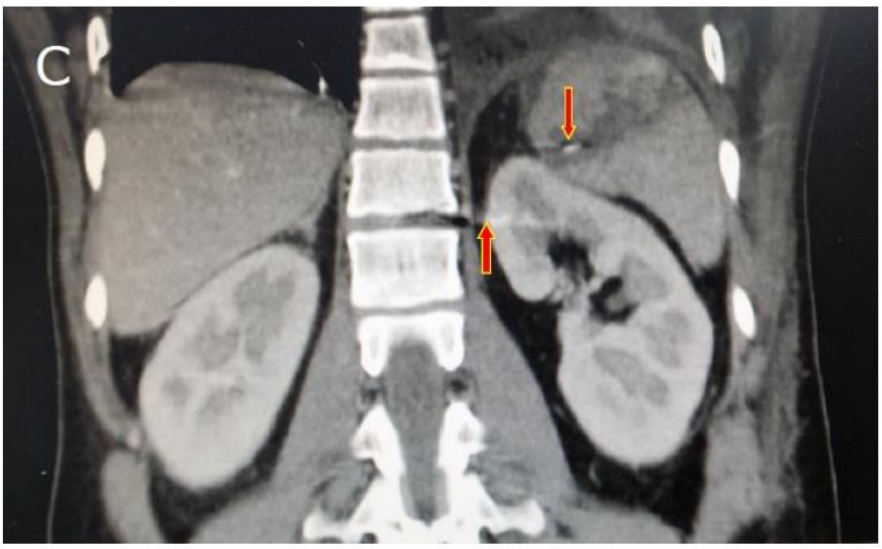


FIGURE 11: Intrasplenic Shrapnel with grade III-IV splenic injury(A)and a large Shrapnel adjacent to the superior pole of the right kidney (B) and (C). Treated conservatively

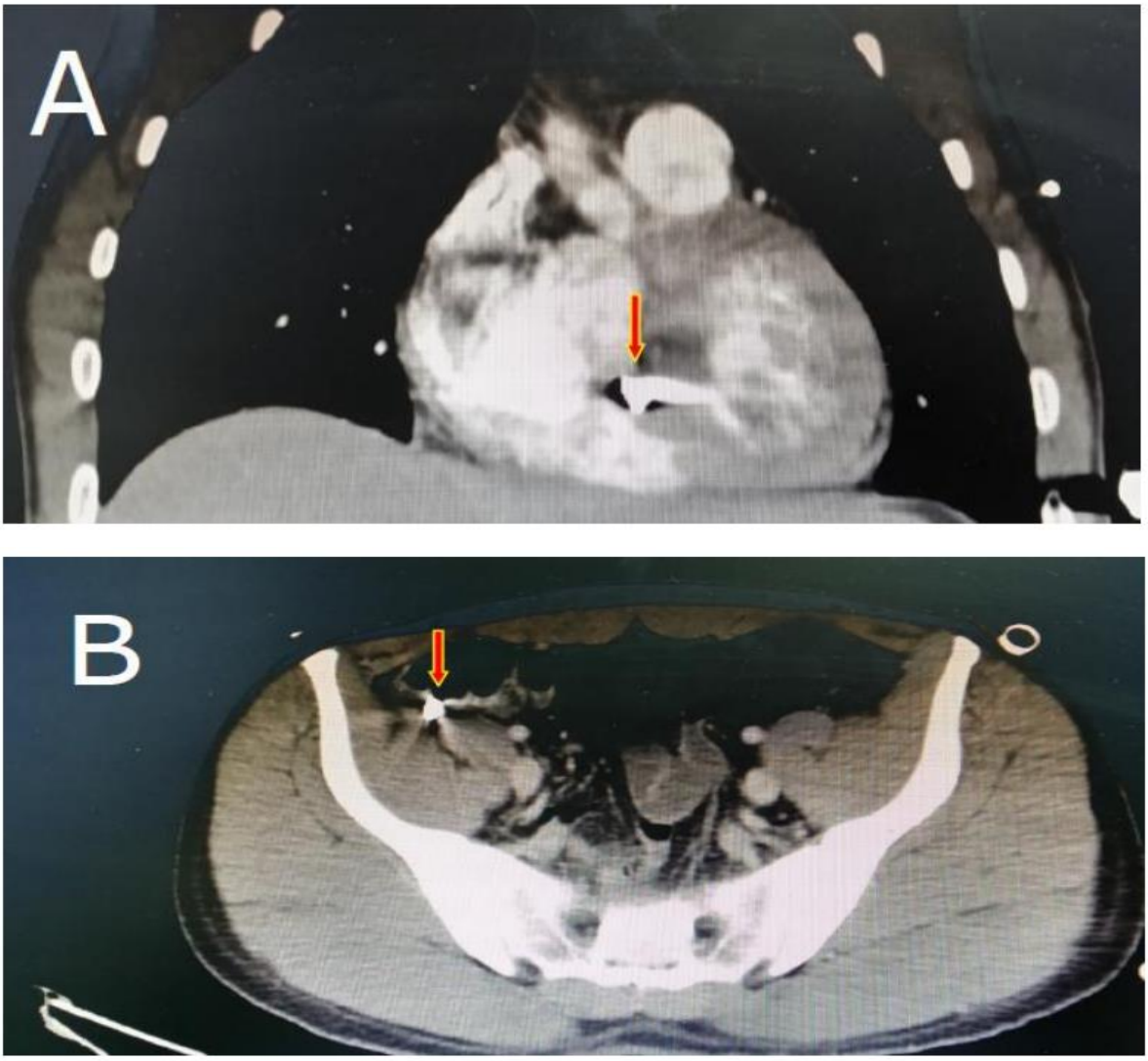


FIGURE 12: first patient with intracardiac (A) and abdominal Shrapnel (B). The patient was treated by open cardiac surgery and right hemicolectomy.

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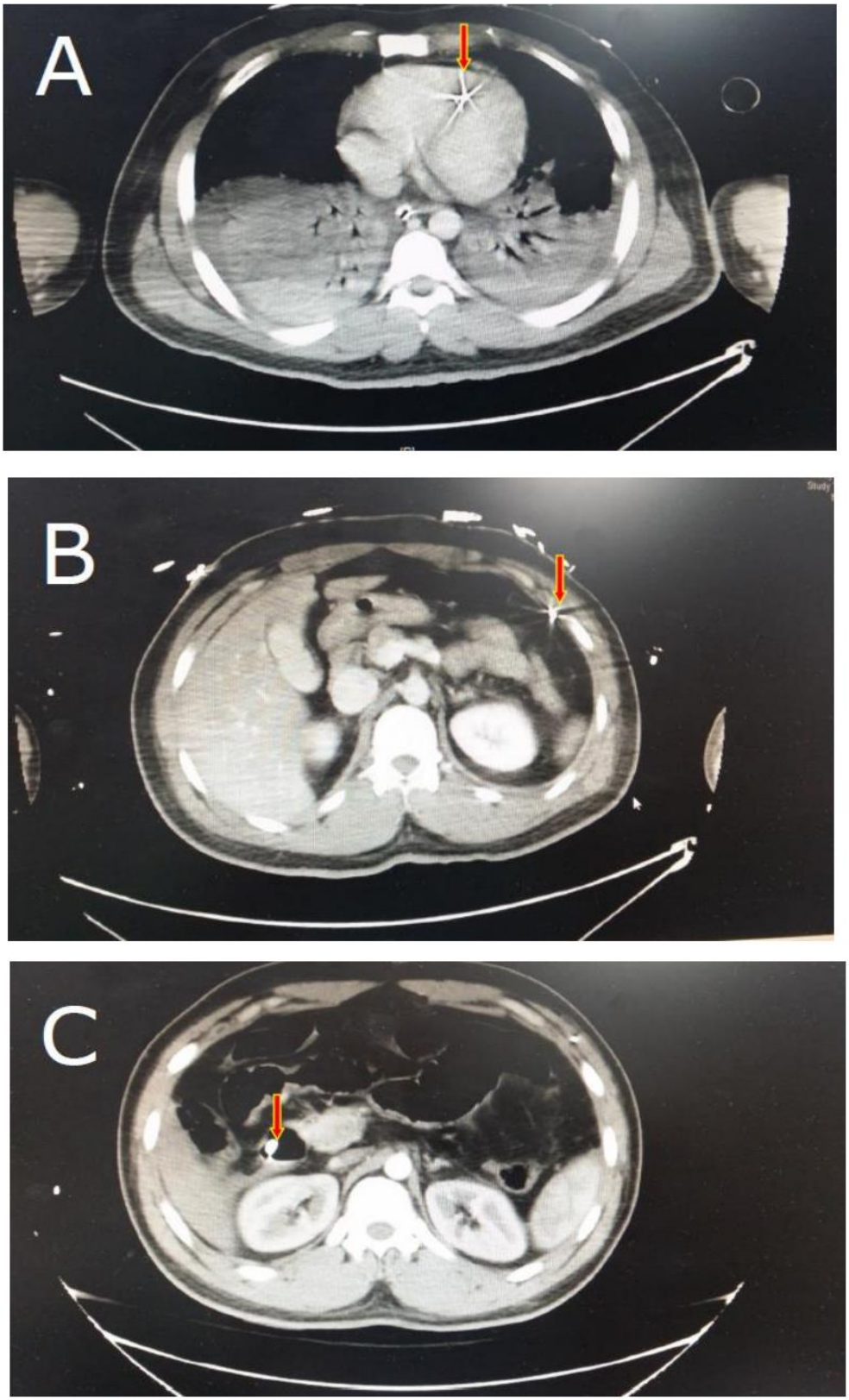

FIGURE 13: second patient with cardiac and abdominal Shrapnel. A: Shrapnel in the interventricular septum. B: Shrapnel scattered allover the abdominal wall and one just inside the abdomen. C: Shrapnel inside the bowel lumen (swallowed?, as he had many facial Shrapnel). The patient was treated conservatively.

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