

## A prospective evaluation of the predictive value of serum amylase levels in the assessment of patients with blunt abdominal trauma

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**Introduction:** Less than ten percent of patients who sustain blunt abdominal trauma will suffer a significant intra-abdominal injury. Identifying these patients is difficult and this study reviews the results of routine serum amylase levels in a series of patients with blunt abdominal trauma.

**Methods:** All patients admitted, by the primary author from November 2010 to November 2012, with a diagnosis of blunt abdominal trauma were included. All these patients had a serum amylase level measurement performed on admission.

**Results:** One hundred and three patients were selected, with an age range from 3 to 68 years. There were 33 females and 70 males. Imaging was obtained in 47 patients (38 CT scans and 9 ultrasounds). Nine (19%) of the patients who were imaged required a laparotomy due to the radiological findings, and 38 (81%) of this sub group underwent successful conservative management. Eighteen patients had a laparotomy on clinical grounds. Intra-abdominal injuries were identified in 38 patients on imaging and/or at laparotomy. In five patients laparotomy did not reveal any injuries. The remaining 38 patients were admitted for serial abdominal observation. They were all discharged home and their symptoms resolved. The serum amylase level ranged from 34 U/L to 3 156 U/L, with a mean of 227 U/L (standard deviation 456 U/L). The levels were raised in 60 patients (58%) of whom 19 (32%) had a significant intra-abdominal injury. The serum amylase level was normal in 43 patients (42%), of whom 19 (44%) had a significant intra-abdominal injury. There were eight pancreatic injuries in the group (pancreatitis (1), pancreatic contusion (3), laceration (1), and transection (3)). The serum amylase level was normal in two and mildly elevated in one of the patients with contusions (91, 92 and 129 U/L respectively), mildly elevated in the patient with pancreatitis (121 U/L), and significantly raised in the others (340 U/L with the pancreatic laceration; 3 156, 472, and 1 497 U/L in those with a transected pancreas). Four patients had a serum amylase level of greater than 1 000 U/L. Two of these had pancreatic injuries (3 156 and 1 497 U/L) and had hospital stays of six and sixteen days respectively. In the other two (3 042 and 1 454 U/L) no intra-abdominal injury was found.

**Conclusion:** The routine use of serum amylase level in the investigation of patients with blunt abdominal trauma cannot be supported as a mildly raised serum amylase level is common following blunt abdominal trauma, is of uncertain clinical significance, and does not have any predictive value. A markedly raised serum amylase level is associated with major pancreatic injury but is in itself a non-specific finding.

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Less than ten percent of patients who sustain blunt abdominal trauma will suffer a significant intra-abdominal injury. Identifying these patients is difficult as concomitant head injuries and fractures make clinical examination unreliable.<sup>1</sup> The spectrum of intra-abdominal injuries secondary to blunt trauma is broad and ranges from lacerations of intra-peritoneal solid viscera to hollow visceral and retroperitoneal injury. The delayed recognition of an intra-abdominal injury is associated with significant morbidity and even mortality. In the modern era abdominal CT scan has become the mainstay for the assessment of such patients. However identifying the need for scan relies on clinical algorithms, based on

the mechanism of injury and the clinical presentation.<sup>2-5</sup> Refining these algorithms may help reduce the need for CT scan, and may help district hospital personnel better identify patients at higher risk for injury and prompt earlier referral for imaging. The measurement of serum amylase levels on admission has been proposed as a screening test for intra-abdominal injury, and is often requested by emergency department personnel. A number of protocols and guidelines suggest that this should be a part of the routine assessment of patients with blunt abdominal trauma. There is not much literature to support these recommendations, which were drafted prior to the introduction of the use of CT scan in

blunt trauma patients, and which are at best based on level two and three evidence.<sup>2-5</sup> Interpretation of these results, which are of uncertain value, may even confuse a clinical situation and lead to inappropriate patient investigation and management. This study reviews the results of routine serum amylase levels in a series of patients with blunt abdominal trauma.

## Methods

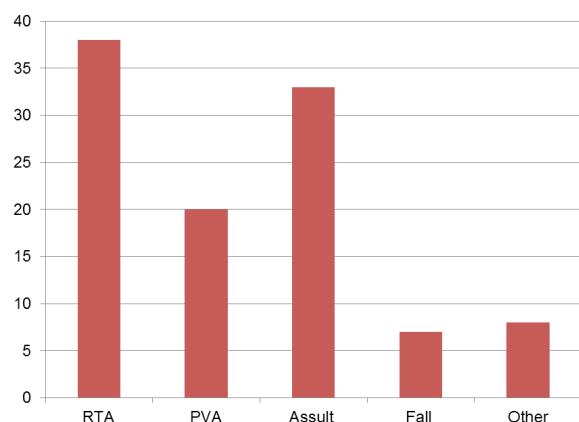
All patients admitted, by the primary author from November 2010 to November 2012, with a diagnosis of blunt abdominal trauma were included. Criteria for admission included patients with either confirmed intra-abdominal injury, or clinical suspicion of intra-abdominal injury, or significant mechanism of injury, for observation. All these patients had a serum amylase level measurement performed on admission. The standard demographic data, mechanism of injury, imaging or operative findings, whether managed operatively or conservatively, whether admission to the intensive care unit (ICU) was required, the length of hospital stay, and eventual outcome were prospectively collected. No patients were excluded. Data was analysed with STATA Statistics/Data Analysis package using Pearson chi squared test to compare the serum amylase level with intra-abdominal injuries sustained, length of stay and outcome. The normal serum amylase value is set by the National Health Laboratory Service (NHLs) at 20–104 U/L. Ethics approval for this study was obtained from the UKZN Biomedical Research Ethics Committee. (BREC no. BE406/13)

## Results

One hundred and three patients were selected, with an age range from 3 to 68 years. There were 33 females and 70 males. Graph 1 details the mechanism of injury. The majority were road traffic related, or due to interpersonal violence, with thirty-three patients assaulted and sustaining punches and/or kicks to the abdomen. Seven patients fell from a height, three of these fell onto an object. Three patients were injured playing football. Two patients fell from their bicycles, one patient fell from a motorcycle, and one patient drove his motorcycle off a bridge. One patient was kicked in the abdomen by a horse. Imaging was obtained in 47 patients (38 CT scans and 9 ultrasounds). Nine (19%) of the patients who were imaged required a laparotomy due to the radiological findings, and 38 (81%) of this sub group underwent successful conservative management. Eighteen patients had a laparotomy on clinical grounds. Figure 1 summarises these results.

Intra-abdominal injuries were identified in 38 patients on imaging and/or at laparotomy. These injuries included ten liver injuries, ten splenic injuries, eight pancreatic injuries, five small and three large bowel injuries, three renal and three bladder injuries, and three diaphragm ruptures. In five patients laparotomy did not reveal any injuries. Table 1 summarises the operative and imaging findings of this cohort. The remaining 38 patients were admitted for serial abdominal observation.

They were all discharged home well and their symptoms resolved.



Graph 1. Breakdown of the mechanisms of injury

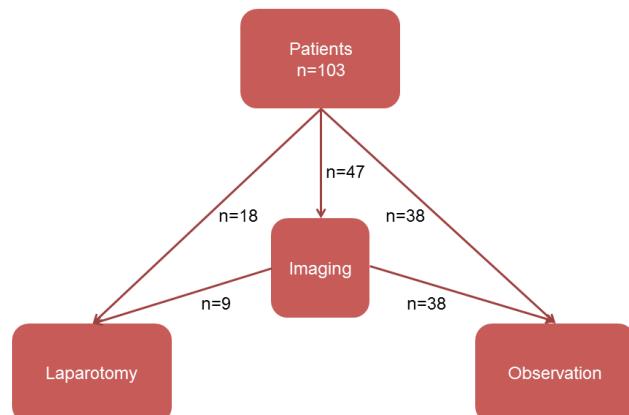


Fig. 1. Breakdown of the clinical management of the cohort

Table 1: Breakdown of the injuries seen

Injuries (n=38)	Management	
	Conservative	Operative
Liver (10)	5	5
Spleen (10)	5	5
Pancreas (8)	2	6
Bowel (8)		
Small bowel (5)		8
Colon (3)		
Urologic (6)	3 (Renal)	3 (Bladder)
Diaphragm (3)		3

The serum amylase level ranged from 34 U/L to 3 156 U/L, with a mean of 227 U/L (standard deviation 456 U/L). The levels were raised in 60 patients (58%), of whom 19 (32%) had a significant intra-abdominal injury, including six with pancreatic injuries. The serum amylase level was normal in

43 patients (42%), of whom 19 (44%) had a significant intra-abdominal injury, including two with pancreatic injuries. Six patients had hollow visceral injuries (three jejunal perforations, two duodenal lacerations and one colonic haematoma). The amylase level was raised in both patients with duodenal injuries (222 and 141 U/L), raised in one of three jejunal injuries (111, 78 and 72 U/L), and normal in the patient with the colonic injury. Sixteen patients had associated head injuries (eight mild, four moderate, and four severe). Ten of these patients had a raised serum amylase level. Ten patients were hypotensive on presentation, one of these did not respond to resuscitation, and required emergency laparotomy to control haemorrhage. Five of these patients had a raised serum amylase level. In 25 patients the initial blood pressure reading was not available. A delay to presentation was present in 12 patients, ranging from one to nine days post injury. In six of these patients the serum amylase level taken on their admission was raised. Fifteen patients required admission to the ICU. Of these, eight (53%) had a raised serum amylase level.

The length of stay was recorded in 89 patients, 14 were lost to follow up due to transfer to other hospitals or departments (5 referred for more specialised care or due to shortage of ICU beds at our hospital, the others down referred for further orthopaedic care or head injury or spinal rehabilitation). Figure 2 summarises the amylase levels in this cohort. The mean length of hospital stay was 5.5 days (standard deviation 5.9 days), with a range of one to thirty days. There was no correlation between length of stay and a raised serum amylase level, and no trend of higher serum amylase level requiring longer hospital stay could be identified. Graph 2 demonstrates this lack of correlation. There were two deaths in the group, and their serum amylase levels were 156 U/L and 137 U/L.

There were eight pancreatic injuries in the group

(pancreatitis (1), pancreatic contusion (3), laceration (1), and transection with duct disruption (3), one of which had a distal pancreatectomy, the other two were transferred to the HPB unit for further management). The serum amylase level was normal in two and mildly elevated in one of the patients with contusions (91, 92 and 129 U/L respectively), mildly elevated in the patient with pancreatitis (121 U/L), and significantly raised in the others (340 U/L with the pancreatic laceration; 3 156, 472, and 1 497 U/L in those with a transected pancreas). Four patients had a serum amylase level of greater than 1 000 U/L. Two of these patients had significant pancreatic injuries (3 156 and 1 497 U/L) and had hospital stays of six and sixteen days respectively. In the other two patients with markedly raised serum amylase levels (3 042 and 1 454 U/L) no intra-abdominal injury was found. The first was involved in a RTA, had a laparotomy which was negative, and was discharged after four days. The second was a patient assaulted by the community with extensive soft tissue injury, was treated with intravenous fluids and discharged after a three-day stay. Graph 3 demonstrates the lack of correlation between serum amylase level and the presence or absence of an injury.

## Discussion

Intra-abdominal injury secondary to blunt abdominal trauma can be immediately apparent as evidenced by haemodynamic instability due to haemorrhage or peritonitis due to hollow visceral perforation, or present in a delayed fashion due to retroperitoneal organ injury or mesenteric injury resulting in ischemia.<sup>1</sup> The severity of the injury and management options are also varied, and imaging is essential in deciding on the appropriate management algorithm.<sup>2-5</sup> Current indications for CT scan for blunt trauma in our department include haemodynamically stable patients who do not have a clinical

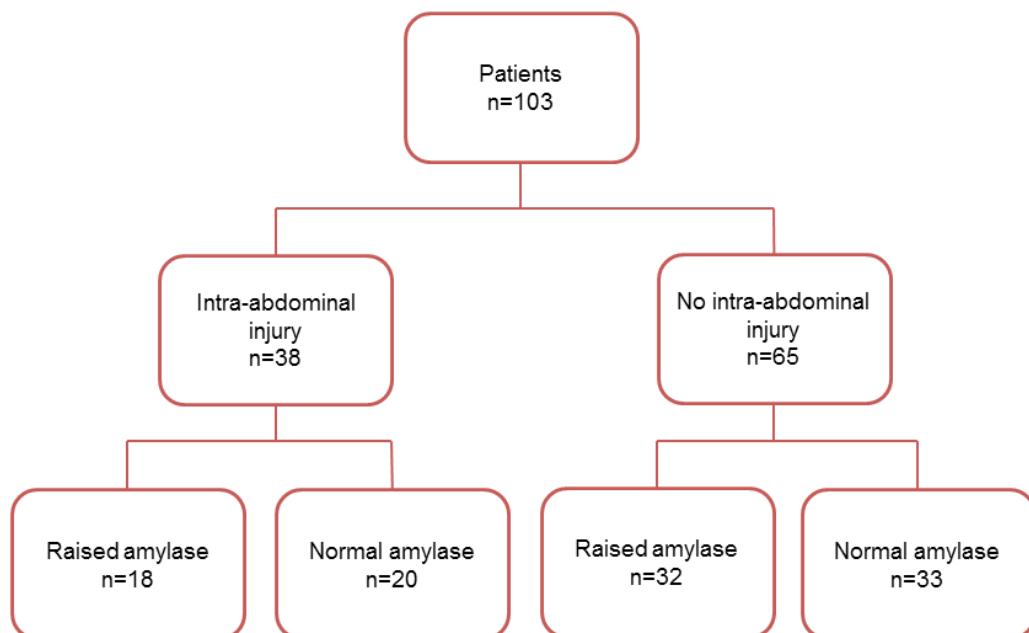
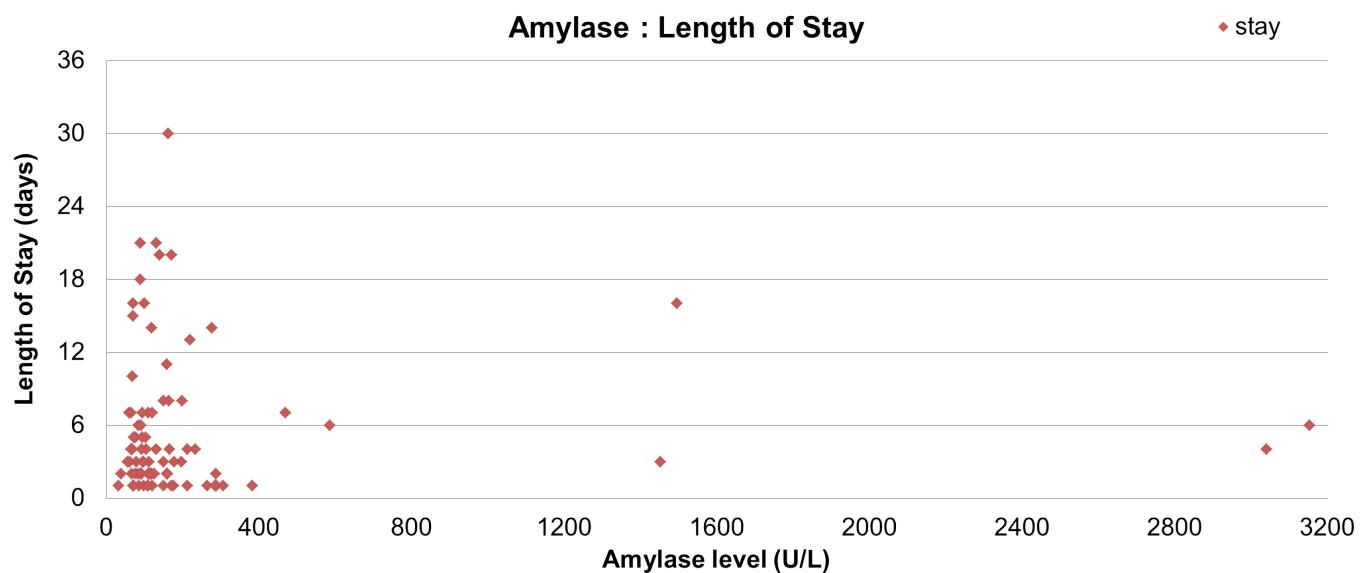
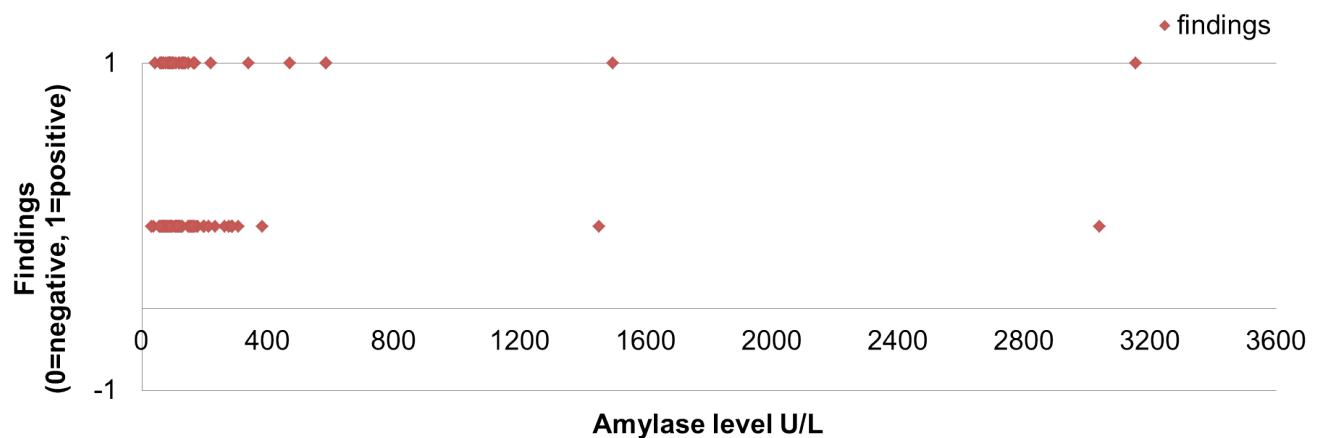


Fig. 2. The amylase levels of the cohort



Graph 2. Amylase levels compared to length of stay in hospital



Graph 3. Amylase levels compared to presence or absence of a significant injury

indication for laparotomy, with a significant mechanism of injury, or equivocal clinical examination, or injuries on both sides of the diaphragm (e.g. Head injury and femur fracture), or a depressed level of consciousness, or significant distracting injury where the reliability of the clinical examination is questionable.

The routine measurement of the serum amylase level on admission in patients with suspected blunt abdominal trauma has been proposed as a predictor of intra-abdominal injury. Although a number of protocols recommend this test as part of the work up of patients with blunt abdominal trauma the available literature to support this practice is scanty.<sup>2-5</sup> It is known that pancreatic injuries are associated with a raised amylase level, but evidence of correlation to other intra-abdominal injuries and the severity or significance thereof is conflicting.<sup>6-11</sup>

In this cohort just under two thirds of patients with

blunt abdominal trauma had a raised serum amylase level, significantly higher than the results published by Farkouh et al.<sup>9</sup> and Boulanger et al.<sup>11</sup> of 25 and 10 percent respectively. However, there was no correlation between the finding of a raised serum amylase level and the presence of a significant intra-abdominal injury, which correlates with the findings of Mure et al.<sup>10</sup> and Boulanger, but is in conflict with the findings of Farkouh, whose work suggested that a hyperamylasemia may indicate the presence of a serious intra-abdominal lesion. One third of patients with a raised serum amylase level had a significant intra-abdominal injury, whilst 44% of patients with normal serum amylase levels were also found to have a significant intra-abdominal injury.

A number of clinical features have been associated with raised serum amylase levels. These include the presence of an associated head injury and/or hypotension as well as delayed presentation.<sup>10,11,12</sup> We could not demonstrate any

such correlations in our cohort. Similarly we could not show any correlation between clinical course and the presence of a raised serum amylase level and a raised serum amylase level did not correlate with a longer hospital stay or need for ICU in our series. Both of the patients who died had mildly raised serum amylase levels.

Pancreatic pathology is classically associated with elevations in serum amylase levels and in our cohort higher grade pancreatic injuries (American Association for the Surgery of Trauma grade two or more) were associated with a significantly raised serum amylase level ( $>3$  times normal). This is in keeping with available literature on pancreatic injury in particular that of Takishima et al. who showed a raised amylase level in all his patients with pancreatic injuries, and Moretz et al. who showed a hyperamylasemia in 60% of their pancreatic injured patients. In our cohort contusions to the pancreas had either normal or only mildly elevated levels.<sup>7,8</sup> However, a significantly raised serum amylase level ( $>3$  times normal) is in itself not predictive of pancreatic injury as evidenced by two patients in this cohort with markedly elevated amylase levels (3042 and 1 454 U/L) but no intra-abdominal injury. The utility of serum amylase levels in the diagnosis of pancreatic trauma is unclear in the literature and from our own data. As such, its routine use could confuse a clinical situation and lead to unnecessary investigations and inappropriate management. At best, markedly elevated serum amylase levels are suggestive of pancreatic injury, and together with serum lipase could play a role in identifying these patients after a CT scan with equivocal findings for pancreatic injury.<sup>12,13</sup>

## Conclusion

The routine use of serum amylase level in the investigation of patients with blunt abdominal trauma cannot be supported as a mildly raised serum amylase level is common following blunt abdominal trauma, is of uncertain clinical significance, and does not have any predictive value. A markedly raised serum amylase level is associated with major pancreatic injury but is in itself a non-specific finding. The management of these patients must continue to rely on aggressive use of advanced imaging to exclude or confirm the presence of a significant intra-abdominal injury.

## REFERENCES

1. Howes N, Walker T, Allorto NL, Oosthuizen GV, Clarke DL. Laparotomy for blunt abdominal trauma in a civilian trauma service. *South African Journal Of Surgery Suid-Afrikaanse Tydskrif Vir Chirurgie.* 2012;50(2):30-2. PubMed PMID: 22622098.
2. Malhotra AK, Ivatury RR, Latifi R. Blunt abdominal trauma: evaluation and indications for laparotomy. *Scandinavian Journal Of Surgery: SJS: Official Organ For The Finnish Surgical Society And The Scandinavian Surgical Society.* 2002;91(1):52-7. PubMed PMID: 12075836.
3. GS FDR. Evaluation of Abdominal Trauma: American College of Surgeons Committee on Trauma; 2003. Available from: <http://www.facs.org/trauma/publications/abdominal.pdf>.
4. Hoff WS, Holevar M, Nagy KK, Patterson L, Young JS, Arrillaga A, et al. Practice management guidelines for the evaluation of blunt abdominal trauma: the East practice management guidelines work group. *The Journal Of Trauma.* 2002;53(3):602-15. PubMed PMID: 12352507.
5. Udeani J J. Blunt Abdominal Trauma Workup. 2013. <http://emedicine.medscape.com/article/1980980-workup#aw2aab6b5b2> Accessed December 2013
6. Kumar S, Sagar S, Subramanian A, Albert V, Pandey RM, Kapoor N. Evaluation of amylase and lipase levels in blunt trauma abdomen patients. *Journal Of Emergencies, Trauma, And Shock.* 2012;5(2):135-42. PubMed PMID: 22787343.
7. Takishima T, Sugimoto K, Hirata M, Asari Y, Ohwada T, Kakita A. Serum amylase level on admission in the diagnosis of blunt injury to the pancreas: its significance and limitations. *Annals Of Surgery.* 1997;226(1):70-6. PubMed PMID: 9242340.
8. Moretz JA, 3rd, Campbell DP, Parker DE, Williams GR. Significance of serum amylase level in evaluating pancreatic trauma. *American Journal Of Surgery.* 1975;130(6):739-41. PubMed PMID: 1200292.
9. Farkouh E, Wassef R, Atlas H, Allard M. Importance of the serum amylase level in patients with blunt abdominal trauma. *Canadian Journal Of Surgery Journal Canadien De Chirurgie.* 1982;25(6):626-8. PubMed PMID: 6182967.
10. Mure AJ, Josloff R, Rothberg J, O'Malley KF, Ross SE. Serum amylase determination and blunt abdominal trauma. *The American Surgeon.* 1991;57(4):210-3. PubMed PMID: 1711299.
11. Boulanger BR, Milzman DP, Rosati C, Rodriguez A. The clinical significance of acute hyperamylasemia after blunt trauma. *Canadian Journal Of Surgery Journal Canadien De Chirurgie.* 1993;36(1):63-9. PubMed PMID: 7680273.
12. Buechter KJ, Arnold M, Steele B, Martin L, Byers P, Gomez G, et al. The use of serum amylase and lipase in evaluating and managing blunt abdominal trauma. *The American Surgeon.* 1990;56(4):204-8. PubMed PMID: 1694634.
13. Mahajan A, Kadavigere R, Sripathi S, Rodrigues GS, Rao VR, Koteswar P. Utility of serum pancreatic enzyme levels in diagnosing blunt trauma to the pancreas: A prospective study with systematic review. *Injury.* 2014 Sep;45(9):1384-93. PubMed PMID: 24702828.