



Rupture of the Diaphragm Due to Penetrative Chest Injury Authors

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Abstract

Diaphragmatic injuries are relatively uncommon and Diagnosis and treatment are similar regardless of mechanism [8]. Rupture of the Diaphragm is a tear of the diaphragm. Most commonly, it occurs as a result of blunt trauma to the chest. It occurs in about 4- 5% of cases of severe blunt trauma to the trunk.

The signs and symptoms commonly found include chest and abdominal pain, difficulty breathing, and decreased air entry on the affected side. When a tear is discovered, surgery must be performed to repair it. The difficulty lies in discovering that a tear of the diaphragm has occurred, because diagnosis is not always obvious. It is known that 10-50% of blunt injuries are diagnosed late. The percentage of missed diagnosis is even greater in penetrating trauma [8]. We present a case of a missed ruptured diaphragm with rapid evolving symptomatology which would have led to disaster if the decision to perform an exploratory thoracotomy had not been taken.

Keywords: Blunt; Diaphragmatic; Penetrating; Rupture.

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1. Introduction

Rupture of the diaphragm due to blunt trauma is no longer uncommon, and its incidence has steadily increased with the rising number of road-traffic accidents [2]. It is now reported to occur in 4% of multiple-injury cases. In 1579, Ambroise Pare' made the first description of diaphragmatic rupture, in a French artillery captain who had been shot eight months before his death from complications of the rupture [2]. Using autopsies, Pare' also described diaphragmatic rupture in people who had suffered blunt and penetrating trauma. Reports of diaphragmatic herniation due to injury date back at least as far as the 17th century. Petit was the first to establish the difference between acquired and congenital diaphragmatic hernia, which results from a congenital malformation of the diaphragm. The first successful repair was performed by Riolfi in 1886[1]. In 1888, Naumann repaired a hernia of the stomach into the left chest that was caused by trauma [3].

Diaphragmatic injuries are present in 1–7% of people with significant blunt trauma and an average of 3% of abdominal injuries. A high body mass index may be associated with a higher risk of diaphragmatic rupture in people involved in vehicle accidents. It is rare for the diaphragm alone to be injured, especially in blunt trauma; other injuries are associated in as many as 80–100% of cases.

1.1. Diagnosis

Initially, diagnosis can be difficult, especially when other severe injuries are present; thus the condition is commonly diagnosed late. Chest X-ray is known to be unreliable in diagnosing diaphragmatic rupture; it has low sensitivity and specificity for this injury. Often another injury such as pulmonary contusion masks the injury on the X-ray film. Half the time, initial X-rays are normal; in most of those that are not, haemothorax or Pneumothorax is present.

However, there are signs detectable on X-ray films that indicate diaphragmatic injury. On an X-ray, the diaphragm may appear higher than normal. The gas bubbles may appear in the chest, and the mediastinum may appear shifted to the opposite side. A nasogastric tube from the stomach may appear on the film in the chest cavity; this sign is pathognomonic for diaphragmatic rupture, but it is rare. A contrast medium that shows up on X-ray can be inserted through the nasogastric tube to make a diagnosis. The X-ray is better able to detect the injury when taken from the back with the patient upright, but this is not usually possible because the patient is usually not stable enough; thus it is usually taken from the front with the patient lying supine. Some statistics suggest that over 90% of diaphragmatic injuries associated with blunt trauma are initially overlooked. It is thought that this occurs due to obscuration caused by overlying pulmonary injuries.

1.2. Pathophysiology

Most diaphragmatic ruptures originate in the back portion of the diaphragm. The tendency to suffer diaphragmatic injuries in this location is due to the congenital weakness of the fusion between the muscles of the ribs and spine with the muscular attachments of the diaphragm

1.3. Epidemiology

In most cases, isolated diaphragmatic rupture is associated with good outcome if it is surgically repaired. The mortality for diaphragmatic rupture after blunt and penetrating trauma is estimated to be 15–40% and 10–30% respectively, but other injuries play a large role in determining outcome.

Although the diagnosis may be missed regardless of mechanism, seemingly innocent penetrating injuries may also be long forgotten by the patient and these are the most commonly missed diaphragmatic injury.

2. Case Study

2.1. History

We present 57 years old male who was a Mines Safety officer with Kansenshi mine driving to Solwezi on 22nd June 2012 at about 19:00 hours. He stopped his car but unfortunately he was stabbed by enemies with a sharp object in his left chest through his left arm. He was taken by help mates to the Kansenshi mine health facility where wounds were bandaged and an Inter costal drain (ICD) was inserted. Because the health facility is small and the patient appeared to be in great pain, he was transferred to the Nchanga South hospital in Chingola for further management. The patient arrived at the Nchanga South hospital at about 03:00hrs, he was in severe pain

2.2 Physical examination

There was a history of a sharp object in his chest. Eight hours later he was reviewed in our hospital in Chingola. On examination the patient was uncooperative with non-functional Inter costal drain (ICD). The Blood Pressure was 153/90mmHg. The abdomen was unremarkable. One hour after admission: The patient was in severe pain, he remained uncooperative, his Glasgow Coma Score(GSC) was 13/15, His Blood Pressure was 149/100mmHg, his pulse rate was 74/min. The SpO₂ was 85%, this indicated the reduced air entry on the left chest.

The Vital signs were observed every 30minutes. Subsequent observations showed the Blood Pressure of 145/92, the patient became very pale, his pulse rate remained at 72/minute and the SPO₂ went down to 78%. The Abdomen was soft and non-tender, the four quadrant tap was negative. Reduced air entry on left chest was still noted. The Chest X-Ray was reviewed and a diagnosis of a Pneumothorax was made. The Plan was to book for debridement of the wounds, and reinsertion of ICD on the stabilised patient.

2.3 Investigations

Preoperatively a chest X-ray was done as depicted in figure 1.

Preoperatively; the patient's vitals were as follows: The GCS was 15/15, the SpO₂ was now 95% because the patient was on Oxygen delivery at 5 l/min of using nasal catheters. However the Blood Pressure was now 171/105 mmHg, the pulse rate was now 90/minute; In Urinalysis the following were observed; Acetone was 2+, and the Urine Blood was 4+. The White Blood Cell was 9.1x10⁹/l, The Haemoglobin went down to 10g /dL. We noted the low Temperature of 35.5C. The P max was 40cm of water.



Figure 1

Figure 2 showing mediastinal shi



Figure 2

2.4. Operative Note

A decision was made. The patient needed surgery particular because of the presence of the high P max of 40 mm of water. We also suspected a rupture of the Diaphragm on the left with the presence of bowel in the chest. A thoraco-abdominal Incision was needed.

The findings were:

- There was part of the Omentum and a lot of clots in the chest wound (figure 3)
- The thoracic cavity contained the stomach ,splenic flexure of the transverse colon, spleen and omentum(figure 4,5 and 6)
- These abdominal viscera entered the chest through a laceration in the anterior aspect Diaphragm on the left hemi diaphragm
- The lower edge of the left lung was lacerated by the sharp instrument (figure 7)

The assessment of the abdominal contents was done. Fortunately there was no injury to the abdominal viscera.

Figure 3 showing omentum in the chest cavity

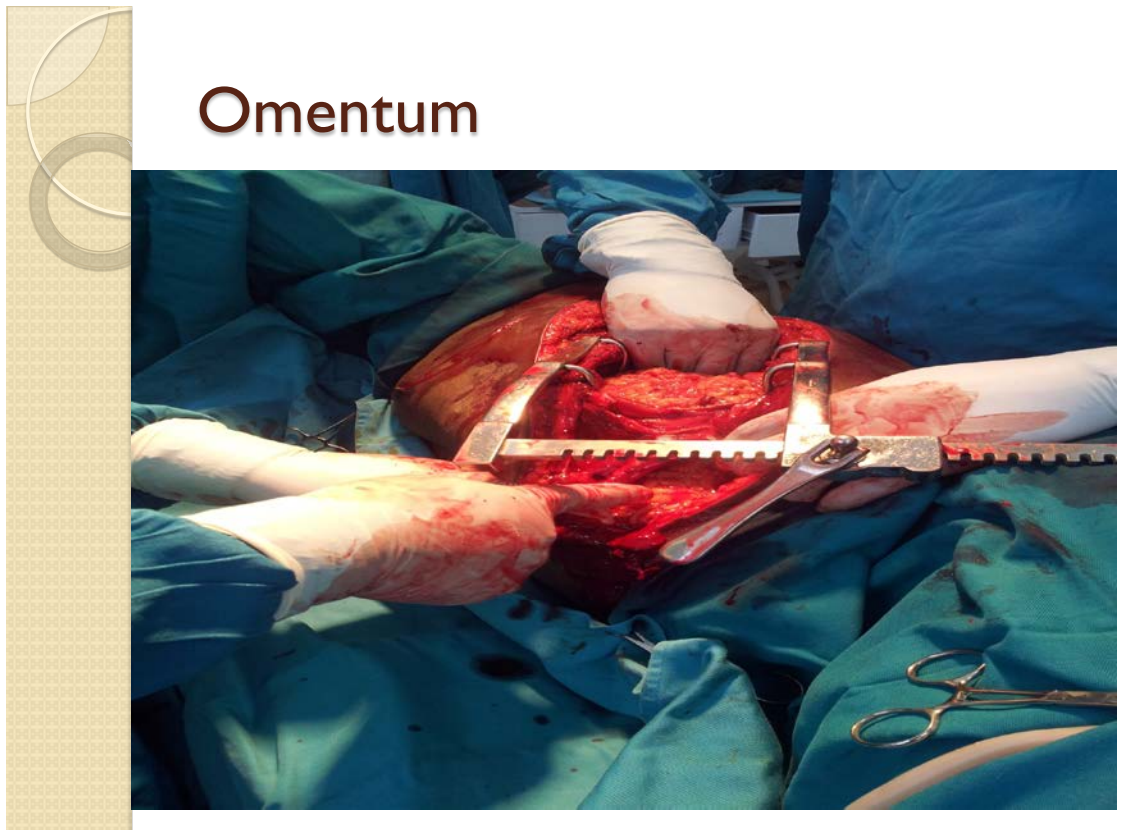


Figure 3

figure 4; thoracic cavity contained the stomach ,splenic flexure of the transverse colon, spleen and omentum

Stomach

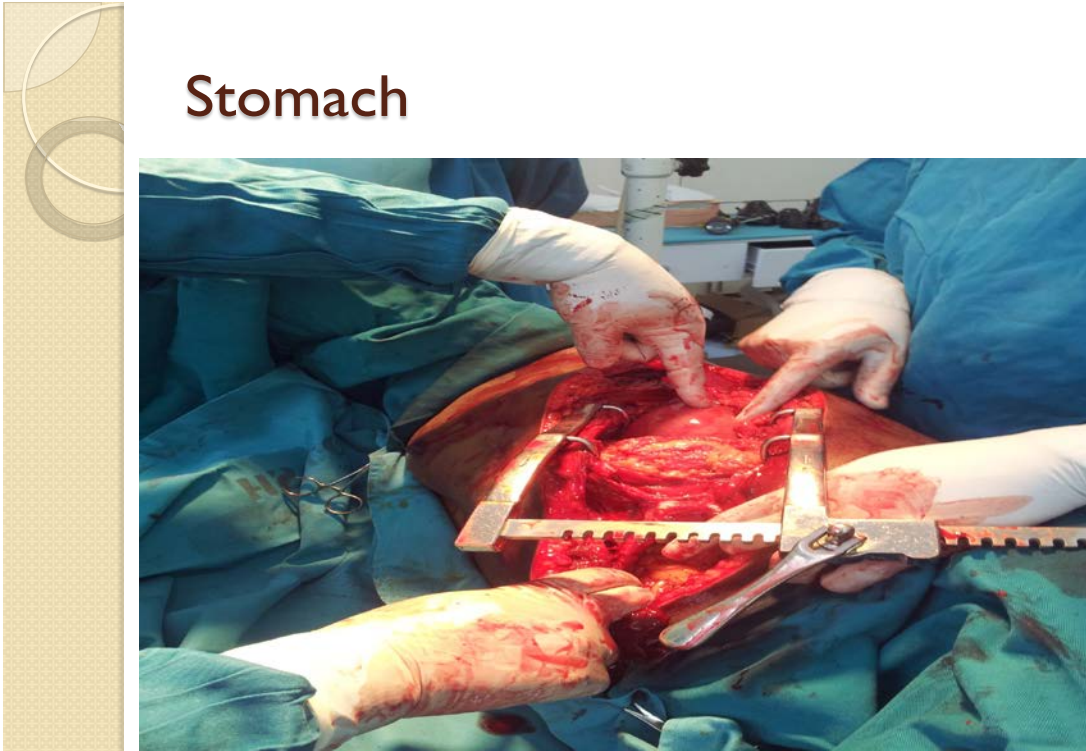


Figure 4

Figure 5; thoracic cavity contained the splenic flexure of the transverse colon and spleen

Transverse colon

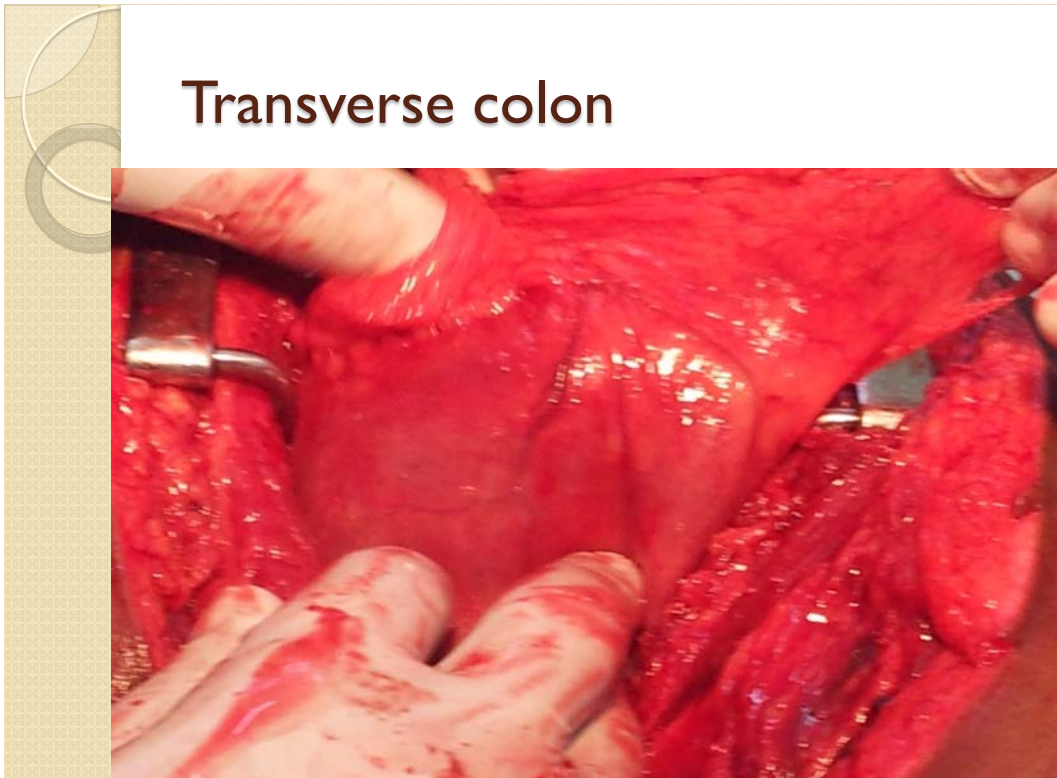


Figure 5

Figure 6; thoracic cavity contained the spleen



Spleen

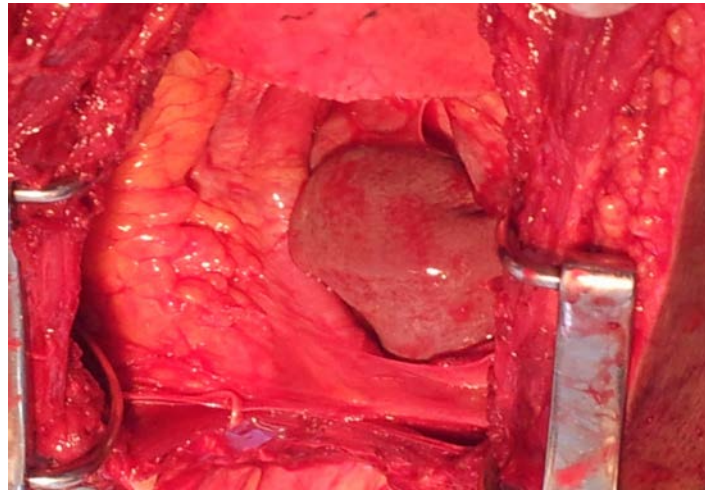
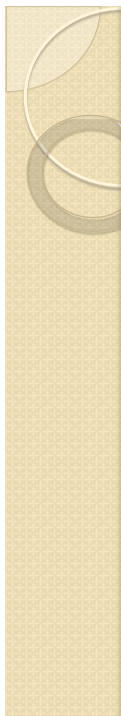


Figure 6

Figure 7; left lung was lacerated



Lacerated Lung

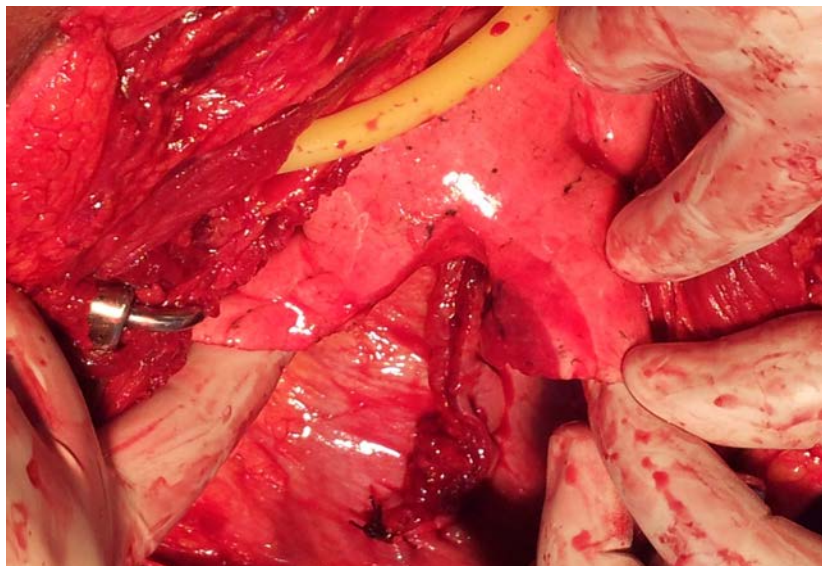


Figure 7

Sutured lung

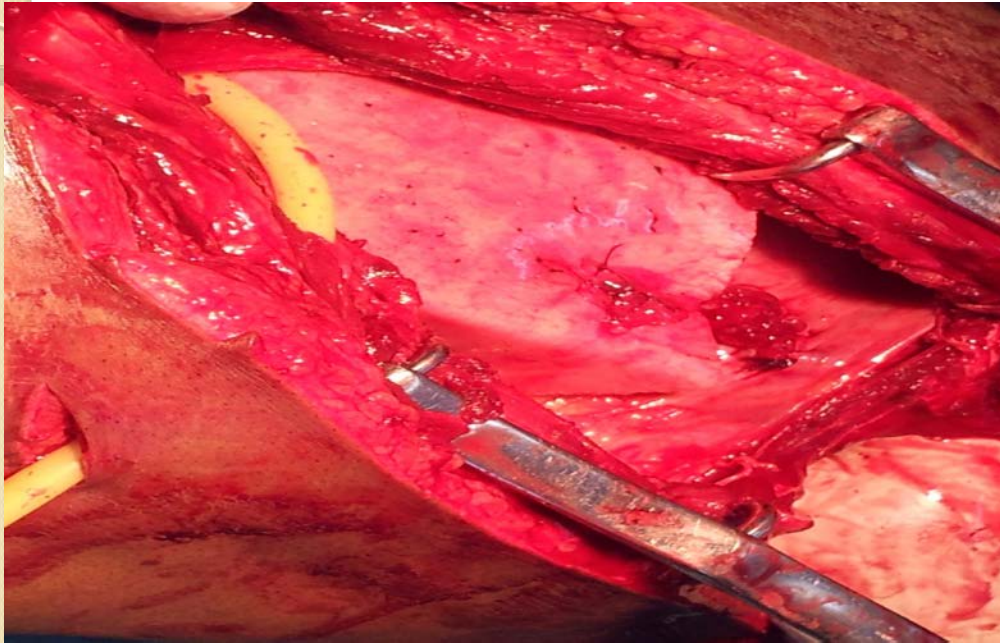


Figure 8: Sutured lacerated lung

2.5. Post-Operative Management

In the immediate post-operative period the patient was taken to the ICU and put on ventilation on the following regime

- Tidal Volume 600ml RR 12/min I:E 1:2
- Fi O₂ 60% ,later reduced to 40%
- PEEP 5cm of water
- Sedated with Propofol and Atracurium hourly for muscle relaxation

He was weaned off the ventilator after 24 hours, when he was fully awake and he was able to maintain Oxygen saturation, and extubated when Oxygen saturation was maintained at 100%. The patient was discharged 10 days after operation and booked for review after three weeks. At three weeks he was well and requested to return to his work.

3. Discussion

When this man came to us we noted his uncooperative behaviour. We immediately noted he had significant respiratory changes. We also note the left kidney injury because urinalysis had showed significant haematuria.

We thoroughly examined our patient and found the following: There were several dangerous features which

developed in the patient:

Firstly; the desaturation which was a result of the compression of the left lung by the abdominal contents which had migrated into the chest. This manifested itself by the following: SPO2 fell to 78%, GCS fell to 13 and the uncooperative behaviour.

Secondly; we noted the shift of the Mediastinum to the right: This would have eventually caused reduced cardiac refilling and death.

Thirdly; we noted that the High P max of 40cm of water was going to eventually cause the remaining diaphragm to stop moving (splintage) and respiratory arrest would have ensued and fourthly; the High blood pressure was as a result of the severe pain. It could have led to stroke and other complications of hypertension.

Our Man needed a major surgery which was carried out.

Over a period of ten years there were three cases of Ruptured Diaphragm seen at Nchanga South Hospital. This was the fourth patient and the only one in whom the cause was penetrative trauma. Two were diagnosed at laparotomy following Blunt abdominal trauma and one was referred to us from another hospital for persistent abdominal pain following a road traffic accident.

Rupture of the diaphragm after blunt trauma is not rare but relatively uncommon [8] occurring in approximately 0.8%-1.6% of patients who are hospitalized with blunt trauma. for example at the Royal Brisbane and Princess Alexandra Hospitals, Brisbane Between 1975 and 1990, in a period of 15 years, only 85 patients with diaphragmatic rupture following blunt trauma were treated[4]. Christiansen, L. A. et al in 1974 presented a 23-year series of only 25 patients with rupture of the diaphragm [5]. Road trauma was the cause in 88% of cases confirming the fact that it occurs in patients involved in major road-traffic accidents and less frequently after falls from a height. These patients usually have severe multisystem injuries because of the large force required to rupture the diaphragm. Our patient was indeed a multisystem injury patient.

Diagnosis may not be obvious: For example it is made preoperatively in only 40-50% of left-sided and 0-10% of right-sided blunt diaphragmatic ruptures. In 10-50% of patients, diagnosis is not made in the first 24 hours [8]. Diagnosis is often difficult because signs do not always show up on X-ray, or when signs do show up they may be similar to signs of other conditions. If not made in the first four hours, the diagnosis may be delayed for months or years. Because we followed our patient every 30minutes we eventually made the diagnosis. We did not miss the patient.

Thus, 10-50% of blunt injuries (and an even greater percentage in penetrating trauma) are diagnosed late. This number is decreasing because of greater awareness and earlier identification. We nearly missed this case but we made the diagnosis by doing a thoracotomy. If we had not done a thoracotomy we probably could have lost the patient. One of the reasons we missed diagnosis may be that we see so few cases and far apart and so our diagnostic acumen is not practiced enough none the less the key issue here is that we need to develop a high index of suspicion for ruptured diaphragm in penetrative chest injury

Diagnosis is usually made by pneumo-peritoneum this is done by insufflation of air into the peritoneal cavity the diaphragm itself can always be localized, and if a Pneumothorax results, the diagnosis of rupture is established.

The chest X-ray, exploratory laparotomy and exploratory thoracotomy are the other diagnostic tools. Above all, a high index of suspicion of the diagnosis of ruptured diaphragm is most important in patients with a history of trauma [5]. Clinical manifestations of this problem can vary from no symptoms to life-endangering problems immediately after the injury. Our patient had life threatening rapidly evolving symptoms. The presence of extraneous shadows above the diaphragm, such as gas-containing or homogeneous areas, along with a shift of the Mediastinal structures away from this side, is extremely suggestive of a ruptured diaphragm [7]. Despite having these features in our patient's chest radiographs we could only relate them to ruptured diaphragm in retrospect. It was a situation of being unfamiliar with this problem and a low index of suspicion.

All kinds of organs may migrate into the chest after rupture. We found the stomach spleen and colon. Cohen et al found an avulsed kidney in the chest [6]. We suspect there was migration of the left kidney from the abdomen to the chest in our patient in that there was significant haematuria before which could have come from renal bruising.

4. Conclusion

Although usually associated with major multisystem trauma or blunt trauma to the trunk and or abdomen, rupture of the diaphragm may occur after seemingly insignificant penetrative chest injury. Casualty medical officers should consider the diagnosis in patients who have a history of penetrative trauma to the chest or abdomen and develop gastrointestinal or respiratory symptoms. The chest x-ray, especially when performed after insertion of a nasogastric tube, is a useful screening tool. Diaphragmatic irregularities or any evidence of gas above the diaphragm (in this case misinterpreted as an atypical "massive Pneumothorax") suggest the need to exclude gastric herniation due to ruptured diaphragm

References

- [1]. Brian K.P. Goh; Andrew S.Y. Wong; Khoon-HeanTay,; Michael N.Y. Hoe, Delayed presentation of a patient with a ruptured diaphragm complicated by gastric incarceration and perforation after apparently minor blunt trauma Case Reports: *CJEM* 2004; 6(4):277-280
- [2]. Diaphragmatic rupture: From Wikipedia, the free encyclopedia en.wikipedia.org/wiki/Diaphragmatic_rupture
- [3]. Asensio JA, Petrone P, Demetriades D, commentary by Davis JW (2003). "Injury to the diaphragm". In Moore EE, Feliciano DV, Mattox KL. Trauma. Fifth Edition. McGraw-Hill Professional. pp. 613–616. ISBN 0-07-137069-2
- [4]. Smithers BM, O'Loughlin B, Strong RWDiagnosis of ruptured diaphragm following blunt trauma: results from 85 cases.*Aust N Z J Surg.* 1991 Oct; 61(10):737-41.

- [5]. Christiansen, L. A., Stage, P., Bille Brahe, E., and Bertelsen, S: Rupture of the diaphragm. A 23-year series of 25 patients with rupture of the diaphragm. (1974). *Thorax*, 29, 559-563.
- [6]. Cohen Z, Gabriel A, Mizrachi S, Kapuler V, Mares AJ. Traumatic avulsion of kidney into the chest through a ruptured diaphragm in a boy. *PediatrEmerg Care*. 2000 Jun; 16(3):180-1.
- [7]. Philip E. Bernatz; Alfred F. Burnside, Jr; O. Theron Clagett: problem of the ruptured diaphragm *JAMA*. 1958; 168(7):877-881. doi:10.1001/jama.1958.03000070033007
- [8]. Michelle Welsford, Rick Kulkarni: Diaphragmatic Injuries in Emergency Medicine; Updated: Dec 6, 2011: emedicine.medscape.com/article/822999-overview