

# Secondary Spontaneous Rupture of the Diaphragm in a Child after Blunt Chest Trauma

Seydou Togo<sup>1\*</sup>, Bourama Kané<sup>2</sup>, Moussa Abdoulaye Ouattara<sup>1</sup>, Issa Boubacar Maiga<sup>1</sup>, Yunping Lu<sup>3</sup>, Donghui Jin<sup>3</sup>, Allaye Ombotimbé<sup>1</sup>, Ibrahim Sangaré<sup>1</sup>, Maiga Abdoul Aziz<sup>1</sup>, Cheik Amed Sekou Touré<sup>1</sup>, Ibrahim Coulibaly<sup>1</sup>, Adama Issa Koné<sup>1</sup>, Sitan Illiassou<sup>1</sup>, Jaques Saye<sup>1</sup>, Cheik Sadibou Traoré<sup>1</sup>, Sékou Koumaré<sup>4</sup>, Moussa Camara<sup>4</sup>, Koita Adama Kononba<sup>4</sup>, Mody Traoré<sup>1</sup>, Zimogo Zié Sanogo<sup>4</sup>, Sadio Yéna<sup>1</sup>, Djibril Sangaré<sup>4</sup>

<sup>1</sup>Thoracic Surgery Department, Hospital of Mali, Bamako, Mali

<sup>2</sup>Pediatric Department, Hospital of Mali, Bamako, Mali

<sup>3</sup>24<sup>th</sup> Chinese Medical Team in Hospital of Mali, Bamako, Mali

<sup>4</sup>Surgery "A" Department, Point G Hospital, Bamako, Mali

Email: [drseydoutg@yahoo.fr](mailto:drseydoutg@yahoo.fr)

Received 12 April 2016; accepted 23 May 2016; published 26 May 2016

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## Abstract

Traumatic diaphragmatic rupture (TDR) is very rare in the pediatric age group. Because of its rarity and its coexistence with more injuries, the diagnosis is often delayed. Very little has been written about this condition in the pediatric age group. TDR, while uncommon, should be considered in cases of blunt thoracic trauma. All patients should undergo meticulous examination preoperatively. The clinical presentation and importance of making an accurate diagnosis and surgery is highlighted. We report a case of secondary spontaneous traumatic left-sided diaphragmatic rupture in a child that was managed by delayed surgical repair.

## Keywords

Pediatric, Thoracic Trauma, Diaphragmatic Rupture, Secondary, Surgery

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## 1. Introduction

Traumatic diaphragmatic rupture (TDR) is rarely seen in children. It occurs secondary to both blunt and pene-

\*Corresponding author.

trating trauma and is associated with a mortality of up to 19% [1] [2]. And accurate diagnosis is difficult because of the paucity of clinical symptoms and thus those injuries may be easily overlooked [1] [3]. In contradiction to adulthood traumas, in children, the clinical picture does not reflect the severity of trauma and any delay in the diagnosis may lead to significant morbidity and mortality. Deformation shear of the diaphragm is thought to be important factor in the pathogenesis of the condition after blunt trauma [4]. The injury is, therefore, seen after high-energy impact, especially side impact, and is usually associated with other serious and often life threatening injuries. In this case report, we aimed to present a case of spontaneous DR in a child that occurs as a complication of underlying diaphragmatic lesion after thoracic blunt trauma who had delayed successful surgical management.

## 2. Case Report

A 2-year-old male child was admitted to our emergency department as a result of tractor crash accident 5 weeks earlier. The patient fell from a moving tractor and the back wheel of the tractor had passed over the child's thorax. A chest X-ray performed previously, 24 hours after the accident had been normal (**Figure 1**).

The child presented acute respiratory distress 10 days ago and was initially wrongly diagnosed with pneumothorax in a rural hospital and an intercostal drain was inserted and intravenous fluids and antibiotics administered. The drain was removed after three days as no air or liquid was drained. He has been referred to our department for more investigations.

At the emergency department he presented sudden onset of dyspnoea, floppiness, and pallor.

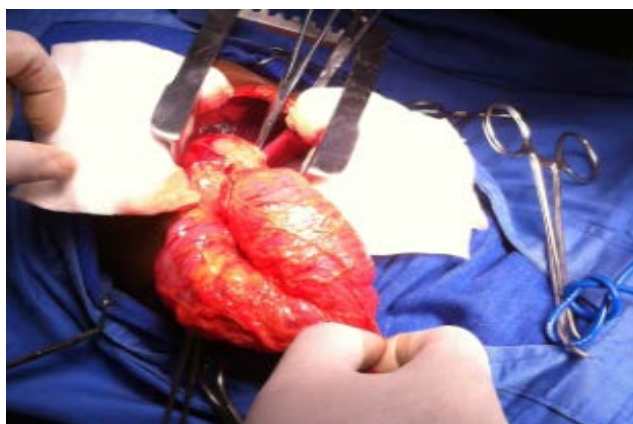
Although no serious injury was found. The abdominal and thoracic ultrasonography (USG) examination performed in the emergency service was normal. Chest radiography revealed visceral herniation in the left hemithorax with no discernible left hemidiaphragm that was described as rupture of the diaphragm (**Figure 2**). The patient was scheduled for operation with the diagnosis of left diaphragmatic rupture (DR). The patient's vital signs were stable and laboratory tests were normal before surgery. The patient underwent left thoracotomy surgical procedure. Complete left hemidiaphragm rupture was observed as well as the presence of visceral herniation (**Figure 3**). The diaphragm was sutured after reinsertion of the intrathoracic viscera. Rupture was repaired using single layer, interrupted non-absorbable monofilament sutures (**Figure 4**). The control of chest radiograph in postoperative was normal (**Figure 5**). The patient was discharged from the hospital without any complications. The patient has been followed up postoperatively in 8 month without any other complaint. Consent of the child parent was obtained for publication of the case.



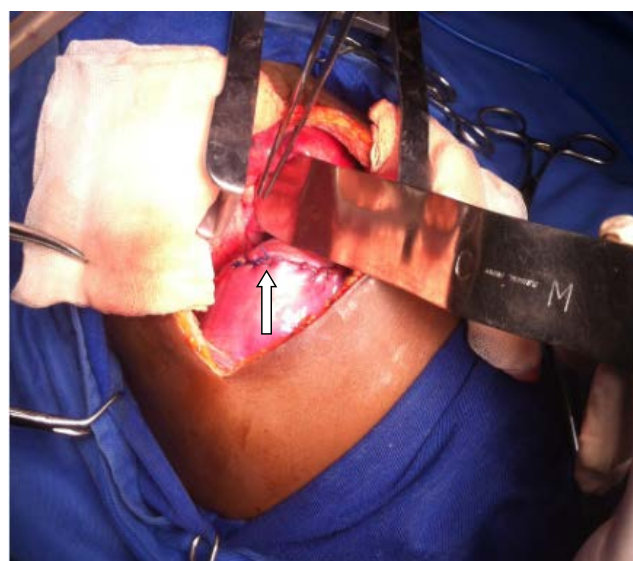
**Figure 1.** Chest X-ray 24 hours after accident.




**Figure 2.** Chest X-ray performed at admission.



**Figure 3.** Intrathoracic visceral contents finding.



**Figure 4.** Diaphragmatic rupture sutured (indicated by )



**Figure 5.** Postoperative chest X-ray.

### 3. Discussion

In the literature, cases reports of spontaneous DR in children are rare. There are no pathognomonic symptoms or signs of spontaneous rupture of the diaphragm and diagnosis is often delayed. The injury is usually missed in approximately 50% of cases [5]. Massive effusion may conceal the underlying TDR by non-visualization of diaphragmatic rim on X-ray. Even in late presentations, unless there's visceral herniation, an injury may easily be missed in the initial radiograph even on CT scan because of the thin diaphragmatic rim. Symptoms or signs of diaphragm rupture are similar to a pneumothorax and it is cited in differential diagnosis. In our context especially in rural area they were few specialists in radiological diagnosis and usually clinical symptoms were the key to the diagnosis. That is why in our case a diagnostic mistake occurred.

The injury is, therefore, seen after high-energy impact, especially side impact, and is usually associated with other serious and often life threatening injuries. The non-specific symptoms are nausea and vomiting, epigastric pain, and dyspnoea. Because motor vehicle accidents are increasing day after day, the number of reported cases tends to increase. There are several mechanisms leading to diaphragm rupture after a blunt trauma. These mechanisms are avulsion of the attachments of the diaphragm or shearing of the stretched membrane after right or left lateral impact to the chest wall, rib fracture fragments directly penetrating the diaphragm and a sudden increase in the intra-abdominal pressure throughout the abdomen with the relatively weak, unprotected left diaphragm tearing from the force. The right hemidiaphragm is also protected from abdominal impact by the energy-absorbing liver [6] [7]. Most of the time, diagnosis of DR is difficult in children due to the paucity of clinical symptoms. In children, the severity of trauma may not be determined as easily as in adults. Hemidiaphragmatic rupture more commonly involves the left side and occurs in 56% - 86% of the ruptured cases. In our patient diaphragmatic rupture was found in the left side and the diagnosis was made easily. There is no single investigation that provides a reliable diagnosis of TDR at initial presentation. Between 33% - 70% are diagnosed on initial CXR, but this figure decreases in patients who are intubated. The remaining cases are diagnosed at laparotomy, thoracotomy or autopsy and around 12% - 14% of cases have a delayed presentation [8]. CT scanning increases diagnostic sensitivity to 66% [9]. Magnetic resonance imaging, ultrasound, upper gastrointestinal contrast studies, laparoscopy and thoracoscopy have all been used in the diagnosis of TDR [10]. Physical examination is rarely useful in the multitrauma scenario. The chest radiography for initial screening of DR has a relatively low sensitivity for diagnosis, which was reported as diagnostic in 46% of the patients with rupture of the

left side and suspicious for DR in another 18% [5]. Most of the authors suggested that the preferred diagnostic method should be CT in blunt traumas. In our patient, chest X-ray allowed the diagnosis. Helical CT is a more accurate diagnostic method in the detection of DR, with a sensitivity of 71% - 84% and a specificity of 77% - 100% [7]. Although CT is more sensitive and specific than the other diagnostic techniques (Chest X-ray, ultrasonography). Diaphragmatic injuries, especially those on the left side, most frequently have diagnosed on simple X-ray or CT during the acute evaluation of trauma patients [11]. In our patient, we preferred Chest X-ray examination initially because of the resources-poor conditions. Previously the chest X-ray was normal but DR after the accident can not be excluded especially when CT scan or MRI was not done. Secondary spontaneous rupture of the diaphragm in children is very rare but should be considered in such circumstances. Associated injuries are common in traumatic rupture of the diaphragm due to the relatively large force required to disrupt the diaphragm, concurrently damaging the adjacent organs. Associated major injuries are reported in 52% - 100% of the patients. The most commonly damaged intraabdominal organs are the liver, reported as being disrupted in 93% of the patients with right-sided injury, and spleen in 24% of those with left-sided injury. In all cases of diaphragm tears, splenic injuries occur in 27% - 63% of the cases. Other commonly associated abdominal injuries include pelvic and renal injuries and associated intrathoracic injuries include hemopneumothorax and rib fractures [12] [13]. There was no associate injuries in our patient. Hemothorax, pneumothorax or rib fracture was not present.

Recognised complications are respiratory compromise due to a volume effect, pleural collection, pneumoperitoneum and intestinal obstruction or strangulation. Spontaneous closure of the diaphragmatic tear is unlikely because of the abdominothoracic pressure gradient, and progression to enlargement of the defect and thoracic herniation of the intra-abdominal contents can be expected. Open surgical repair has been the traditional method of treating blunt traumatic diaphragmatic injuries. Acute ruptures are best approached transabdominally via a midline incision as this permits assessment of associated intra abdominal injuries [4]. Diaphragmatic ruptures presenting in the latent phase, which can be from a few months to several years later, are more easily approached through the chest. This provides good access to the sac, as adhesions between the abdominal and intra-thoracic viscera may need to be broken down.

Surgical approach is most often abdominal in acute cases, but we require a thoracic approach because of the delayed repair. Mesh or prosthetic repair is rarely needed in the acute stage, but may be useful for a delayed repair. Laparoscopy may be a useful technique when standard diagnostic methods fail to reveal a DR and it is also useful for management. We did not apply any mesh or prosthetic measures in our patient because the diaphragm rupture was well sutured after abdominal reinsertion of intrathoracic viscera. She was followed up closely for 1 week. The patient was out of any complaint 1 month after surgery. Parental consent was obtained to publish the case.

#### 4. Conclusion

TDR is very rare in children and often associated with factors that contribute to the delay in diagnosis. To obviate delay in diagnosis, it is important to have a high index of suspicion as well as careful interpretation of the initial and follow-up radiological investigations including CT-scan of the chest and abdomen. Rapid surgical management when diaphragm rupture is diagnosed could decrease morbidity and mortality.

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