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The Management of Excessive Pleural Fluid in the Pleural Cavity in a Poor Hospital Setting

Smith AO[*1,2,4,5], Samuels RJ[1,5], Smalle IO[1,3,5] and Kpaka RB[2,5]

[1]Ministry of Health and Sanitation (MOHS), Government of Sierra Leone, 4th Floor Youyi Building, Freetown, Sierra Leone

[2]Eastern Technical University, Sierra Leone, Department of Public Health, Faculty of Health Sciences and Disaster Management, Kenema Eastern Province, Sierra Leone

[3]University of Sierra Leone, College of Medicine and Allied Health Sciences (COMAHS) New England, Freetown, Sierra Leone

[4]Xuzhou Medical University, Xuzhou City, 221002, Jiangsu Province P.R China

[5]Expresscare Medical Clinic, 72 Hangha Road, Kenema, Eastern Province, Sierra Leone

[*]Corresponding author:

Alhaji Osman Smith,
Department of Blood Diseases Institute, Xuzhou Medical University, Xuzhou City, 221002, Jiangsu Province, People's Republic of China
E-mail: osmansmith14@yahoo.com

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Hemothorax; pleural effusion spontaneous; chest tube drain

1. Abstract

Patients with spontaneous hemothorax or pleural effusion in the absence of trauma or disease- related causes are commonly encountered in poor hospital settings without a cardiothoracic surgeon or underwater seal draining connecting system. In these case reports, a 56-year-old and 25 years patient who presented with dyspnea was diagnosed with spontaneous hemothorax and pleural effusion, respectively. The one with automatic massive hemothorax was treated with a 20Fgauge catheter as chest drains for 72 hours without complications. At the same time, the other with moderate pleural effusion was treated with aspiration of pleural fluid. The two patients have also been treated with intravenous dexamethasone 12mg twice for at least 24 hours to enhance the reabsorption of the pleural fluid, fellow by a serial chest x-ray to monitor the lung expansion, plus antibiotics as prophylaxis. The excellent outcome of these patients indicates that unilateral hemothorax and pleural effusion can be treated in low-middle-income countries with poor hospital settings with minimal complications. In conclusion, these case reports show clinicians in poor hospital settings reduce the mortality or morbidity of the patient who is diagnosed with hemothorax or pleural effusion without a conventional underwater-seal drainage connecting system.

2. Introduction

The pleural fluid in the pleural cavity serves a physiologic function in respiration and lubricates the movement of the lungs with an estimated volume of 10-20ml within the pleural cavity. Assessing disease and diagnosing abnormality within the pleural cavity is a valuable measure [1,2]. In everyday clinical practice, the accumulation of fluid within this cavity denotes the types of fluid present in the pleural cavity; these include; hemothorax [blood in the pleural cavity] and pleural effusion [accumulation of serous fluid in the pleural cavity]—the excess liquid or blood drainage via chest tube placement or tube thoracostomy. The chest tube is inserted at the 4th -5th intercostal space in the anterior or mid-axillary line. The safety area is accessed by positioning the patient supine, lying on the bed at a 40-60 degrees Celsius angle, and slightly rotated with an ipsilateral arm over the head or behind the neck, [3–5]as shown in [Figure 1]. This space also serves as a route to install steroids to enhance the absorption of pleural fluid or antibiotics for post-pneumonectomy or sclerosing agents in pleurodesis and fibrinolytic/DNAse/saline due to parapneumonic effusion and empyemas [6,7]. A standard chest tube or thoracostomy tube provides drainage of fluid or air from the pleural cavity by re-establishes a negative intrapleural pressure, allowing the lungs to re-expand

within the pleural space, as shown in [Figure 2]. Accurately managing a patient that needs a chest tube requires skilled personnel that can safely insert the line with minimum discomfort to the patient. Also, a piece of knowledge in the principles of surgical drains and an understanding of the underwater seal drainage system is being utilized [5,7]. However, in low-middle countries, the chest drain tube connecting to an underwater seal drainage system is not readily available for blood or serous fluid drainage in the pleural space. This creates challenges for clinicians or inexperienced personnel in managing patients with these abnormalities, leading to morbidity and mortality. In this report, we established a safe method for the drainage of excess pleural fluid or blood in the pleural cavity without a chest tube with an underwater seal connecting system.

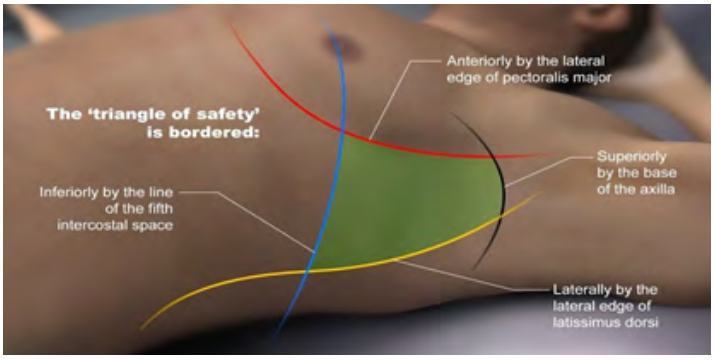

Figure 1: Illustrates the triangle of safety borders for inserting chest tube drains. The red line is bounded anteriorly by the lateral edge of the pectorals major muscle; the blue line is bounded inferiorly by the fifth intercostal space; the yellow line is bounded laterally by the lateral border of the latissimus dorsi, the black line is bounded superiorly by the base of axilla and the central green indicates the various site of chest tubes insertion.

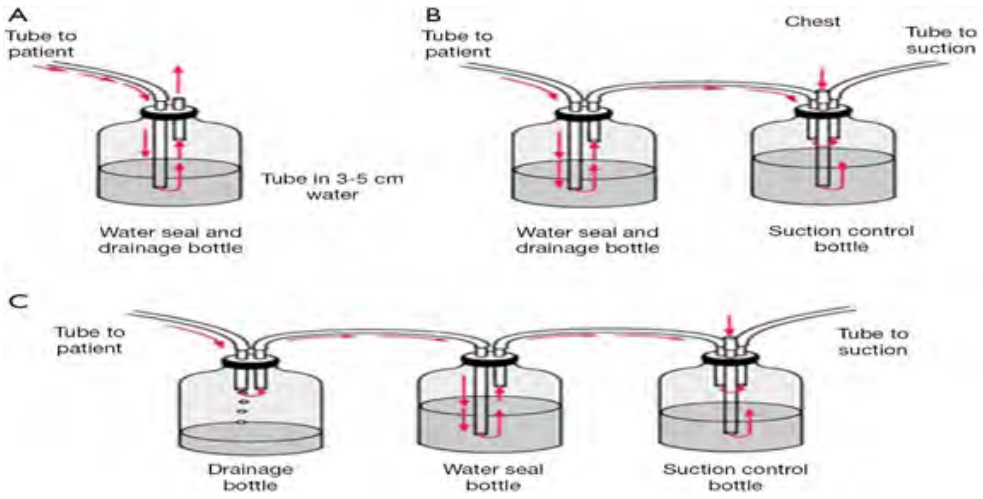

Figure 2: A chest tube drainage system (A) is a single bottle with underwater seal drainage and a tube to the patient.
(B) A two-bottle with underwater seal drainage and suction control bottle with two lines, one to the patient and one suction (C) A three-bottle with the underwater seal, one drainage bottle and suction control bottle with tubes, one to the patient and one suction.

3. Case 1 Presentation: History, Physical Examination, Investigations and Treatment

A 56-year-old man patient presented to the Kenema Government hospital with progressive breathlessness over four days, associated with nausea, vomiting, epigastric pain, insomnia and poor urine output. He had a past medical history of peptic ulcer disease [PUD] for four years, treated with anti-ulcer drugs. The patient denied taking herbal medications, alcohol, smoking, kola nut, vaping tobacco, and trauma. A general physical examination revealed illed looking patient in severe respiratory distress, evidenced by intercostal recession and conjunctival pallor. The vital signs of blood pressure of 137/88mmHg, a pulse of 82 beats/min, respiratory rate of 28 breaths/min, temperature 36.50 C and oxygen saturation of 85% without oxygen. On systemic examination, the cardiorespiratory revealed a decreased expansion of the chest on the left side, stony dullness to percussion and a marked decrease in the air entering on the left side of the trunk compared to the right, and first and second heart sounds were heard no murmurs on auscultation. The abdominal examination revealed epigastric tenderness, and the liver, spleen and kidneys were normal on palpation and normal bowel sound on auscultation. The genitourinary examination revealed the left side hydrocele and other genital organs appeared normal.

The laboratory investigation showed a haemoglobin level of 9.1g/dl [12-16g/dl], hematocrit value of 27% [40-50%], average white blood cell counts and differentials, urinalysis, urea and creatinine and liver function test [LFTs] respectively. Also, the serological tests of viral screening [HIV, hepatitis B & C] and syphilis and microscopic thin malaria parasite were negative. On admission, the patient has treated with intravenous omeprazole 40mg, 12mg dexamethasone, and intramuscular injection of 20mg buscopan bd for 48 hours, followed by oxygen support 5L/min via nasal prone and urethral catheterization. After 48 hours of admission, the patient was reviewed with normal oxygen saturation of 97% without oxygen support and poor urine out of less than 200ml per 24 hours. The patient was further treated with intravenous furosemide 160mg start, followed by 80mg bd for 48 hours. On review of the patient a few days later, the patient's urine output was restored with more than 1500ml of urine per 24 hours and referred to the radiological department to conduct a chest- x-ray posterior view which revealed massive left-sided pleural fluid with a deviation of the trachea to the right side of the chest as shown in [Figure 3A] followed aspiration of the 5ml of blood with needle and syringe at fifth intercostal space which confirmed spontaneous left-sided hemothorax as shown in [Figure 3B].

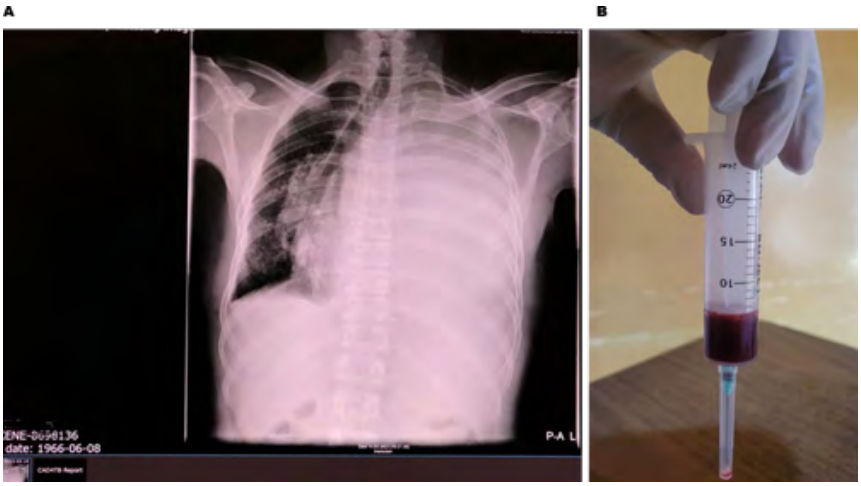

Figure 3: (A) The chest-x-ray of the patient, which shows massive left-sided spontaneous hemothorax with tracheal deviation to the right (B) The aspirated blood at the triangular safety area mid-axillary line with 10ml syringe and needle. The blood aspirated is 5ml, as seen on the syringe.

4. Procedure: The Drainage of Hemothorax Without a Standard Underwater Seal Connecting the Drainage System

Material and reagents

1. Local anaesthetic: lidocaine hydrochloride [2% w/v].
2. Small and large gauge needles [sizes 25 &18] and syringes [5 and 10ml]
3. 75% alcohol and 10% povidone-iodine
4. Sterile gauze, gloves and gown
5. Surgical blade [size 11] and Ethicon Prolene [M-3, 15mm, 3.8c]
6. Sterile: artery forceps or curve artery forceps, scissors
7. Urine bag and plaster
8. Urethral catheterization [French gauge 20 -yellow, 6.7 mm]
9. 500ml normal saline and gauge 22 cannula plus plaster
10. Prophylactic antibiotics include ampicillin and ampiclox, preferably amoxicillin and clavulanic acid [augmentin 1.2g].

5. Procedure for Drainage of Hemothorax

The patient was positioned at an angle of 40 degrees with the left upper limb above the head and an infusion of 500 ml of normal saline during the procedure to minimize complications. The triangular safety area is located at the fifth intercostal space mid-axillary line, clean in a circular inside-out with 75% alcohol twice and once with 10% povidone-iodine followed by infiltration of the site with 5ml local anaesthetics [lidocaine] from the surface to the deeper tissues. After 2 minutes of the infiltration of the local drugs, an incision is created at the fifth intercostal space anterior to the fifth rib to avoid the intercostal vessels. The artery forceps are used to separate the intercostal muscles, and the curved artery forceps clap with the 20F catheter and are introduced into the pleural space. When blood flow is confirmed, the catheter is connected to the urine bag, and the indwelling catheter suture and area are dressed in sterile gauze, as shown in [Figure 4A]. The patient was placed on 1.2g intravenous augmentin and monitored with regular pulse oximetry and serial chest -x-ray, as shown in [Figure 4B].

Figure 4: (A) The chest drain insertion with an indwelling 20F gauge catheter connected to the urine bag containing the flowing blood. (B) The serial chest -x -ray after catheter insertion in the pleural space. After 24 hours total: 600ml of blood was drained, and the trachea was returned to its anatomical position; after 48 hours, 1600ml of blood was exhausted; after 72 hours, a total of 2500ml of blood was drained.

6. Post-Procedure Course

We had no hemodynamic instability or significant bleeding after inserting the indwelling 20F gauge catheter at the fifth intercostal space. A total of 2500ml of blood was drained from the pleural space, and a serial chest-x ray taking after the procedure to monitor the expansion of the lung. During blood drainage from the pleural cavity, the patient has transfused two units of packed red blood to maintain hemodynamic stability. The patient was given 12mg dexamethasone intravenously twice for 48 hours to enhance the reabsorption of blood in the pleural cavity. Also, the patient was placed on prophylaxis intravenous augmentin 1.2g twice daily for 72 hours and followed oral antibiotics of prednisolone 60mg daily for seven days and oral augmentin 632mg twice daily for seven days. The patient was discharged seven days after the procedure, followed by weekly follow-up.

7. Case 2 Presentation: History, Physical Examination, Investigations and Treatment

A 25-year-old man patient presented to the Kenema Government hospital with progressive breathlessness over fourteen days, associated with fever and an unproductive cough. Headache, dizziness and left-sided chest heaviness. He had a past medical history of peptic ulcer disease [PUD] for one year, treated with anti-ulcer drugs. The patient denied taking herbal medications, alcohol, smoking, kola nut, vaping tobacco, and trauma. A general physical examination revealed a healthy-looking patient with moderate respiratory distress evidenced by left chest wall indrawing. The vital signs of blood pressure of 128/90mmHg, a pulse of 98 beats/min, respiratory rate of 26 breaths/min, temperature 36.80C and oxygen saturation of 96% without oxygen. On systemic examination, the cardiorespiratory revealed a decreased expansion of the chest on the left side, stony dullness to percussion and a marked decrease in the air entering on the left side of the trunk compared to the right, and first and second heart sounds were heard no murmurs on auscultation. All other systemic examinations appeared normal. The laboratory investigation showed a haemoglobin level of 12.1g/dl [12-16g/dl], hematocrit value of 45% [40-50%], average white blood cell counts and differentials, urinalysis, urea and creatinine and liver function test [LFTs] respectively. Also, the serological tests of viral screening [HIV, hepatitis B & C] and syphilis and microscopic thin malaria parasite were negative. The patient was referred to the radiological department to conduct a chest-x-ray posterior view which revealed moderate left-sided pleural fluid without deviation of the trachea shown in [Figure 5A], followed by aspiration of the 5ml of pleural fluid with needle and syringe at the fifth intercostal space which confirmed spontaneous left-sided pleural effusion as shown in [Figure 5B].

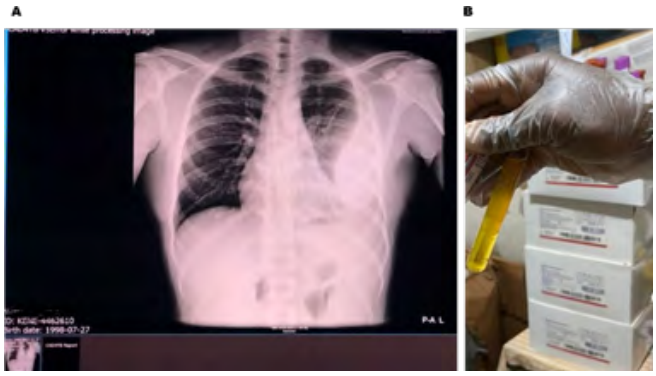

Figure 5(A): The chest-x-ray of the patient, which shows moderate left-sided spontaneous pleural effusion (B) The aspirated fluid at the triangular safety area mid-axillary line with 10ml syringe and needle. The fluid aspirated is 5ml, as seen on the collecting tube.

8. Procedure: Aspiration of the Plural Fluid from the Pleural Cavity

Material and Reagents

1.Small and large gauge needles [sizes 25 &18] and syringes [5 and 10ml]

2.75% alcohol and 10% povidone-iodine

3.Sterile gauze and gloves

4.500ml normal saline and gauge 22 cannula plus plaster

5.Prophylactic antibiotics include ampicillin and ampiclox, preferably amoxicillin and clavulanic acid [augmentin 1.2g].

Procedure

The patient was positioned at an angle of 40 degrees with the left upper limb above the head and an infusion of 500 ml of normal saline during the procedure to minimize complications. The triangular safety area is located at the fifth intercostal space mid-axillary line, clean in a circular inside-out with 75% alcohol twice and once

with 10% povidone-iodine. A 10ml needle and syringe were used to aspirate 450ml of the pleural fluid from the pleural cavity with constant monitoring of the patient's oxygen saturation.

9. Post-Aspiration Course

We had no hemodynamic instability or significant bleeding after aspirating the pleural fluid with a 10ml syringe and needle at the fifth intercostal space. A total of 450ml of pleural fluid was drained from the aspirated pleural cavity, and a serial chest-x ray taking after the procedure to monitor the expansion of the lung. The patient was placed on intravenous dexamethasone and 1.2g amoxicillin, and clavulanic acid for 24 hours, followed by serial monitoring of chest- x-ray, as shown in [Figure 6].

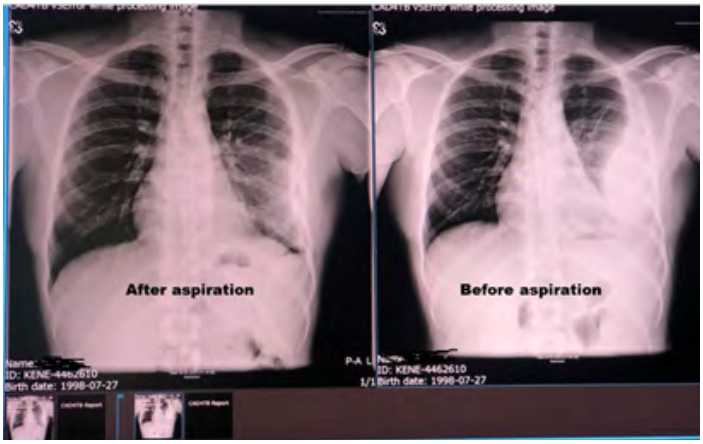

Figure 6: The patient's chest-x-ray shows moderate left-sided spontaneous pleural effusion without tracheal deviation. The chest-x ray before and after aspiration of pleural fluid at the triangular safety area mid-axillary line with 10ml syringe and needle.

10. Discussion

Spontaneous hemothorax is clinically defined as the accumulation of blood in the pleural cavity in the absence of trauma or other causes or when the pleural fluid hematocrit greater than 50% of the peripheral blood hematocrit and the lack of iatrogenic trauma of the lungs or pleural space. Other causes of spontaneous hemothorax include coagulopathy and intraabdominal vascular injury[3,8]. Our patient did not have any of the alternative etiologies of spontaneous hemothorax. The management of unexpected hemothorax depends on the amount of blood present in the pleural cavity which can either be the conservative or surgical approach. Massive spontaneous hemothorax is typically managed by cardiothoracic surgeons. However, poor hospital setting without cardiothoracic surgeons or the unavailability of a water under-seal connecting system makes it challenging for inexperienced clinicians that encounter this case in clinical practice, especially in low-middle countries. The management of spontaneous hemothorax falls under two categories: aspiration or insertion of a chest drain in the proper hospital setting but poor hospital setting; the latter method cannot be applied due to the unavailability of chest drains, which makes it a difficult task in the treatment spontaneous hemothorax. In the report, we developed a low-cost, practical approach to the management of massive spontaneous hemothorax in the absence of cardiothoracic surgeons or water under seal chest-drain connecting systems.

Pleural effusion is the accumulation of pleural fluid in the pleural space either due to the inability of the lungs to reabsorb the secreted fluid or excess release of the pleural fluid. Pleural effusion is commonly encountered in clinical practice due to transudate or exudate causes of pleural effusion, such as congestive heart failure, pneumonia or malignancy. The absence of any underlying etiologies is referred to as spontaneous pleural effusion [4,9]. The management of pleural effusion also falls under two categories: aspiration or chest drain insertion. In poor hospital settings, without proper water, underseal chest drain connecting creates difficulties in the management of pleural effusion. Therefore, chest drain insertion should be avoided in a patient who is a hemodynamically stable patient who presents with moderate pleural effusion with an estimated fluid of 1-1.5 litres[10]. Our patients fall into this category, and we reduce hospital admission without inconvenient the patient's daily activities.

11. Conclusion

Accumulation of pleural fluid in the pleural cavity, either blood or serous fluid, can occur due to various causes and in the absence of any reasons denoted spontaneous. Clinicians in low- middle-income countries faced with these cases should use a low-cost, effective practical approach described by the diagnostic algorithm [Figure 7] for unilateral hemothorax or pleural effusion.

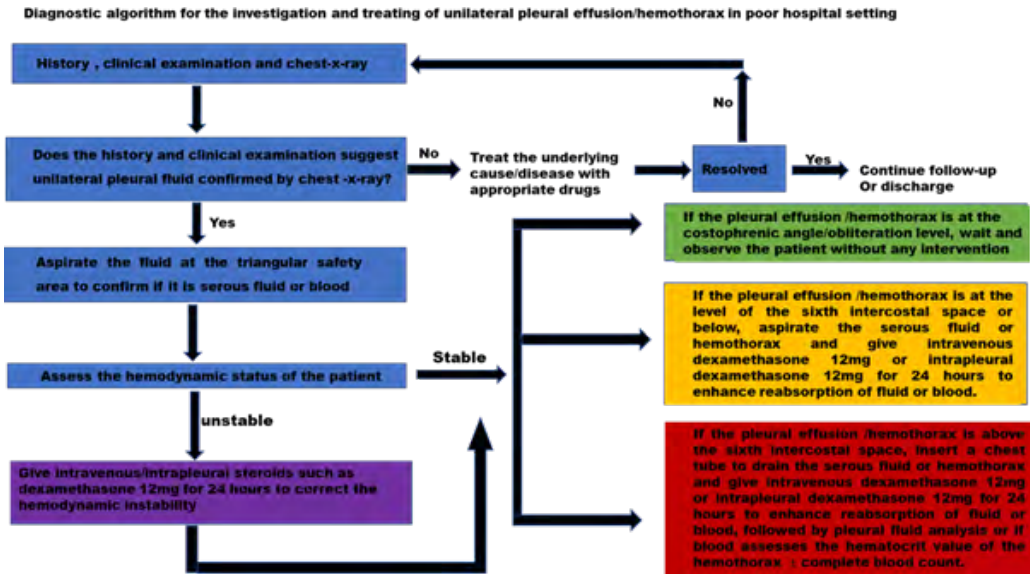

Figure 7: The diagnostic algorithm for investigating and treating unilateral pleural effusion/hemothorax.

12. Acknowledgment

we want to say thank to the patients for their trust and support in carrying out these procedures and Annex staff of Kenema Government hospital for their support thorough out the procedures.

13. Data Availability

The data generated are included in the case report.

14. Funding Statement

Not available

15. Conflict of Interest

The authors declare no conflict of interest.

16. Ethical Approval

verbal and written consent were in line with the standard practice of medicine is Sierra Leone.

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