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Association of Cardiovascular and Thoracic Surgeons of Nigeria (ACTSON)

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Association of Cardiovascular and Thoracic Surgeons of Nigeria (ACTSON)

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Editorial

It is often said that 'the beginning is always the hardest'. While this statement may not be absolute, a peep into our social and academic/clinical experiences, would lend credence to this incontrovertible statement. From the social point of view, those who were courageous enough to sacrifice their freedom for the allurings of marriage, would attest that the first few years of the married life, were the most 'turbulent' but as the years trickled by, the opacity waned. Similarly, we can all recall our anxieties and the palpitations we had when we started reading our anatomy textbooks at the beginning of the pre-clinical years. Personally I had to close my 'Cunningham's Manual of Practical Anatomy' on two occasions when I attempted reading ahead of the class before the session began as the Latin terminologies for the different body parts were far from neological to me. They were not just jargons but completely absurd. However, when the session began and with every passing lecture backed up with Cadaver Dissections, these 'jaw-breaking' terminologies became easier to 'chew' and digest.

If the above examples are inappropriate perhaps the challenges bedevelling our efforts to begin local 'Open Heart' surgery programs may score the point. Better still, the experiences of centers that have surmounted the hurdles would confirm that while the beginning was nerve racking and nightmarish, subsequent and recent forays are like navigating through charted seas. In the same vein, it took great courage and a 'leap of faith' by a determined few to inaugurate our dear association ACTSON; for there were always such questions as 'what happens to our relationship with the Nigerian Cardiac Society, what do we hope to achieve?'. Some of us even felt the older generation may not be happy with the whole idea, considered to be too ambitious! Today however, the story is different as the achievements speak for themselves! Not only have we grown in numbers with more centers offering cardiothoracic and vascular services, the number of centers performing open heart surgeries and the variety and complexities of these surgeries would make medical tourism for open heart surgeries a thing of the past in no distant future.

This same fate(difficult beginnings), like the 'sword of Damocles', seems to have befallen two lofty ambitions of our budding association; the 'database project and the association's journal project'. Ironically, like Damocles and Dionysius in this mythology, we have willingly given up on the database project! We are now left with the journal project whose history simulates that of a postdated pregnancy in an old primipara, made possible via artificial insemination after two attempts and which must be sectioned to avert an obstetric calamity! It is our prayer that with successful delivery of the maiden edition, the challenges of funds and paucity of manuscript would be a thing of the past.

I would want to enjoin all members of this great Association, to put in extra effort in seeing to the survival of this Journal by sending in manuscripts and encouraging others(non-members) to patronize the Journal. By this, we hope that the subsequent editions will not only have higher manuscript content, but also attract adverts from Medical Device companies and Pharmaceutical Industries. *'Bonne lecture'*

Sunday A. Edaigbini, *FWACS, FICS*
Editor

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INFORMATION FOR AUTHORS

Instruction to Authors

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Books and Other Monographs

1. Personal author(s): Parija SC. Textbook of Medical Parasitology. 3rd ed. All India Publishers and Distributors. 2008.
2. Editor(s), compiler(s) as author: Garcia LS, Filarial Nematodes In: Garcia LS (editor) Diagnostic Medical Parasitology ASM press Washington DC 2007: pp 319-356.
3. Chapter in a book: Nesheim M C. Ascariasis and human nutrition. *In* Ascariasis and its prevention and control, D. W. T. Crompton, M. C. Nesbemi, and Z. S. Pawlowski (eds.). Taylor and Francis, London, U.K.1989, pp. 87–100.

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2. Drafting and critical review of the article for sound intellectual content
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Annals of Cardiovascular and Thoracic Surgeons of Nigeria **Original Articles**
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Comparison of the efficacy of flutter valve urine drainage bag and underwater seal system in the management of pleural effusion

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ABSTRACT

Background: Pleural effusion is relatively common. A safe and cost-effective means of drainage is therefore necessary in order to care for these patients, especially those in low socioeconomic class. The use of underwater seal is commonly employed and has been the gold standard in the drainage of pleural effusion. Considering the low cost of the flutter valve urine bag, it could be a viable alternative to the underwater seal system. This study compared the efficacy of flutter valve urine drainage bag and underwater seal in the management of pleural effusion.

Objectives: To determine which drainage system results in faster achievement of adequate lung re-expansion and more efficient drainage of effusions between the underwater seal and flutter valve urine bag.

Materials and methods: 130 patients who were 18 years and older with pleural effusion were randomized to receive either an underwater seal drainage system or a flutter valve urine drainage bag. The duration of chest drainage, average daily volume drained, residual effusion and time to achieve full lung re-expansion were recorded for both groups and compared. Lung expansion and residual effusion were monitored using serial chest radiographs.

Results: Both groups had large residual effusions at first chest x-ray ($p = 0.393$), 67.7% of the underwater seal group and 60 % of the flutter valve urine bag group did not have fully expanded lungs, ($p= 0.563$). However, at the second chest x-ray, 96.92% of the underwater seal group, and 90.77% of the flutter valve urine bag group had fully re-expanded lungs ($p =0.137$). 100% of the underwater seal group, and 86.15% of the flutter valve group had no residual effusion at second chest x-ray ($p = 0.022$).The mean daily effusion drained was 473.95ml (SD: 187.8) for the underwater seal group, and 428.37ml (SD: 261.45) for the flutter valve urine bag group, ($p =0.256$). The mean duration of drainage in days was 4.57 (SD:3.394) and 4.75 (SD: 2.424) for the flutter valve urine bag group and underwater seal system group respectively with $p = 0.722$.

Conclusion: The flutter valve urine drainage bag is as efficient as the underwater seal drainage bottle in the management of pleural effusion.

Keywords: *Pleura, Effusion, flutter Valve, underwater seal, Chest tube*

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INTRODUCTION

Pleural effusion is a collection of fluid within the pleural space. It is a common problem encountered in medical practice[1]. About 20ml of fluid which is low in protein is present in the pleural space, forming a 10mm thick lubricating interface between the parietal and visceral pleurae[2]. 1 to 6μm stomata in the parietal pleura which facilitate drainage into the sub-mesothelial lymphatic lacuna, tend to offer little resistance to the movement of proteins and fluid. A pressure gradient facilitates movement into, but not out of the pleural space, since intrapleural pressure is also lower than interstitial pressure. Pleural fluid mainly leaves the space by bulk flow through the parietal lymphatics rather than by diffusion or active transport[3]. Pleural fluid turnover rate is about 0.15 ml/kg/h.[2] Pleural fluid accumulation results from increased production, and or reduced absorption.[1] Therefore, it arises from the systemic pleural vessels, and moves across the pleural space and exits through the parietal pleural lymphatics in the dependent part of the cavity[4].

The major mechanisms responsible for the formation of pleural effusion includes: increased hydrostatic pressure, reduced oncotic pressure, increased capillary permeability, and lymphatic obstruction. Pleural effusion can be classified as either transudative or exudative. Pleural fluid is an exudate if one or more of the following criteria are met: Ratio of pleural fluid protein to serum protein is >0.5; Ratio of pleural fluid lactate dehydrogenase (LDH) to serum LDH is >0.6; Pleural fluid LDH is>2/3 the upper limits of normal value for serum LDH (200 IU/L).The pleural fluid cholesterol-to-serum ratio are the most accurate diagnostic indicators for pleural exudates [5].

Common causes of exudative effusion include; Malignancies, Parapneumonic effusions and tuberculosis. Less common causes include; Pulmonary embolism, rheumatoid arthritis and other autoimmune pleuritis and benign asbestos effusion, pancreatitis, post-myocardial infarction and post-coronary artery bypass graft. Rare causes include yellow nail syndrome and other lymphatic disorders for example lymphangioleiomyomatosis and fungal infections.[1] The most common causes of hemorrhagic pleural effusion include tumours, both primary pleuroparenchymal as well as secondaries(metastasis), trauma and tuberculosis[6]. The features of transudative effusion include: Pleural fluid protein to serum protein ratio less than 0.5; Pleural fluid lactate dehydrogenase (LDH) to serum LDH ratio less than 0.6; and pleural fluid LDH less than 2/3 of the upper limits of laboratory normal value (200IU/L) for serum LDH[1].Causes of transudative effusion include left ventricular failure and liver cirrhosis while less common causes are hypo-albuminaemia, peritoneal dialysis, hypothyroidism, nephrotic syndrome, mitral stenosis. Rare causes include constrictive pericarditis, urinothorax, and Meigs' syndrome[1].

Figure 1: Romson's underwater seal system

Treatment options for pleural effusion include addressing the underlying cause and thoracocentesis or closed thoracostomy tube drainage.[7,8].

Tube thoracostomy is a safe and effective procedure for the treatment of pleural collections[8]. In a resource poor setting like Tropical Africa, where many are poor[9], a cost-effective means of achieving adequate pleural drainage and good lung re-expansion with minimal complications is paramount. Traditionally, the underwater seal bottle (Figure 1) has been used for drainage of pleural effusion. The underwater seal bottle comes in different designs, and it is the ***gold standard*** for pleural drainage. It comes as a single chamber or dual chamber designs. Both have risk of iatrogenic pneumothorax[10].

The ambulatory chest drainage system was designed as an alternative to the underwater seal. It has flutter valve that prevents re-entry and is vented into a flexible drainage bag.

The flutter valve (also known as the Heimlich valve after its inventor, Henry Heimlich), is a one way valve designed as a rubber sleeve within a plastic casing where the rubber sleeve is arranged so that air and fluid can pass through the valve in one way while the sleeves open and then closes when air or fluid is sucked back the other way. The Heimlich valve (Figure 2) is usually connected to chest tubes on one end, and drainage bag on the other end. The direction of flow is imprinted on the body of the valves.

With the flutter valve drainage bag, there is no need for tube clamping during ambulation. It is also lighter and can be carried around by the patient, relatively easier to use within and even outside the health facility. This system has been incorporated in many urinary drainage bags which are readily available (Fig. 3, and 4).

As at the time of writing this paper, the underwater seal drainage system cost between ten and fifteen thousand naira (25 to 35 US dollars) while the flutter valve urine bag cost between three hundred and five hundred naira (0.73 to 1.21 US dollars).These exclude the cost of the chest tube and suture materials.

Some advantages observed by Adegboye *et al.* from the use of Aldon's urobag (flutter valve bag), were reduction in the cost of pleural drainage, availability of this drainage system and its use for out-patient care when indicated.[11] The presence of clinically significant fluid in the pleural space connotes a pleural effusion. It can be transudative or exudative, and it is a common presentation encountered in thoracic surgical practice[12].

The underwater seal in the present form was first described by Kenyon in 1916[13]. It consists of a tubing within a drainage container which is placed about an inch below water level, and a vent to allow for escape of displaced or drained air. The vent can also function as a point for connection to suction in order to aid drainage. The total volume of the drainage container should be large enough to collect over 500 to 600 ml of fluid above the initial water seal level[14]. For the purpose of moving the patient, the tube should be clamped with at least two tube clamps. This is to prevent the occurrence of iatrogenic pneumothorax or the underwater seal fluid going into the patient's chest. Thus, tube clamping is quite important during mobilization of the patient with an underwater seal drainage system. The entire design is cumbersome and restricts patient's mobility[15]. The flutter valve urine drainage bag has an incorporated Heimlich valve, and when used as a chest drainage system, eliminates the need for tube clamping. This is because the one-way flutter valve does not allow fluid or air to return once drained. This system allows early ambulation and early discharge home[16].The idea of valve drainage system has been around since 1944[17]. The Heimlich valve was used for emergency chest drainage during the Falkland wars and was fairly successful[16]. Thompson in 1981 showed that bags with integral non return valve could be used for chest drainage[18] and successfully also outside the hospital for ambulatory patient.[19] Alastair *et al.* In a randomized clinical trial of chest drainage systems[16], demonstrated the effectiveness of the flutter valve drainage bags compared to the underwater seal among post-operative patients. In a similar study, VuoriSalo S. et al, compared the flutter valve drainage bag and underwater seal for pleural drainage after lung surgery[15]. They concluded that the flutter valve drainage system was a safe and feasible alternative in the management of post-operative air leaks and hemorrhage after lung surgery. In another study, Waller D.A., made a physiological comparison of flutter valve drainage bags and underwater seal systems in the management of post-operative air leaks[20]. The result of this study shows that when post-operative air leak exists without a persistent pleural space, the flutter valve may provide a physiologically more effective alternative to the underwater seal. This physiologic advantage that the flutter valve drainage system has over the underwater seal may make it a better option in the drainage of pleural effusion.

The normal pleural space is usually at a negative pressure of $-8cmH_20$ to $-3cmH_20$[20, 21] . A physiologically more acceptable drainage system is the one that maintains a more negative intrapleural pressure at resting tidal volume. The flutter valve drainage bag has been shown to possess that advantage over the conventional underwater seal[20]. The fluid filled dependent loop often seen with the underwater seal may increase intra pleural pressure to as high as 8cm$H_2$0 and diminish drainage to zero[22].

Most studies comparing the flutter valve drainage system with the underwater seal were done in the operative patients who had various lung surgeries or other thoracic procedures and have shown favorable outcomes regarding the flutter valve bag, coupled with its low complication rates[23] and thus a viable alternative to the underwater seal. The urinary collection bag or the Urosac[R], has an incorporated flutter valve, and can be used as a cheap and easily available substitute[24].Urosac used as chest drainage bags has been shown to be safe, effective and economical in several studies.[25,26,27,28] They are light sterile, and have a strap for the patients to wear it under their clothing. The Urosac bags have been used safely and effectively in pleural effusions of various etiologies.[24,27] The Heimlich flutter valve has also been shown to be an effective replacement for the underwater seal[29].

RELEVANCE OF THE STUDY

This study compared the, cheap readily available Urine bags which have an in-built flutter valve mechanism with the standard more expensive underwater seal for chronic drainage like in pleural effusion where the collections are much larger than in the post-operative patients. The essence of this study is converting a urine (flutter valved) drainage bag into a chest drainage system.

JUSTIFICATION FOR THE STUDY

Considering the numerous advantages of the flutter valve bag, availability, low cost, effectiveness as a chest drainage system, and the low socio-economic status of the majority of our patients, it became imperative to study its use as compared to the conventional underwater seal system among patients with pleural effusion.

LIMITATIONS

This study may be limited by the differences in the length and internal diameters of the tubings of the collection systems. This is because, theoretically, the length and radius of the tubing has an effect on the flow rate (Poiseuille's law) and thus, the daily volume of effusion drained. This limitation were minimized by using chest tubes and drainage chambers from same manufacturer for all patients in order to ensure uniformity. Length of the flutter valve urine bag was 87cm with an internal diameter of 0.5cm, while the length of the underwater seal tube used was 150cm with internal diameter of 1cm. Same sized chest tube (32 Fr) were used for all patients.

THE OBJECTIVES OF THE STUDY

1. To determine which drainage system results in faster achievement of adequate lung re-expansion between the underwater seal and flutter valve urine bag.
2. To determine and compare the mean duration and volume of effusion drained among patients who had the underwater seal and with those who had drainage with the flutter valve urine bag.
3. To determine and compare complication rates (pneumothorax and tube blockage) among the patients with pleural effusion who had drainage with underwater seal and those who had drainage with the flutter valve bag.

METHODOLOGY

Study setting/site:

The study was carried out at the University College hospital, Ibadan. It is a tertiary referral hospital located in the southwestern part of Nigeria.

Study population:

The study population included patients who are 18 years and over with pleural effusion who were admitted into the medical, gynaecological, and surgical wards.

Study design: The study was a prospective randomized control trial, with the control group being those with pleural effusion who received underwater seal drainage, while the study group were those with pleural effusion who were treated with flutter valve urine drainage bag.

Inclusion criteria:

1. Patients presenting with pleural effusion (such effusion were large enough to obliterate the

diaphragmatic outline on a posterior- anterior chest radiograph, to warrant closed tube drainage)
2. Patients who were 18 years or older.
3. Patients whose thoracocentesis yielded **free flowing,** serous, serosanguinous, or hemorrhagic effusion.

Exclusion criteria:

1. Patients with chronic empyema thoracis, due to the high incidence of trapped underlying lung that may not readily expand after drainage of the effusion.
2. Patients with hemothorax
3. Patients with seropurulent or purulent effusion as seen at thoracocentesis.

Duration of drainage:

The total drainage period was defined as the time from tube insertion to when daily drainage falls to 100mls or less, for two consecutive days and in the absence of tube blockage.

Methods for estimation of effusion:

Measurement of level of effusion using standard PA chest x-ray: The volume of effusion was first estimated on the initial radiograph at presentation. During subsequent radiographs as treatment progressed, the residual effusion was again estimated and compared for both groups.

At a volume of approximately 50mls, pleural fluid appears as a meniscus on the lateral chest radiograph, but it takes up to 200mls of fluid to make a meniscus visible on the PA chest x-ray. The diaphragmatic contour is obscured with effusion of about 500mls.[30] Effusion that obscures the cardiac borders (left or right) or half of the hemithorax could be as much as 1 to 2litres. Pleural effusion reaching up to the anterior fourth rib, is about 1000mls.[31] On these erect PA chest radiographs, effusion that reach the apex (over 1000ml) could be up to 2.5 to 3 litres in volume. Thus, from the chest x-ray, homogenous opacity involving whole hemithorax indicates large effusion, while homogenous opacities extending up to the middle lung zone indicates moderate effusion, and that involving the lower lung zone indicates mild effusion. Other methods of estimation of pleural fluid include the use of thoracic ultrasound scan and computed tomography (CT) scan. Using a 2.5 MHz ultra sound (USS) probe in the posterior axillary line, pleural fluid height can be used to predict its volume in erect patients.[32] Also, in supine patients, the amount of pleural fluid can be estimated by USS[33] and CT scan.[34] But for the purpose of this study, the erect PA chest x-ray was used for pleural fluid volume estimation.

Equipment:

Chest tubes (Figure 5; Shree Umiya Surgicals PVT LTD, Ahmedabad 382445, India), underwater seal drainage set (Romoseal underwater seal; Romson's International, Noida 201305, India, Figure 7), flutter valve (urinary) drainage bags (Figure 6: Huaian Angel Medical Instruments Co. Ltd. Huaian, Jiangsu, China.).

Sampling technique /strategy:

Randomization was carried out by selecting an unmarked envelope which randomly assigns patients to receive either an underwater seal drainage system or a flutter valve drainage bag.

Sample size determination:

1. N = sample size
2. F= estimated non response (attrition) rate, in this case, 0. Since all recruited patients will get either an underwater seal or a flutter valve drainage bag
3. Z_x = corresponds to 1.96 for the significance level á, which is taken at 0.05 (confidence interval 95%)
4. Statistical power is taken as = 0.8
5. $Z_â$= corresponds to standard normal deviate, of 0.842 for the statistical power of 0.8

Using the formula:

the control group being those to receive underwater seal treatment, and the treatment group being those to receive the flutter valve drainage bag. Using formula for proportion

P1 = 0.7(based on the percentage lung re expansion at the end of pleural drainage)[23]

Po=0.9 (assuming an approximate effect size of 20%)

$$N = \frac{2 \times (1.96 \times 0.842)^2 \times 0.8 \times (1-0.8)}{(0.2)^2} = 62.8$$

N= 63 per group. (126 for both groups)

A total of 130 patients were recruited for the study.

Ethical consideration:

Ethical approval for the study was obtained from the research and ethics committee of the university college Hospital Ibadan, Nigeria. UI/UCH Ethics Committee assigned number: UI/EC/16/0037. Participation in this study was entirely voluntary. For patients who decline to participate, their treatment was not affected in any way.

Data Collection Procedures:

Randomization was effected by choosing from a group of (130, of 65 each for each group) unmarked envelops which indicated either underwater seal or flutter valve drainage bag.

Chest tube insertion:

The patients had size 32 Fr chest tubes inserted under aseptic conditions on the side of the effusion. The patients were positioned lying at 45 degrees head up, with the arm on the affected side abducted. After cleaning the anterior and lateral chest wall with povidone iodine, the 5^{th} or 6^{th}intecostal space was determined by counting from the sternal angle of Louis. The skin was infiltrated with Lignocaine in the mid axillary line. A 2 to 3 cm transverse skin incision just above a rib is made, and tissues were dissected using a number 3 artery forceps up to the pleura. Digital exploration of the pleural space was carried out and a size 32Fr tube was inserted and directed appropriately and secured using nylon 2 suture (for both anchoring and purse string).

Monitoring of the Drainage and Complications*:*

Following chest tube insertion, the total volume of effusion drained was recorded on a daily basis until drainage dropped to 100mls or less for two consecutive days. The total duration of chest drainage, and lung re expansion were monitored and recorded on the proforma, so also was residual effusion. Lung expansion and residual effusion were monitored using serial chest radiographs, and these were done at first and second chest x ray following chest tube insertion. The onset and frequencies of complications were noted. For the purpose of this study, only two complications were considered for convenience and to avoid too many cofounders; chest tube blockage and iatrogenic pneumothorax. The urine bag tube is narrower than the underwater seal tube. Despite using same sized chest tubes, stasis in the urine bag tube may cause chest tube blockage. Chest radiographs were done within the first three days of chest tube insertion, and repeated between five to seven days post chest tube insertion if the lung was not fully re expanded. These were repeated every three days if the lung was not fully expanded until it became fully re expanded.

Data presentation and analysis: Both qualitative and quantitative data were analyzed using Statistical package for Social Sciences (SPSS), version 23, statistical software. Chi square test was used to test for statistical difference for categorical variables, while continuous variables were analyzed and compared using student-t test. Statistical significance was taken as < 0.05. N = number of patients, SD= Standard deviation.

RESULTS

A total of one hundred and thirty (130) patients were recruited, with sixty-five (65) each having either underwater seal bottle or flutter valve urine drainage bag for the drainage of their pleural effusions. Most (61.5%), of the patients were below 50 years of age, and were predominantly females (57.7%).

Table 1: Descriptive characteristics of the patients

	N	%
AGE(years):		
18 -50	80	61.5
>50	50	38.5
Total	130	100
Sex distribution:		
Males:	55	42.3
Females:	75	57.7
Drainage System:		
Underwater seal (uws)	65	50
Flutter valve Urine bag (Fv)	65	50
Side of effusion:		
Left;		
uws	29	22.3
Fv	37	28.5
Total	66	50.8
Right;		
uws	36	27.7
Fv	28	21.5
Total	64	49.2
Duration of drainage (days):		
Uws	4.57	
Fv	4.75	
Etiologies of the effusion:		
Malignancies (breast, ovarian, lung, cervical, maxillary, pancreatic, lymphoma)	76	58.46
Tuberculosis	30	23.08
Pneumonia	19	14.62
Cardiac failure	2	1.54
Renal failure	3	2.31

Uws: Underwater seal, Fv: Flutter valve Urine bag

Table 2: First diagnostic chest X-ray, prior to chest tube insertion: Severity of effusion.

Drainage System	Large effusion N (%)	Moderate effusion N (%)	Mild effusion N (%)	Total N (%)
Underwater seal	25(19.23)	35(26.92)	5(3.85)	65(50)
Flutter valve Urine bag	18(13.84)	36(27.69)	11(8.46)	65(50)
Total	43(33.08)	71(54.61)	16(12.31)	130(100)

Pearson's Chi Square; p = 0.393

Table 3(a): Completeness of drainage based on lung re- expansion at first chest x-ray post chest tube insertion

Drainage system	Lung fully re expanded N(%)	lung partially expanded N(%)	Lung collapsed N(%)	Total
Underwater seal	21 (32.30)	41(63.08)	3(4.62)	65(100)
Flutter valve urine bag	26(40)	35(53.85)	4(6.15)	65(100)
Total	47	76	7	130

Table 3 (b): First post chest tube insertion chest x-ray: Patterns of lung re-expansion

Drainage system N (%)	Fully expandedN (%)	Not fully expanded N (%)	TotalN (%)
Underwater seal	21(32.31)	44(67.69)	65(100)
Flutter Valve urine bag	26(40)	39(60)	65(100)
Total	47	83	130

Using Pearson's Chi- square, P value = 0.563: There is no association between the drainage system and lung re expansion

Table 3 (c): Mean number of days after chest tube insertion that first chest x-ray was done.

Drainage system	Mean (days)	SD
Under water Seal	1.74	1.07
Flutter valve Urine bag	1.75	0.943

Table 4: Mean daily volume of effusion drained:

Drainage system	N	Mean(ml)	SD
Underwater seal	65	473.95	187.798
Flutter valve Urine bag	65	428.37	261.454

Comparing the two groups using t test, p= 1.14

Table 5: Lung re-expansion at second chest x-ray following chest tube insertion

Drainage System	Fully expanded N (%)	Not fully expanded N (%)	TOTAL
Underwater seal	63 (96.92%)	2 (3.08%)	65 (100%)
Flutter valve drainage	59 (90.77%)	6 (9.23%)	65 (100%)

Using Pearson's Chi- square, P value = 0.137: There is no association between the drainage system and lung re expansion.

Table 6: Mean number of days post chest tube insertion that *second chest x-ray* was done.

Drainage system	Mean (days)	SD
Under water seal	5.80	1.762
Flutter Valve urine bag	6.03	2.722

Table 7: Residual effusion at first post CTTD chest x-ray. (Homogenous Opacity)

Drainage System	Large effusion	Moderate effusion	Mild effusion	None	Total
	N(%)	N(%)	N(%)	N(%)	N(%)
Under water Seal	3(4.6)	3(4.6)	38(58.5)	21(32.3)	65(100)
Flutter Valve Urine Bag	2(3.08)	15(23.07)	28(43.08)	20(30.77)	65(100)
Total	5	15	66	41	130

Pearson's Chi square; P= 0.073

Table 8: Residual effusion at second chest x-ray post chest tube insertion.

Drainage system	Large effusion	None	Mild to moderate effusion	Total
	N(%)	N(%)	N(%)`	N(%)
Underwater seal	0	65(100)	0	65(100)
Flutter valve urine bag	6(9.23)	56(86.15)	3(4.62)	65(100)
Total	6	121	3	130

Pearson Chi square analysis shows P value of 0.022. (There is significant association)

Table 9: Duration of pleural drainage in days

Drainage system	N	Mean (days)	SD
Underwater seal	65	4.75	2.424
Flutter valve urine bag	65	4.57	3.396

P value (student t test) 0.722 not significant. Drainage chamber does not affect the duration of pleural drainage.

Table 10: Complications (tube blockage, pneumothorax).

	Pneumothorax	Tube blockage
	N (%)	N (%)
Underwater Seal	10(15.4)	16(24.62)
Flutter valve urine bag	1(1.5)	26(40)

DISCUSSION

At the completion of the study, the results showed that the flutter valve urine bag is as effective as the underwater seal drainage system for the management of pleural effusion. Out of the one hundred and thirty patients, the majority (61.5%), of patients were below 50 years of age, and there were more females (figure 8). The latter appears to be in agreement with the literature as although the incidence of pleural effusion (from malignant and benign etiologies), is equal in both sexes, almost 75% of malignant effusion tends to occur in females due to breast and gynaecological malignancies.[1]

Malignancies were the most common causes of effusion in this study ahead of other causes of exudative effusions like pneumonias (Table 1). Garcia-Vidal C and Carratala J. noted parapneumonic effusion as the most common of exudative effusion ahead of malignancies like breast, bronchogenic and ovarian cancers.[2] Pneumonias are more common in children who were excluded from this study.

The distribution of homogenous opacity (and by extension, the approximate volume of effusion) was assessed at the first diagnostic chest x-ray prior to chest tube insertion (Table 2). This shows massive effusion (whole hemithorax) among 46 patients (35.38%). Most (54.61%) of the patients, however, had moderate effusion with homogenous opacity involving the middle and lower lung zones. Sixty-four patients had their effusion on the right while, while others (66) were on the left side. However pleural effusions are generally more common on the right[3] especially among patients with cardiac failure. The reason for this is not clear. This study involved a wide array of etiologies of pleural effusions like pneumonias, malignancies (both primary and metastatic) cardiac and pericardial diseases. This may account for the almost equal incidence of effusion seen on both sides of the chest.

Following chest tube insertion and commencement of drainage, the first chest x-ray post tube insertion (Table 3b), showed that a higher number of those who had drainage with the flutter valve urine bag had their lungs fully re-expanded (26 out of 65 patients). Thus, 40% of the flutter valve group had fully re-expanded lungs at first chest x-ray (Table 3a). This is against the underwater seal group with 32.30% full lung re-expansion at the first chest x-ray post chest tube insertion. This difference, however, was not statistically significant (p = 0.563). This shows that there was no association between the drainage system and the rate of lung re-expansion at first chest x-ray post tube insertion. This first chest x-ray was done 1.75 mean days (SD: 0.943) for the flutter valve urine bag group, and 1.74 mean days (SD:1.07) for the underwater seal group (Table 3c). It was not feasible to have the chest x-ray done at a uniform time for all patients due to the logistics of variations in timing of payment for the chest x-ray, patient load at the hospital's radiology unit, and the clinical state of the patient.

The second chest x-ray (post tube insertion) was done 5.8 mean days (SD: 1.762) for the underwater seal group, and 6.03 mean days (SD: 2.722) for the flutter valve urine bag (Table 6). The underwater seal group was found to have a higher percentage (96.92) of fully expanded lung, as against the flutter valve urine bag group with 90.77% of their lungs fully re expanded (Table 5). Despite this, however, no association was found between the drainage system used and lung re- expansion (p = 0.137). Thus, irrespective of the drainage system (underwater seal or the flutter valve urine bag), a good rate of lung re expansion is expected about 6 days following commencement of drainage.

The underwater seal group, on the average, drained more effusion on a daily basis (table 4) than the flutter valve urine bag group (mean: 473.95ml and 428.37ml respectively). However, the average volume of effusion drained daily does not seem to be affected by the drainage system used as there was no statistical significance found (p = 1.14). This finding is in agreement with Alastair et al, who also found no statistically significant difference in the mean volume drained when flutter valve was compared with underwater seal in post-operative patients.[16]

The residual effusion at first chest x-ray, shows that an approximate number of both groups had no residual effusion, accounting for about a third of each group (Table 7). During this period, more patients (58.5%) of the underwater seal group compared to the flutter valve urine bag had mild residual effusion (homogenous opacity of the lower lung zone only). With a p value of 0.073, the use of either drainage system was not associated with a lower estimated residual effusion at this first chest x-ray. During the second chest x-ray however (Table 8), there was significant association between the drainage system used and residual pleural effusion (p=0.022). All the patients in the underwater seal group had no residual effusion at the second chest x-ray, compared to the flutter valve urine bag group with (86.15%) having no residual effusion. The implication of this is that the underwater seal is more efficient in evacuation of the pleural effusion from the pleural space than the flutter valve urine bag. This differs from the findings of Waller D.A *et al*, who showed the flutter valve system to be physiologically more efficient in chest drainage since it was found to exert more negative intra pleural pressure at resting tidal volume.[20]Their measurements were, however, done in patients with post-operative air leaks, and that may account for the difference observed in this study that is done in patients with pleural effusion. Moreover, the flutter valve urine bag is also highly effective considering the high percentage of patients without residual effusion at second chest x-ray which was done approximately 6 mean days post chest tube insertion.

The underwater seal drainage system drained a marginally higher volume of effusion on a daily basis than the flutter valve urine bag. However, this difference was not statistically significant (p=0.256). On the other hand, the flutter valve urine bag took a slightly shorter duration (mean: 4.57days, SD:3.4) for pleural drainage to fall to 100ml or less (table 9), as compared to the underwater seal (mean:4.75days, SD:2.4). But this difference in mean duration of pleural drainage was also not statistically significant. This means irrespective of the two drainage system used, the duration of pleural drainage is not affected, and one expects the mean duration to be around 5 days. VuoriSalo et al found a longer mean drainage time for flutter valve (3.3 SD+/- 4.0 days) as against a mean of 2.6 days (SD+/- 2.0) for underwater seal. [15] Their study, again, was done after lung surgeries for which prolongation of chest drainage is mainly as a result of post-operative air leaks and not effusion. Moreover, patients who required suction had to be changed to underwater seal in their study since it is impossible to apply suction to the flutter valve drainage bag. External suction shortens duration of pleural drainage.[15]

Charalambos Z. et al, noted that a two bottle underwater seal system is generally more efficient for drainage than the one bottle system which is better suited for pneumothoracis.[4] The one bottle system was used for this study. For non-massive malignant and paramalignant effusions, it has been shown that the flutter valve drainage bag is a safe alternative to the underwater seal system[5]

The complications that were specifically investigated in this study were pneumothorax and tube blockage (table 10). A higher incidence of tube blockage was noted in the flutter valve urine bag group. This could be due to the narrower caliber of the urine bag tube as compared to that of the underwater seal. The stasis within the narrower urine bag tube may result in blockage of the chest tube. Thus, regular daily milking of the tube was needed in order to ameliorate this complication. There was, however, a higher incidence of pneumothorax noted with the underwater seal group. Most of the cases were due to poor handling(tilting) of the drainage chamber allowing air to enter the tubing. The rate of pneumothorax was 1.5% in the flutter valve urine bag group and 15.4% in the underwater seal group. The pneumothorax in the flutter valve group likely resulted during tube insertion. A low complication rates for flutter valve system was reported by Nelson De Araiyo *et al.*[23] Other studies did not notice a difference in the occurrence of complications between the two groups. [15, 16] This may be accounted for by the short duration of pleural drainage noticed for post-operative patients as compared to more prolonged drainage periods for pleural effusions.

CONCLUSION

At the conclusion of this study, it can be inferred that the flutter valve urine drainage bag is as efficient as the underwater seal drainage bottle in the management of pleural effusion with respect to the rate of lung re-expansion, residual effusion, the daily volume of fluid drained and the average duration of pleural drainage. The underwater seal bottle, however, results in a higher incidence of iatrogenic pneumothorax as compared to the flutter valve urine bag. Whereas, the flutter valve urine bag results in a higher incidence of chest tube blockage due to stasis in the narrower urine bag tube and the need for regular "milking" of the drainage bag tube. The nature of the effusion may play a role but was not included in the study. Also, it was found that pleural effusion occurred in both hemithoraces with approximately equal incidence.

Considering the low cost of the flutter valve urine bag compared to the underwater seal, it is a viable alternative for drainage of pleural effusion among our teeming poor patients.

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Small-bore chest tubes drain pleural effusions as quickly as large bore tubes and are equally effective: a randomised trial

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ABSTRACT

Background and objective: The appropriate size of chest tube that is effective and comfortable in draining pleural effusions has been a matter of debate for decades. Conventional knowledge assumes that the larger the chest tube, the better the drainage and therefore the more effective. In this study, we test the correctness of this assumption, comparing their drainage rates and effectiveness.

Methodology: This was a randomised control trial of adults with serous pleural effusions requiring drainage. They were block randomised into 2 groups: one received a large-bore 28FG chest tube inserted via blunt dissection whilst the second received small-bore 10FG wire-guided chest tubes inserted via the Seldinger technique. The drainage rates were determined. Non-remediable drain failure was defined as drain blockage or dislodgement requiring drain replacement. Drain effectiveness was defined in percentage as 100- percent non-remediable drain failure.

Statistical analysis: Data was collected and analysed using SPSS® version 22. Appropriate statistical tools were utilised where appropriate. A p-value less than 0.05 was considered significant.

Results: There were 46 patients presenting with 50 pleural effusions with 25 per group. The mean age was 45.13±15.83 years. There was no statistical difference in the volume of fluid drained at timed intervals in both groups. The small-bore tubes drained the pleural effusions to completion at an average of 6.68 days compared to the large bore tubes with an average of 9.08 days (p=0.155). The absolute drainage rates per day were 527.18mls/day for the small bore tubes and 396.80mls/day for the large bore tubes (0.049). The small-bore tubes were associated with substantially less procedural and post-procedural pain and required a smaller dose of lignocaine for insertion. Drain effectiveness, defined as the ability to successfully drain the effusion to completion with radiological evidence of full lung re-expansion was 92% and 96% for the large and small-bore tubes respectively.

Conclusion: Small-bore chest tubes are as effective as large-bore chest tubes. They drain pleural effusions to completion at an equal time and are associated with less post intubation pain.

Keywords: *small bore, large bore, chest tubes, hydrothorax, pleural effusion*

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INTRODUCTION

Hippocrates in 5BC made the first reference to chest intubation for drainage of pleural effusion.[1] Since his description, there have been many changes to pleural drainage over the centuries, culminating in the use of large-bore drains connected to an underwater seal.[2-5] Recently, there has been a trend towards pleural drainage using small-bore tubes, defined as tubes 14FG or smaller in diameter as they are more comfortable for the patient.[6, 7] The Poiseuille law however states that the rate of flow through a tube is directly related to the fourth power of its radius,[8] thus raising concerns about the efficacy and drainage rates of these small-bore tubes for pleural drainage.[9, 10] Large tubes are associated with significant pain and discomfort[11] leading to multiple research investigating the efficacy of small tubes which are believed to be more comfortable.[12]

Many of the studies comparing both tube sizes lumped a diverse range of pleural collections including serous fluid, pus, blood, chyle, air etc. together, making comparison difficult.[4, 13-15] Additionally, In Nigeria the large bore tubes are the more common tubes[16] as there is more experience with them and they are readily available. Unlike many previous studies, this study limits the comparisons of efficacy and drainage rates of small and large bore tubes to pleural effusions alone and by including only serous pleural effusions, the comparisons made are more meaningful. The primary end-points are the drainage rates, efficacy, pain and complications associated with both tubes.

MATERIALS AND METHODS

This was a randomised control study carried out from June 2016 to June 2018. The case definition for enrolment was any patient above 16years of age with a serous pleural effusion deemed to require drainage. All consecutive consenting patients above 16 years of age presenting with pleural effusions were recruited into the study. Patients with loculated pleural effusions, trapped lung, absent lung and pregnant women were excluded from enrolling into the study. Two patients discovered to have loculated effusions after chest intubation were excluded from the study. All non-serous pleural collections were excluded from this study. These patients were identified by a diagnostic thoracocentesis while they were being evaluated. The patients were block randomised first into two groups: those presenting with bilateral effusions requiring drainage and those presenting with unilateral effusions requiring drainage. Those presenting with unilateral pleural effusions were then simply randomised into one of two groups by picking and unsealing a pre-numbered sealed envelope numbered either 1 or 2 with group 1 receiving a size 10FG Chest tube (Biometrix Medical®, Gronsveld, Netherlands) inserted via the Seldinger technique while group 2 received a size 28FG chest tube inserted via the blunt dissection techniques as has been previously described in literature.[17, 18] Patients with bilateral effusions were doubly randomised to receive a large and small bore tube in either pleural space. These patients with bilateral effusions first picked a sealed envelope labelled 1 or 2 indicating the first type of chest tube to be inserted and then picked another sealed envelope indicating left or right to determine where this first tube will be inserted. The second pleural space was then intubated using the second type of chest tube. Chest intubation was done under local anaesthesia using 1% lignocaine with adrenaline within the safe dose of 5mg/Kg of body weight. A starting volume of 10mls of 1% lignocaine was drawn for all patients except in 5 patients who had lost a lot of soft tissue. These patients received less than 10mls. The skin, soft tissue, periosteum of the ribs above and below and the pleura of the selected intercostal space was infiltrated with the local anaesthetic. Additional lignocaine was administered if the patient complained of pain during the procedure. The total volume of lignocaine administered was noted for each patient and the mean volume calculated. The chest tubes were inserted within the triangle of safety under aseptic conditions and access to the pleural space was gained via the 5th intercostal space mid axillary line. Diagnostic thoracocentesis was done just prior to chest intubation. After chest intubation, oral analgesic using Diclofenac/misoprostol tablets, 75mg twice daily was administered to all patients for 24 hours and any need for more analgesia during and after this period was recorded. The requirement for more analgesia was based on the patient's complains of persistent pain and request for analgesia. Both chest tubes were connected to an underwater bottle. Completion of drainage was defined as successful drainage of the effusion to less than 100mls/day for 3 consecutive days with chest x-ray finding of satisfactory lung re-expansion following which the drains were removed. Pleurodesis using 10% povidone iodine (20ms of 1% plain xylocaine plus 40mls of 10% povidone iodine and 40mls of normal saline) was done for patients with malignant pleural effusions and pain was assessed using the numerical rating scale. A proforma was completed by a member of the surgical team who did not participate in inserting the chest tube, with majority of proformas filled by a different intern. Drain failure was defined as anything that impeded the flow of pleural fluid through the tube from drain blockage (from kinking or coagulum) requiring intervention (tube rolling, flushing or adjustment) or drain dislodgement. Drain failure was further classified into two: remediable failure if it could be relieved by simple interventions like rolling or flushing or non-remediable if it required drain replacement. Drain effectiveness was then measured as 100 minus percent non-remediable drain failure.

The data was analysed using SPSS version 22. Mean and standard deviation were calculated for quantitative variables. Qualitative variables are presented as frequencies. Chi square test and independent sample t-test were applied for qualitative and quantitative variables. A *p*-value less than 0.05 was taken as significant

Ethical approval was received before the commencement of the study from the Ethics Board of the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria (protocol number ERC/ 2015/06/07) and informed consent was obtained from all participating patients. The study was conducted in accordance with the standards approved by the Helsinki declaration (1975) and its 2000 revision

RESULTS

A total of 50 pleural effusions in 46 patients satisfying the inclusion criteria were drained in the period reviewed. Twenty-five intubations were done with the small bore Seldinger type tubes while in the remaining 25, the large bore chest tube was inserted via the blunt dissection technique

The mean age of the patients was 45.13±15.83 years (large bore 42.00 ± 17.597, small bore 48.55±13.212) with a male to female ratio of 1:2 in both groups. Malignant pleural effusions accounted for half of all the effusions (table 1). Most effusions were right sided (45.6%) with left sided effusions occurring in 34.8% of cases. Nine patients (19.6%) presented with bilateral effusions of which only four required bilateral closed thoracostomy tube drainage. The sub group analysis is as shown in table 1. There was no statistical difference in the side of the effusion and the type of chest tube used (**p=0.121**).

The total volume of fluid drained in the first 24 and 72 hours and the total volume of fluid drained before extubation or pleurodesis showed no difference between the two groups statistically (table 2).

It took an average of 9.08 days for the large bore to drain the pleural effusions to100 mls/day while it took the small bore Seldinger tubes an average of 6.68 days to achieve similar results. This result though a clinically important observation was not statistically significant (**p=0.155**). The small bore tubes drained the pleural effusions at a rate of 527.18 ± 265.0 mls/ day compared to the large bore chest tubes which drained at a rate of 396.80 ± 183.4 mls/day (**p=0.049**).

Drain failure occurred with both small and large bore tubes at about the same frequency. Twenty per cent of the small and large bore tubes each were occluded by coagulum, tending to occur between the 2nd and 3rd day for the small bore tubes and on the 4th day for the large bore tubes. All instances of drain failure from blockage or kinking were easily resolved by flushing, rolling or adjusting the tube. The other causes of drain failure are as shown in figure 2. Drain effectiveness (expressed as 100 – per cent non-remediable drain failure) was 92% for the large bore chest tubes and 96% for the small bore Seldinger type chest tubes (given that the non-remediable failure rates were 8% for the large bore tubes and 4% for the small bore tubes, all of which were due to accidental tube dislodgement)

The small bore Seldinger chest tubes were associated with substantially less pain compared to the large bore chest tubes. The mean pain score (numerical rating scale[19]) at intubation (assessed immediately after the procedure) for the small bore Seldinger type tube was 3.44, compared with a score of 6 for the large bore tube. The progression of pain in the patients is as shown in figure 1. The dose of local anaesthesia administered at insertion of the chest tubes was significantly less for the small bore tubes requiring an average of 10.84 ± 2.882mls of 1% xylocaine with adrenaline compared to 15.52 ± 6.832mls for the large bore tubes **(*p*=0.003)**. As shown in table 3, the patients who received small bore tubes required fewer doses of analgesics after intubation.

There was no iatrogenic injury of thoracic or abdominal viscera in this study. Five patients developed post thoracostomy empyema (two small bore, three large bore). Of the five patients developing post thoracostomy empyema, three had their tubes for

Table 1: Bio-demographic profile of study population

	Large bore tube	Seldinger type tube	Total	*p* value
Gender distribution				
Male (n)	8	7	15	0.913
Female (n)	16	15	31	
Total	24	22	46	
Age distribution				
Mean (years)	42.00 ± 17.597	48.55 ± 13.212	0.164	
Range (years)	18-77	32-79		
Diagnosis				
Malignant pleural effusion	12	14	26	0.092
Parapneumonic effusion	4	2	6	
Tuberculous effusion	6	1	7	
Catamenial effusion	0	2	2	
Chronic kidney disease	1	0	1	
Congestive cardiac failure	1	1	2	
Rheumatoid arthritis	0	1	1	
Idiopathic	1	4	5	
Total	**25**	**25**	**50**	

Table 2: Mean volumes of pleural fluid drained at timed intervals

	Type of chest tube	N	Mean	Std. Deviation	*T* value	*p* value
Volume drained in first 24 hours (mls)	Large bore tube	25	1258.00	667.12	-0.438	0.663
	Seldinger tube	25	1355.60	891.23		
Volume drained in first 72 hours (mls)	Large bore tube	25	1838.60	892.67	-0.639	0.526
	Seldinger	25	2024 1142.69			
Total volume drained before extubation (mls)	Large bore tube	25	3014.40	1803.00	-0.108	0.914
	Seldinger tube	25	3070 1868.05			

Table 3: Need for more analgesia beyond 24 hours post intubation

Type of chest tube	Need for additional post thoracostomy analgesia		Total	*p* value
	Yes	No		
Large bore group	18 (72%)	7 (28%)	25	.002
Seldinger group	6 (24%)	19 (76%)	25	
Total	24	26	50	

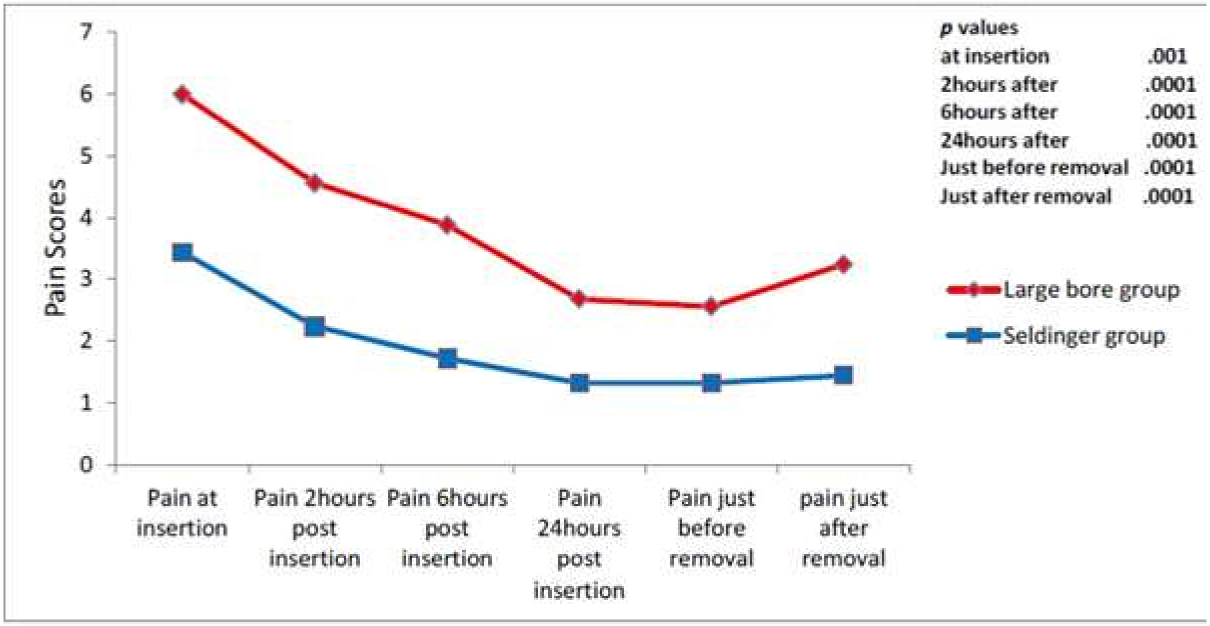

Figure 1: Mean pain scores associated with small and large bore tubes

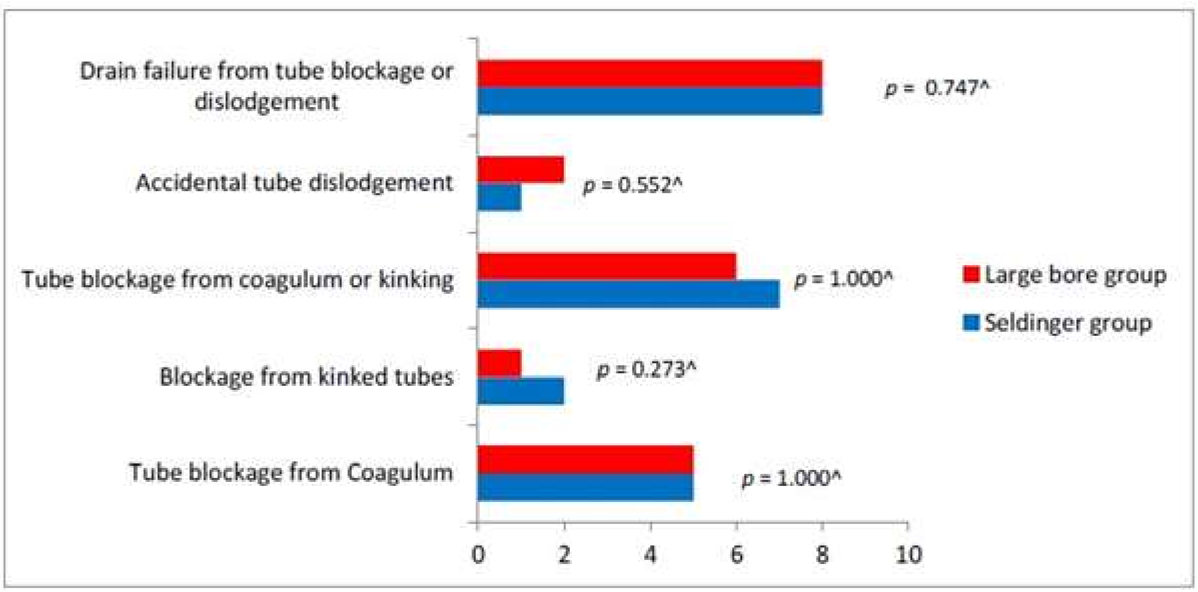

Figure 2: Causes of drain failure with small and large bore chest tubes

more than two weeks prior to developing empyema with an average tube dwelling time of 16.60 ± 8.142 days compared with a mean of 6.91 ± 4.856 days for patient who did not develop empyema. This difference was statistically significant (**p=0.0003**). For the other complications, four patients had tube site sepsis (one small bore and three large bore) and three patients' iatrogenic pneumothorax (one small bore and two large bore tubes) at intubation as shown in figure 3. There were no statistical differences in complication rates

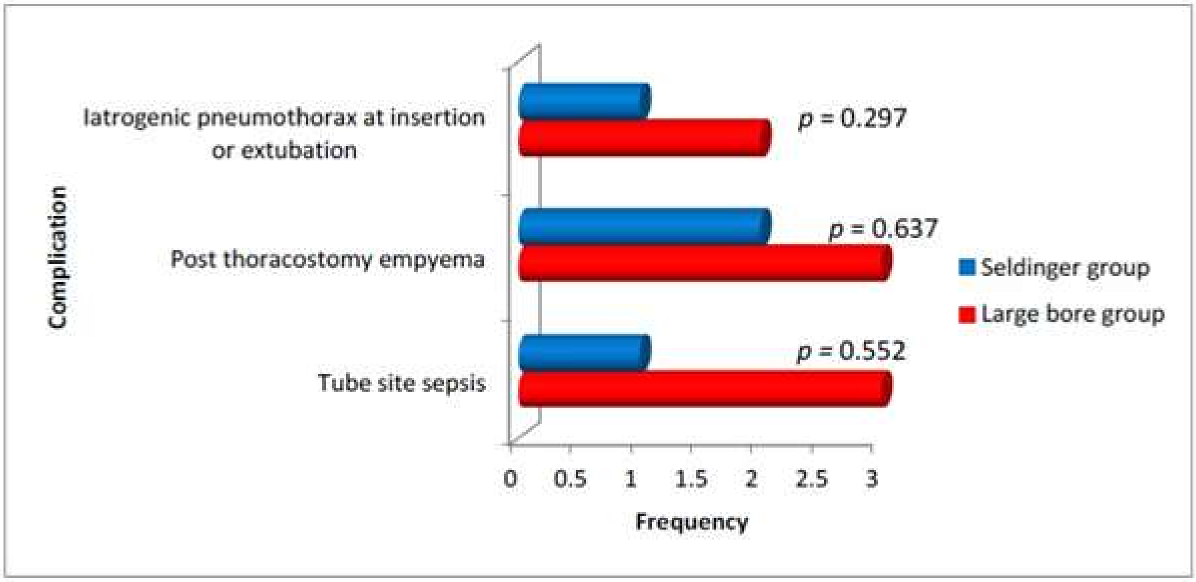

Figure 3: Complications of small and large bore tubes

between the small and large bore chest tubes as shown in figure 3.

DISCUSSION

This study shows that small bore Seldinger type chest tubes are as effective as the large bore chest tubes in evacuating pleural effusions and achieved completion of drainage at similar time intervals. There was no significant difference in the volumes of fluid drained in the first 24 and 72 hours as well as in the total volume of fluid drained in both groups (table 2). The small bore chest tubes however tended to drain the effusion over fewer days compared to the large bore chest tubes (6.68 vs. 9.08 days) although the difference did not reach statistical significance. However, in terms of the rate of drainage of the pleural effusion, the smaller bore tubes did drain faster than the large bore chest tubes (527.18 mls/day vs. 396.80 mls/day **p=0.049**). This result is similar to that found by Olugbemi et al in Lagos Nigeria.[15] He showed that small bore drains were as effective as large bore drains and drained effusions within a week compared to large bore chest tubes which drained over one to two weeks although his results did not reach statistical significance too. Ekpe et al[20] in his study in Uyo, Nigeria, also noted that there was no difference in the duration of drainage of pleural effusions between large bore chest tubes and small-bore chest tubes. Outside Nigeria, Krishnakumar in India[21] and Sabry in Egypt[11] in their studies also showed that small bore chest tubes drained pleural effusions faster compared to the large bore chest tubes.

These findings are contradictory to the Poiseuille law which states that the rate of flow through a tube is directly proportional to the fourth power of its radius.[8] Some hypotheses exists to explain this contradiction: first, the lesser pain and better comfort associated with the small bore tubes makes the patient more complaint with physiotherapy, thus improving lung re-expansion and effusion evacuation. This is supported by the findings of Santos et al[22] who demonstrated that optimised lung expansion was associated with quicker resolution of pleural effusions and shorter duration of hospital stay. A second possible explanation for the faster drainage by the small tubes is the greater capillary effect exerted by smaller tubes compared to large tubes.[23] A study by Niinami et al[24] showed that while large bore tubes drained fluid nine times faster in vitro, in vivo in pigs, there was no significant difference in drainage thus demonstrating that there are other forces at play apart from the Poiseuille forces.

Drain effectiveness stood at 92% for the large bore tubes and 96% for the small-bore tubes, making both tubes equally effective in draining serous pleural effusions. Mehra et al in Australia[13] similarly, showed that small bore tubes outperformed the large bore tubes having a failure rate of 19.2% compared to

26.9% for the large bore tubes. Similarly, Olugbemi[15] in Lagos, Nigeria reported no significant difference in incidences of tube blockage between small and large tubes. Additionally, Ekpe[25] in his study comparing small bore and large bore tubes in draining haemothorax showed that tube blockage from clots occurred at a similar rate (10% each) in both sets of tubes with both tubes effectively evacuating the haemothorax prior to removal.

There was significantly less pain in the small-bore arm of this study compared to the large bore arm probably related to the lesser tissue trauma created by the small-bore tubes and the method of insertion (the Seldinger technique). This is corroborated by findings from the MIST trial[14] which showed that pain on chest intubation was related to the size of the tube (small vs. large) and the method of insertion (Seldinger vs. dissection) with small tubes and the Seldinger technique associated with less pain. Given that pain score changes of at least 1.3 to 2 (numerical rating scale) is regarded as clinically perceptible,[26-28] it would follow that the greatest benefit of using the small-bore tubes would occur at intubation and within the first 24 hours of intubation.

Similar to the findings by Krishnakumar,[21] patients receiving the smaller chest tubes also required a shorter duration of analgesia post intubation with only 24% of patients in this group requiring analgesics beyond 24 hours of intubation compared to 72% for the large bore tubes.

All complications occurred less frequently in the small-bore tube as shown in figure 3. There was however, no statistical difference between the total complication rates or specific complications in both arms of the study. Krishnakumar[21] in his study also noted that complications tended to occur more in the large bore chest tubes whereas Orlando did not notice any significant difference in complications rates between small and large bore chest tubes.[29] All the infective complications were resolved with antibiotic therapy and regular change of wound dressing where required. In no instance was there a need for any form of surgical intervention.

CONCLUSION

Small bore chest tubes inserted via the Seldinger technique are as effective as the large bore chest tubes in draining pleural effusions, are less painful and are not associated with more complications.

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Paediatric gun shot injury: An increasing problem in sub-Saharan Africa

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ABSTRACT
Background: There has been a significant increase in the incidence of gunshot wounds among children under nineteen years of age in the past decades. Despite this increase, paediatric gunshot wounds have, however, received little attention. The increase in terrorism, banditry and communal violence in many parts of Africa has exposed the vulnerable, especially children, to increased risk of potentially lethal injuries or even death.

Case Presentation: We present the case of a fourteen-year-old male with a retained intrathoracic bullet in the soft tissues around the isthmus of the thoracic aorta following a gunshot to the chest. He had left anterior thoracotomy and bullet extraction and he had an uneventful recovery.

Conclusion: Retained Intra-thoracic missiles are traditionally managed conservatively, but safe surgery could be carried out for specific indications such as visceral injury or sharp objects in the vicinity of vital organs with potential risk for organ injury. An increase in global terrorism and gun violence has exposed children to potentially lethal injuries and sometimes death.

Keywords: *Gunshot wounds, intra-thoracic, thoracotomy*

INTRODUCTION

Trauma remains a leading cause of morbidity and mortality in the paediatric population and penetrating thoracic injuries can result in devastating injuries to multiple organ systems [1,3,7]. There has been a significant increase in the incidence of gunshot wounds among children under nineteen years of age in the past decades [1-3]. Paediatric gunshot wounds have however, received little attention in the literature in spite of this increased incidence [1,2,5,7]. The increase in terrorism, banditry and

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communal violence in many parts of Africa may necessitate treatment of patients with thoracic gunshot injuries, requiring a broadening of existing skills and knowledge of various injury mechanisms [8]. We present the case of a fourteen-year-old male with an intra-thoracic bullet lodged around the isthmus of the thoracic aorta.

CASE PRESENTATION

A 14-year old male was referred to the Jos University Teaching Hospital north-central Nigeria following an

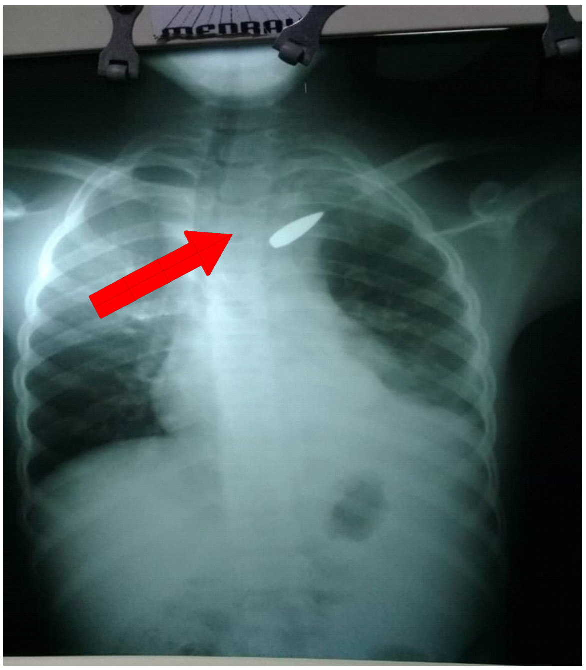

Figure 1: Antero-posterior Chest X-ray showing the bullet (arrow)

attack on the farm by unknown gunmen, who shot at him on the left side of the chest at close range. He was rescued and initially managed at a district hospital before his referral to our hospital. At presentation, he was dyspneic, with oxygen saturation of 90% on room air and 95% on oxygen by nasal prongs. There was an entry wound on the left infra-clavicular region but no exit wound. A chest drain was inserted followed by a gush of air and instant drainage of 250ml of blood. Chest x-ray showed a radio-opacity conforming to the shape of a bullet around the aortic knob and left clavicular fracture (fig 1 & 2). A Chest computed tomography (CT) scan showed a hyper-dense foreign body in the soft tissues around the aortic isthmus (fig 3). The patient was prepared and had left antero-lateral

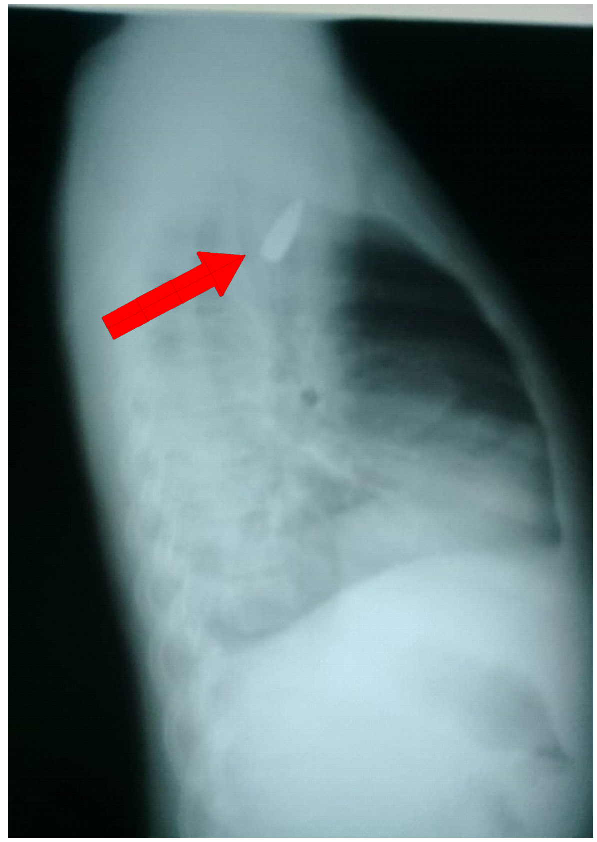

Figure 2: Lateral chest X-ray showing the bullet in the middle mediastinum (arrow)

thoracotomy with a finding of haematoma around the aortic isthmus. Gentle dissection was done and the aorta and left subclavian artery were isolated and ensnared in snuggers to ensure proximal and distal control in the event of inadvertent bleeding following entry into the haematoma. The mediastinal pleura over the haematoma was incised and the bullet was retrieved from within the haematoma (fig 4&5). There was no breach of the adventitia of the aortic wall by the bullet which was embedded in the soft tissues around the aortic isthmus. The chest was closed with a chest tube left in the pleural cavity. The patient had an uneventful postoperative recovery and has remained in good health as at one year follow up.

Penetrating intrathoracic injuries in children resulting from gunshot wounds can affect vital intrathoracic organs which could result in significant morbidity and mortality [1-4,8,9]. A chest radiograph is usually is done in haemodynamically stable patients at presentation [3,4,6] but this has limitations for arriving at a reliable surgical decision. A chest computed tomography angiography scan is required to allow for a targeted surgical approach and avoid unnecessary

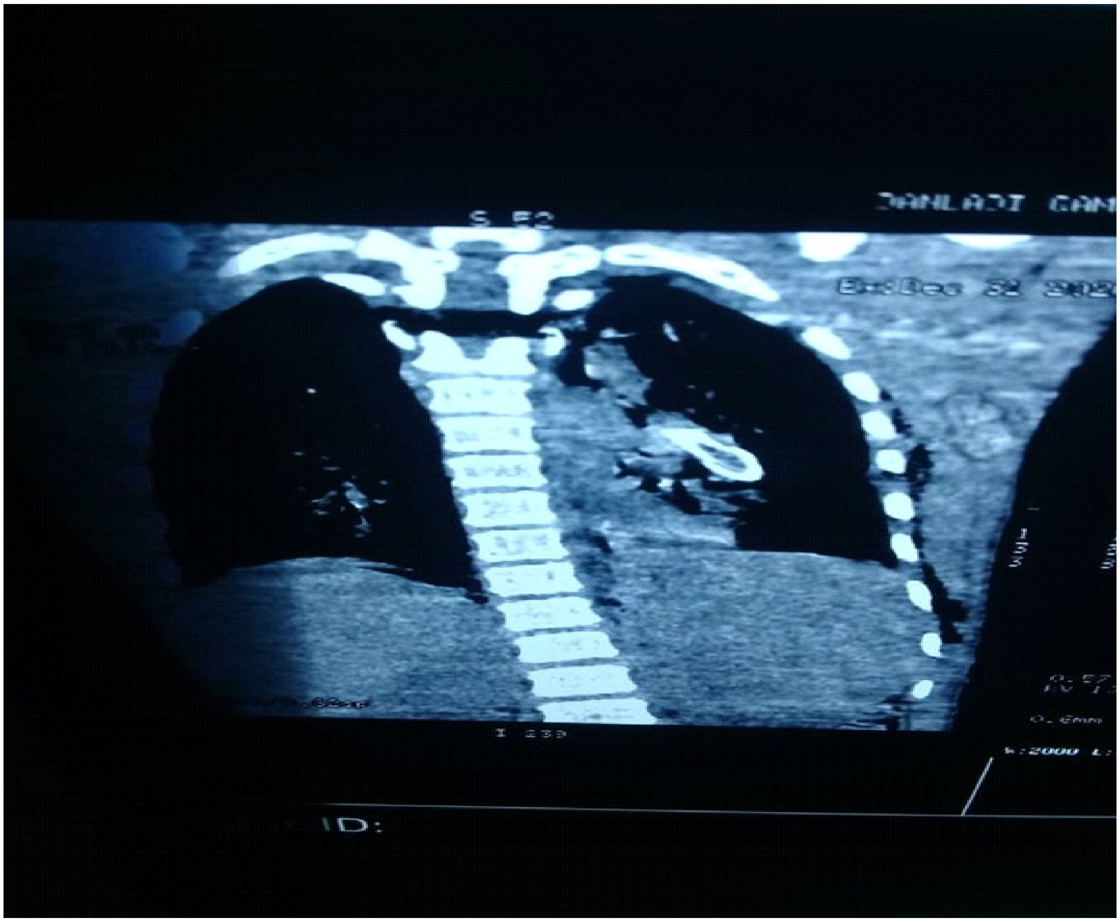

Figure 3: Chest CT scan showing the bullet around the aortic arch (black arrow)

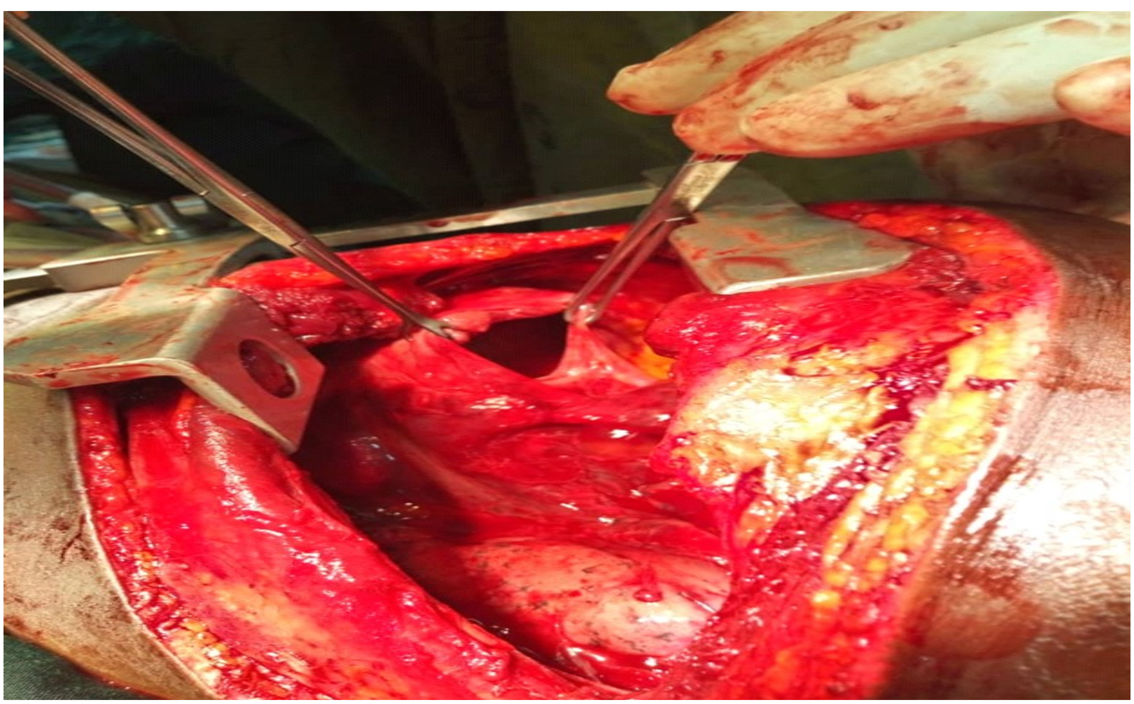

Figure 4: Intraoperative picture showing the soft tissue cavity from where bullet was retrieved (Black arrow)

Figure 5: Bullet specimen after removal

operation [3,9]. In the management of a stable patient with a retained intrathoracic missile, the decision to remove or not to remove the retained missile has been a topic of discussion.

Retained intrathoracic foreign bodies due to penetrating chest trauma are generally treated conservatively, surgery could however, be performed for specific indications such as visceral injury or sharp objects embedded in the vicinity of vital structures [1-3,8,9]. The location of this bullet close to the aortic isthmus informed the decision to operate the index patient to avoid potential future migration of the bullet into the aorta and distal embolization as well as migration into other surrounding vital organs. It was also difficult to decide from the CT scan images available the exact location of the bullet and whether or not the aortic wall was breached. A CT angiography with 3-D reconstruction could have revealed the relationship of the bullet and the aorta. The patient and the parents also desired the bullet removed. All these informed the decision for extraction of the bullet.

Thoracotomy has long been considered the standard approach for exploration and management of thoracic injuries, as it was believed to allow for full visualization of injuries, retrieval of foreign bodies, control of bleeding and resection of damaged lung tissues [7,9,11]. Minimal access surgery has become widely adopted in institutions where facilities and skills are available. Video-Assisted thoracocic Surgery (VATS) has been established as the standard approach to most elective thoracic operations with an excellent safety profile and is currently a safe and feasible alternative to thoracotomy in the management of chest trauma, especially for haemodynamically stable patients [11]. The index patient had anterolateral thoracotomy for the retrieval of the bullet as the facilities for video-assisted thoracic surgery were not available.

CONCLUSION

Paediatric gunshot wounds are not uncommon and with the increase in terrorism, banditry and communal clashes especially in Africa, this becomes obviously a matter of public health concern. Surgery is required when the bullet injures or is embedded in the proximity of vital intrathoracic organs to avoid erosion or migration into these structures which could result in mortality or morbidity.

No conflict of interest

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Tension pneumothorax complicating laparoscopic Heller's oesophagocardiomyotomy and the failure of needle decompression to relieve symptoms

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ABSTRACT
Background: Although per-oral endoscopic myotomy is becoming increasingly popular, many centres in the developed world still treat achalasia cardia by laparoscopic modified Heller's oesophagocardiomyotomy. Since the proximal extent of dissection lies within the thorax (thoracic oesophagus), inadvertent injury to the pleura(e) can cause a carbon dioxide pneumothorax. There could also be a rupture of a pleural bleb leading to air pneumothrax.

Objective: To report a rare case of tension pneumothorax complicating laparoscopic modified Heller's oesophagocardiomyotomy, and the uncommon failure of needle thoracentesis to yield any diagnostic or therapeutic value.

Methodology: A 73-year-old woman underwent laparoscopic modified Heller's oesophagocardiomyotomy for achalasia cardia through a 5-port technique. Oesophageal dissection was extended to the distal 5cm of the thoracic oesophagus.

Results: Left tension pneumothorax occurred as a complication of laparoscopic modified Heller's oesophagocardiomyotomy. Although clinical findings were not classical of tension pneumothorax, attempted multiple needle thoracentesis was also not diagnostic. A left tube thoracostomy yielded a gush of air and progressive improvement in clinical status.

Conclusion: Tension pneumothorax should be entertained when there is progressive deterioration in saturation during laparoscopic modified Heller's oesophagocardiomyotomy. Although an emergency needle thoracentesis is both diagnostic and therapeutic in most cases, its failure, or any diagnostic dilemma, should warrant an emergency tube thoracostomy as the benefit outweighs the risks.

Keywords: *Tension pneumothorax, laparoscopic Heller's, needle thoracentesis*

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INTRODUCTION

Although per-oral endoscopic myotomy is becoming increasingly popular, many centres in the developed world still treat achalasia cardia by laparoscopic Heller's myotomy.[1,2] Pneumothorax is a recognized but uncommon complication following laparoscopic Heller's myotomy.[3,4] However, tension pneumothorax is a rare occurrence.[3] The occurrence of progressive desaturation during laparoscopic upper abdominal operation, with high inspiratory pressures with or without cardiovascular instability should be a red herring for tension pneumothorax. This is promptly relieved by needle decompression which seldom fails to relieve the symptoms. We report a case of left tension pneumothorax during a laparoscopic modified Heller's oesophagocardiomyotomy and the uncommon failure of multiple attempts at needle decompression, necessitating emergency tube thoracostomy.

METHODOLOGY

The patient is a 73-year-old woman who had presented with intermittent dysphagia of 1-year duration. Clinical evaluation including a barium swallow (figure 1) and

Figure 1: Pre-operative barium swallow revealing a dilated oesophagus with pooling of contrast, with smooth tapering at the lower oesophageal sphincter.

oesophagogastroduodenoscopy revealed features suggestive of achalasia cardia. She was counselled and prepared for laparoscopic modified Heller's oesophagocardiomyotomy. A 5-port technique was employed for the procedure. After insertion of all ports, the lesser omentum was dissected and with gentle traction, up to 5cm of thoracic oesophagus was mobilized and dissected free. Oesophageal myotomy commenced from the distal 5cm of the thoracic oesophagus and extended to 2 cm on the cardia of the stomach. A 5mm abdominal oesophageal perforation was also noted, but due to the worsening cardiorespiratory state of the patient, a conversion to open repair and omental patch buttressing was opted for via a mini-laparotomy.

RESULTS

During the procedure, the patient was noticed to develop progressive desaturation with high inspiratory pressures and worsening cardiovascular instability (pulse

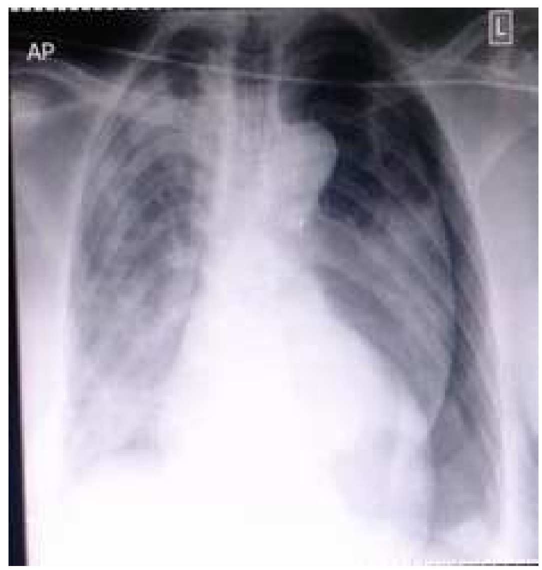

Figure 2: Anteroposterior chest X-ray (taken in the semi-recumbent position) revealing left tension pneumothorax. Note the depression of the left hemi-diaphragm as a result of the tension pneumothorax.

rate of 132 beats per minute and blood pressure of 88/50 mmHg). Although examination findings were not classical, a suspicion of left tension pneumothorax was entertained. Multiple attempts at needle thoracocentesis to yield the classical "diagnostic" and "therapeutic" value failed. She was transferred to the intensive care unit where she was ventilated. She had a mobile chest X-ray done (fig. 3) but however suffered an episode of cardiac arrest while the chest X-ray was being carried out which resolved following cardiopulmonary resuscitation. While awaiting the chest

Figure 3: Anteroposterior chest X-ray revealing expanded left lung post tube thoracostomy

X-ray film report, a prophylactic left chest tube was planned for and quickly inserted as the benefit was adjudged to outweigh the risk of its insertion should a tension pneumothorax be absent. Large gush of air and steady improvement of cardiorespiratory status were promptly noted. The patient recovered and was discharged home after 1 week with complete relief of symptoms of achalasia. She was followed up for up to 6 weeks after discharge home with no symptoms of recurrence of dysphagia.

DISCUSSION

Pneumothorax has been recognized as a complication following upper abdominal laparoscopic procedures. This is theoretically more likely following modified Heller's oesophagocardiomyotomy due to the extent of dissection through the oesophageal hiatus (at least distal 5cm of thoracic oesophagus) and the risk of inadvertent injury to the pleura in the process. When that occurs, the gaseous (carbondioxide) insufflation in the peritoneal cavity flows into the pleural space and can lead to varying degrees of pneumothorax. It is also proposed that high intra-abdominal pressures could open congenital pleura-peritoneal canals where present.[3] Diaphragmatic blebs have been known to rupture during laparoscopic surgery, causing pneumothorax.[5]

Tension pneumothorax often presents with severe compromise of the respiratory and often the cardiovascular systems. There is usually associated high inspiratory pressures.[6] In worse cases, it can lead to cardiovascular instability[6], respiratory arrest, and less frequently cardiac arrest,[6] all of which our patient suffered in the course of evaluation and treatment of this complication.

Tension pneumothorax is relieved in the emergency by needle thoracentesis and decompression in the second intercostal space, mid-clavicular line. This is both diagnostic as well as life-saving, and allows for proper evaluation and definitive tube thoracostomy if indicated.[6,7] In our patient, the diagnostic dilemma encountered due to failure of relief of symptoms by the multiply-attempted needle decompression led to the worsening of symptoms and subsequent cardiac arrest. However, successful emergency decompression isn't achieved in all instances. Emergency needle thoracenthesis has been noted to have failed in relieving tension pneumothorax.[6–8] Proposed reasons for such failure include the use of cannula with insufficient length to pass through the full thickness of the patient's chest wall.[7,9] In our patient, size 16G cannulae were used in the multiple attempts, and were of sufficient length to penetrate the pleural space. It could also be due to air leaking from the lung faster than it escapes through the cannula.[7] In our case, except for the created pneumoperitoneum, there was no bronchopulmonary injury to warrant a broncho-/alveolo-pleural fistula. Moreover, no air was noted at any moment, escaping from the multiply-inserted cannulae. Needle thoracentesis could also fail as a result of blood or tissue blocking the cannula.[7] In as much as this appears to be the most-likely reason for our failure of emergency needle decompression, it should have been mitigated by the multiple attempts that were made which all failed. Moreover, the cannulae used were all examined and the lumina were found to be patent.

Lastly, the high intrapleural pressure present in a tension pneumothorax results in the outward compression of the chest wall structures. This outward chest wall compression may be sufficient to kink or compress a flexible plastic cannula which is best suited for vascular cannulation.[7] This could account for the failure we noted.

Despite our experience, emergency needle decompression still remains the first line of treatment in tension pneumothorax. However, the clinician should bear in mind that the absence of a diagnostic yield nor clinical improvement does not portray the absence of a tension pneumothorax. Perhaps, repeating the needle decompression in the 5th intercostal space, anterior to the mid-axillary line (according to the Advanced Trauma Life Support Protocol of 2018)[6,10] may be successful. Further still, with unexplained cardiorespiratory deterioration and suggestive clinical examination findings, a tube thoracostomy can be quickly planned for and inserted as the benefits (should there be a tension pneumothorax) far outweigh the risks (of inserting a chest tube should there be no tension pneumothorax).

CONCLUSION

Tension pneumothorax should be entertained when there is progressive deterioration in saturation during laparoscopic modified Heller's oesophagocardio-myotomy. Although an emergency needle thoracentesis is both diagnostic and therapeutic in most cases, its failure, or any diagnostic dilemma, should warrant an emergency tube thoracostomy as the benefit outweighs the risks.

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The role of self expanding metal stents to relieve dysphagia in advanced oesophageal cancer; early experience from a Nigerian Teaching Hospital

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ABSTRACT
Background: Oesophageal cancer has poor prognosis because the majority of patients present late with dysphagia and advanced non-operable disease even in advanced societies. Self-expanding Metal Stents (SEMS) arecommonly used to palliate malignant dysphagia. The use of SEMS to palliate dysphagia secondary to advanced oesophageal cancer in Nigeria has not been reported. This study aims to describe our institutional experience using SEMS in the palliation dysphagia secondary to advanced oesophageal cancer.

Materials and Methods: This study was a retrospective data analysis of all patients who had SEMS for the palliation of dysphagia secondary to advanced oesophageal cancer from January 2014 – December 2021(8-year Period).

Results: SEMS implantation was attempted in 16 patients.There were 10 males (62.5%) and 6 females (37.5%). The mean age was 59.6 $\pm$ 14.7 years. Dysphagiawas grade 2 in 3 patients (18.8%), grade 3 in 11 patients (68.8%) and grade 4 in 2 patients (12.6%). Mean dysphagia grade was 2.9 $\pm$ 0.5. The distribution of the tumour level seen at endoscopy was cervical in 2 patients (12.6%), upper thoracic in 4 patients (25%), mid-thoracic in 4 patients (25%) and lower thoracic in 6 patients (37.6%). The SEMS was successfully deployed in 14 patients (87.5%) anddysphagiaconfirmed as grade2 before discharge. Histology showed an equal distribution of squamous cell carcinoma and adenocarcinoma. There was no periprocedural mortality. At 3 months of follow up all of the stented patients were alive and 13 (92.9%) remained at dysphagia grade 2. At 3 months, tumour overgrowth and occlusion of a SEMS was noted in a patient with cervical tumour.

Conclusion: We have successfully used SEMS to palliate dysphagia secondary to advanced oesophageal cancer with good results and encourage its use in other Nigeria institutions. The cost of the SEMS at 200,000 Naira($485)limitsmore widespread use.

Keywords: *Oesophageal Cancer, Self-Expanding Metal Stents, Nigeria.*

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INTRODUCTION

Oesophageal cancer is the 9th commonest cancer worldwide and the 6th leading cause of cancer deaths[1]. The incidence in Africa is about 0.7% while in Lagos Nigeria it makes up 0.4 to 0.6% of all malignancies in the population. There is a low prevalence in West and Central Africa with an Age range between 45 to 65 years and a male preponderance (M:F=1.5:1)[2, 3]. Oesophageal cancer has a poor prognosis despite advances in treatment with a median survival of only 8.4 months, 1-year survival of less than 37% and 5 year survival rate of less than 10%[4-6]. Given that the oesophagus has no serosal layer to contain the local spread of the tumour, by the time patients present with dysphagia there is about 50-75% luminal obliteration with extensive tumour spread and the cancer is already locally advanced and inoperable in >80% of patients [3-6].

Risk factors for oesophageal cancer include cigarette smoking (>15 years), alcohol intake (>200g/week), low intake of vegetables, premalignant lesions (achalasia, Gastro-oesophageal reflux disease, Barret's oesophagus) and caustic injuries[7]. Duration of symptoms are usually short (4-8 months)[3,7]. With the local involvement of tumour in advanced cases precluding surgical resection, palliation of dysphagia is preferable[6,8]. Surgical resection of oesophageal cancer should be with the intention of cure and the use of surgical resection to palliate advanced oesophageal cancer has a high morbidity and surgical mortality[6]. The goal of palliation is to improve the quality of life by relieving dysphagia, vomiting, aspiration pneumonitis and possible respiratory failure without increasing morbidity or mortality[8,9].

Options of palliation include laser therapy, photodynamic therapy, radiofrequency ablation therapy, cryoablation therapy, sclerotherapy, chemotherapy, radiotherapy, surgical resection/bypass and endoprosthesis[10]. Oesophageal endoprosthesis are safe, effective and rapidly relieve dysphagia. There are two types of Oesophageal Endoprostheses, Self-expanding Plastic Stents (SEPS) and Self-expanding Metal Stents(SEMS) with the latter having become the gold standard due to the minimal complications associated with it. SEMS has been in use since the 1970s and the design has evolved over the years[11,12].

SEMS are cost effective, easy to deploy and can be done as outpatient cases. SEMS can be made of stainless steel or nitinol alloy. The use of Plastic Stents is discouraged because of the high complication rate of occlusion by food impaction and stent migration[10,12]. SEMS can either be uncovered, partially covered or fully covered (with polyurethane membrane). Uncovered stents are more prone to tumour ingrowth while covered stent are prone to migration necessitating anti migration design (flanged edges or double layer stent with a covered inner layer and an uncovered outer layer)[11,12].

SEMS can be placed anywhere along the oesophagus based on tumour level (cervical, upper/mid/lower thoracic) provided there is at least a 2cm margin above and below the tumour for anchoring the proximal and distal flanges to minimize risk of migration [11-13]. SEMS placement can be done either under fluoroscopic guidance, endoscopic guidance or combination of both techniques and it can also be used with adjuncts like radiotherapy /brachytherapy, laser therapy, cryotherapy or photodynamic therapy. These adjuncts help to recanalize the oesophagus aiding easy deployment of the stent as well as also improving survival outcome. Stent deployment can be associated with pain, bleeding, GERD (prevented by anti-reflux design {sleeves/valves} or PPI), migration & tumour ingrowth/overgrowth[11,12].

Dysphagia is one of the most distressing symptoms of oesophageal cancer. It interferes with quality of life and nutrition and increases the risk of aspiration pneumonia. Owing to short life expectancy once diagnosed, the treatment of dysphagia should be delivered promptly and should relieve dysphagia rapidly and durably[8].The treatment of dysphagia secondary to advanced oesophageal cancer in Nigeria usually involves a feeding gastrostomy/jejunostomy (which doesn't relieve the dysphagia) +/- Oesophagectomy (which has a high morbidity and mortality).SEMS rapidly relieve dysphagia by exerting a radial force on the oesophageal wall to establish a lumen through the tumour, relieving dysphagia immediately and thus improving the nutritional status and quality of life. [11,12].

There is no mention in Nigerian literature on the use of SEMS to palliate malignant oesophageal dysphagia. The aim of this study is to describe our institutional experience with the use of SEMS to relieve dysphagia secondary to advancedoesophageal cancer.

MATERIALS AND METHODS

This study is a retrospective case series of all consecutive patients that presented with dysphagia secondary to advanced oesophageal cancer and were assessed as fit enough to undergo SEMS implantation in our unit from January 2014 to December 2021. Data was extracted from the unit database. The extracted data included patient demographics, grade of dysphagia, the level of tumour at endoscopy, procedural success, histology, complications and outcome. Summary data was presented as mean $\pm$ standard deviation or percentages and numbers as appropriate.

Dysphagia was graded using the Mellow and Pinkas score [14]. Grade 1 (able to swallow solid food with difficulty), grade 2 (able to swallow soft or semi-solid food only), grade 3 (able to swallow liquified foods and liquids only) or grade 4 (unable to swallow liquids/saliva).

The tumour level at endoscopy was classified as cervical (<18cm from the incisors), upper thoracic (18-22cm), mid-thoracic (23-32cm) and lower thoracic (>32cm) [15].

Data extraction for this retrospective study was approved by our Institutional Ethics Review Board.

Procedure

Patients were considered for insertion of a Self-Expanding Metal Stent (SEMS) if they had been diagnosed as having advanced oesophageal cancer with dysphagia grade of 2 or more.

The procedure was done under conscious sedation with topical pharyngeal anaesthesia and the patient in the left lateral decubitus position. An initial flexible oesophagoscopy was performed to confirm the level of tumour (figure 1) and biopsies taken (if not previously done). Under fluoroscopy a flexible guide wire was gently advanced through the oesophageal lumen via the endoscope, beyond the tumour, and confirmed to be in the stomach (figure 2). The proximal and distal extent of tumour was then marked on the chest wall with metal markers to guide intended proximal and distal landing points of the proximal and distal stent flanges. The oesophagoscope was then withdrawn leaving the guidewire in place.

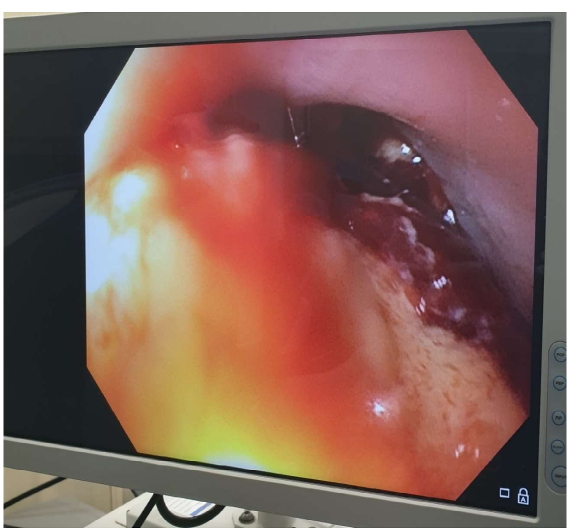

Figure 1: Endoscopic view of oesophageal cancer

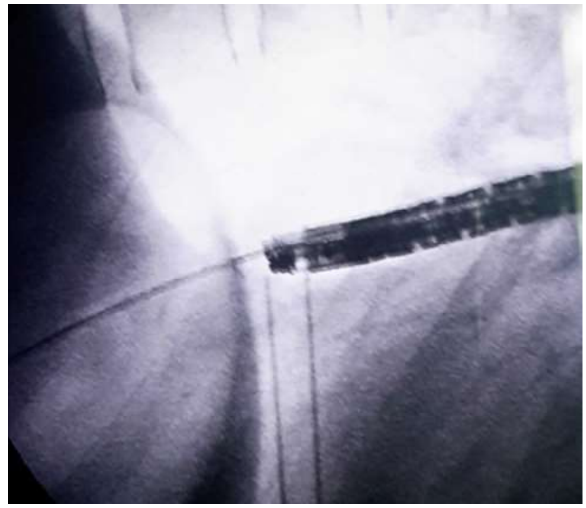

Figure 2: Fluoroscopic image of guide wire advanced through the Oesophagus via the endoscope

The stent introducer preloaded with the SEMS (figure 3) was then passed over the guide wire, and carefully positioned so that the proximal flange was at

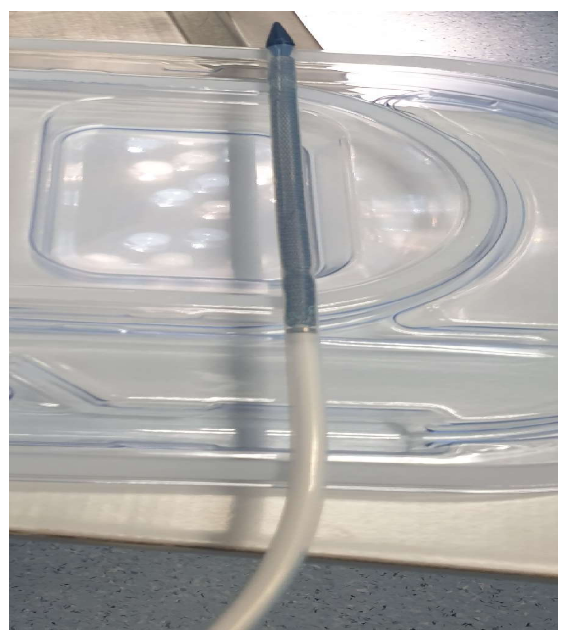

Figure 3: Stent introducer preloaded with the SEMS

least 2cm above the proximal metallic marker (figure 4) and the distal flange also at least 2 cm beyond the distal metallic markers (figure 5). This places the flanges of the SEMS in normal oesophagus for anchorage to minimize the risk of migration [11, 12]. The SEMS was then deployed and the introducer system and guidewire were withdrawn (Fig 6). Oesophagoscopy was repeated with the scope passed through the stent into the stomach to confirm patency and that the proximal and distal extent of the SEMS were tumour free (figure 7).

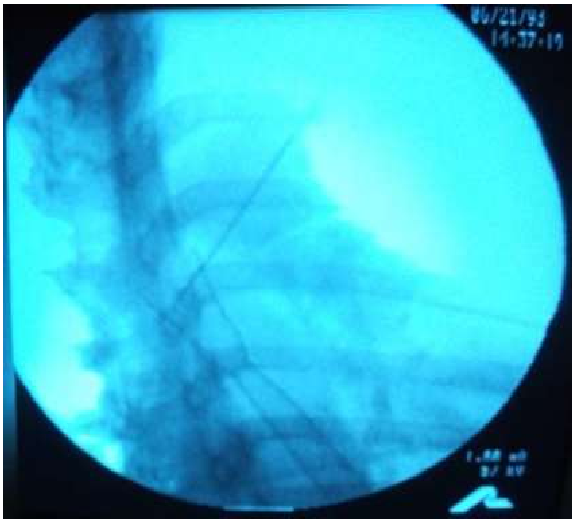

Figure 4: Fluoroscopic image of stent proximal flange above metallic marker

Figure 5: Fluoroscopic image of stent distal flange beyond metallic marker

Figure 6: Fluoroscopic image of fully deployed stent

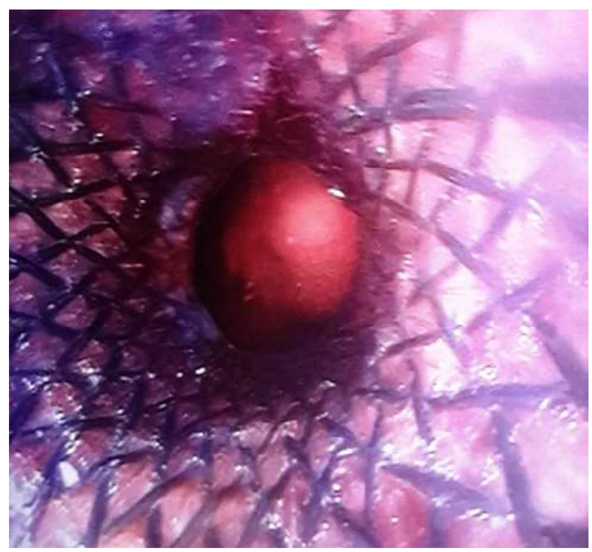

Figure 7: Endoscopic view of fully deployed stent

Patients were discharged after a few hours once confirmed able to swallow semi-solids and liquids freely. Advice was given to take solid food in only small portions to avoid stent obstruction from a large bolus. This was followed by referral to an oncologist for chemotherapy and/or radiotherapy. All patients were booked for follow up at 3 months to assess continued palliation of dysphagia.

RESULTS

Over the study period, 16 patients underwent flexible oesophagoscopy for placement of a SEMS. The annual distribution of procedures is as shown in figure 8. There were 10 males (62.5%) and 6 females (37.5%). The mean age was 59.6 $\pm$ 14.7 years. All patients had advanced oesophageal cancer with dysphagia.Dysphagia grade at presentation was grade 2 in 3 patients (18.8%), grade 3 in 11 patients (68.8%) and grade 4 in 2 patients (12.6%). Mean dysphagia grade was 2.9 $\pm$ 0.5. The distribution of the tumour level seen at endoscopy was cervical in 2 patients (12.6%), upper thoracic in 4 patients (25%), mid-thoracic in 4 patients (25%) and lower thoracic in 6 patients (37.6%). The SEMS was successfully deployed in 14 patients (87.5%). The 2 patients with unsuccessful procedures were those who presented with grade 4 dysphagia and complete luminal obstruction, so the guide wire could not be passed through the tumour into the stomach. Following successful stent deployment, the dysphagia grade was confirmed to be grade 2with the patients able to swallow semi-solid food and drink liquids freely before discharge home later the same day.

The distribution of histology was squamous cell carcinoma in 8 patients (50%) and Adenocarcinoma in 8 patients (50%). There were no periprocedural mortalities. There were no early complications of bleeding or perforation seen. There was only 1 patient with a late complication of tumour overgrowth at 3 months which occluded the stent. This was in a patient with a cervical tumour and he subsequently had a feeding gastrostomy performed. There were no stent migrations. The remaining 13 patients stillhad dysphagia grade 2 at 3 months follow up. There was no long-term follow up.

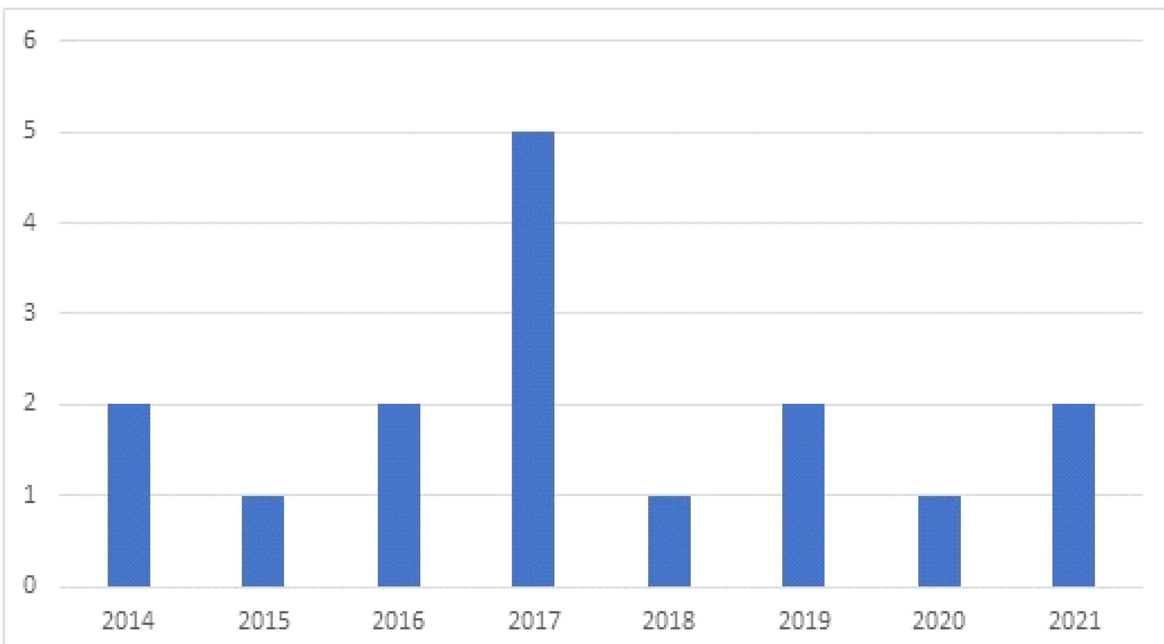

Figure 8: Bar chart showing annual distribution of procedure

DISCUSSION

The major challenge with advanced oesophageal cancer is dysphagia,with more than 50% of patients manifesting it at presentation and also accounting for 80-90% of presenting complaints[4].By the time of presentation, most patients in Nigeria have locally advanced or metastatic disease. Offering oesophagectomy is a major undertaking with a high mortality rate, median survival of only 8.4 months with less than 10% 5-year survival[4].It is therefore often preferableto palliate dysphagia thereby improving the quality of life and refer for adjuvant therapies such as chemotherapy and radiotherapy to achieve some improvement in overall survival. It has been recommended that optimal management of advanced oesophageal cancer is to relief dysphagia and reduce tumour bulk without increasing morbidity or mortality, with the former being the most significant in improving the quality of life. The placement of SEMS has become the gold standard for relief of malignant dysphagia with proven efficacy as SEMS achieves immediate relief of dysphagia with a low morbidity and mortality[6,8,9].

The common practice in Nigeria when a patient presents with dysphagia from advanced oesophageal cancer is to perform a feeding gastrostomy or jejunostomy to establish enteral nutrition. This does not relieve the dysphagia and therefore does not improve quality of life. Some patients are worked up for oesophageal replacement but the tradeoff is a high mortalitywith limited median survival[4,5].

In our institution, we initially started off performing oesophagectomy for advanced oesophageal cancer. The limited survival made us change our practice to initial palliation of the dysphagia to improve quality of life for the limited life span of the patients. It has now becomestandard practice in our institution to insert a SEMS for patientspresenting with dysphagia secondary to advanced oesophageal cancer and subsequently refer to oncology for chemotherapy/radiotherapy.Procedural success is excellent when there is still a lumen to pass the guidewire. The only 2 failures we experienced were in patients with grade 4 dysphagia and complete luminal obstruction where we could not pass a guidewire across the tumour into the stomach. Access to other modalities like laser, ablation therapies and brachytherapy to restore the oesophageal lumen in cases with obstruction could further improve the procedural success[8,11.]

A major limitation was the cost of obtaining the SEMS. The majority of our patients pay out of pocket and consider the cost of stent purchase (200,000 Naira/$485) out of reach. This has limited the number of patients we have been able to offers SEMS.

CONCLUSION

Oesophageal stenting is a very safe, efficient and rapid palliative method for malignant dysphagia which restores oral intake and therefore improves quality of life. Our study shows that SEMS can safely be used to palliate dysphagia in Nigerian patients with advanced oesophageal cancer and by improving dysphagia grade itprovides a sustained improvement in quality of life. Reducing the cost of SEMS or seeking funding to cover the costs would enable many more patients to benefit. We encourage the use of SEMS in other Nigerian institutions.

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Emergency resuscitation and repair of ruptured abdominal aortic aneurysm in a low resource setting: a case report

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ABSTRACT
Background: Abdominal aortic aneurysm (AAA) occurs when the diameter of the abdominal aorta grows or enlarges to more than 50% of its original size. This can rupture and becomes a life-threatening condition with a mortality rate approaching 90%.

Case Presentation: The patient was a 57-year-old hypertensive man who presented with a one-day history of sudden severe abdominal pains, with no preceding history of trauma. He had significant smoking history (35 pack years). His vital signs were normal except his blood pressure (BP) which was 217/130mmHg and Respiratory rate, 24cpm. Abdominal findings - tender pulsatile mass in the right lower quadrant. He became unconscious, was resuscitated, intubated, ventilated mechanically, sedated, and commenced on 3 inotropes. He also developed acute kidney failure. He had an emergency Abdominal USS done which suggested a ruptured AAA. He was reviewed by a Vascular surgeon. Emergency contrast abdominal CT scan showed a ruptured infrarenal abdominal aortic aneurysm - 9.5cm its maximum transverse diameter. He had repair of ruptured abdominal aortic aneurysm via a midline abdominal incision and a right groin incision, using a PFTE trouser graft. Post-operative recovery was good and renal impairmentresolved.

Conclusion: Ruptured AAA is a clinical condition whose diagnosis can be sinister and requires a thorough history and physical examination. Emergency USS of the abdomen is essential and contrast CT of the Abdomen, diagnostic. The successful management of these patients also depends on prompt review by a Vascular surgeon, availability of trouser graft and immediate repair of the ruptured AAA and availability of ICU facility.

Keywords: *Aneurysm, inotrope, Mechanical Ventilation, Vascular graft, Thrombus.*

INTRODUCTION

Abdominal aortic aneurysm (AAA) occurs when the diameter of the abdominal aorta grows or enlarges to more than 50% of its original size. This can rupture and when it does, is a life-threatening condition with a mortality rate approaching 90% with greater than 44% prehospital mortality. Of those that make it to the hospital, emergency surgery still has a mortality rate of 50%[1]. The diagnosis of Ruptured AAA can sometimes be difficult, hence, a high index of suspicion is necessary for survival. The classical presentation includes a pulsatile mass in the abdomen, back pain, and episodes of haemodynamic instability. Another

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common presentation is loin pain. Managing a ruptured AAA in our environment is challenging due to many factors ranging from availability of facilities and vascular grafts to surgical skills.

Case Presentation

We hereby report a case, 57-year-old man, who presented at a private facility with a one-day history of severe abdominal pains of sudden onset, radiating to the back, no known relieving factor, with associated nausea, vomiting, retching and loss of appetite. There was no history of palpitation or shortness of breath. No preceding history of abdominal trauma

Abdominal findings were those of a tender pulsatile mass on the right lower quadrant, could not get above or below it.

Blood investigations essentially normal except White blood count (WBC) – 13.7 x 10^6/L and C-Reactive protein (CRP) – 154.1.

IV Morphine, 10mg was also ad ministered for pain. He was commenced on IV Ceftriaxone (Rocephin) and intravenous fluids

He suddenly became unresponsive and Glasgow Coma Scale (GCS) had dropped to 3/15. Cardiopulmonary resuscitation (CPR) was immediately instituted successfully. He was then intubated, ventilated mechanically, and commenced on Inotropic support (Adrenalin at 0.1mic/kg/min, Noradrenalin at 0.2mic/kg/min and Dopamin at 5mic/kg/min), with fluid resuscitation for persistent hypotension. He also received three (3) units of packed cells.

Abdominal ultrasound scan (USS) done revealed an extensive abdominal aortic aneurysm extending above the renal artery to the superior mesenteric artery. He was then reviewed by a Cardiothoracic surgeon and referred to us.

At presentation to us, He was unconscious and intubated and on ventilatory support (SIMV mode, FiO2 - 70%, PEEP – 5), sedated with a GCS of 3/15, on three inotropes (Adrenaline, Noradrenaline and Dopamine as stated above), anuric (for about 3hrs), pale, dehydrated.

He had an emergency contrast Computerised Tomography (CT) scan of the abdomen, pelvis and lower limbs. (Figure 1A-D below). This showed: Ruptured infrarenal abdominal aortic aneurysm extending to the right common iliacs, measuring approximately 19cm in craniocaudal diameter, 9cm in its maximum AP diameter and 9.5cm its maximum transverse diameter. Mural defect posteriorly and to

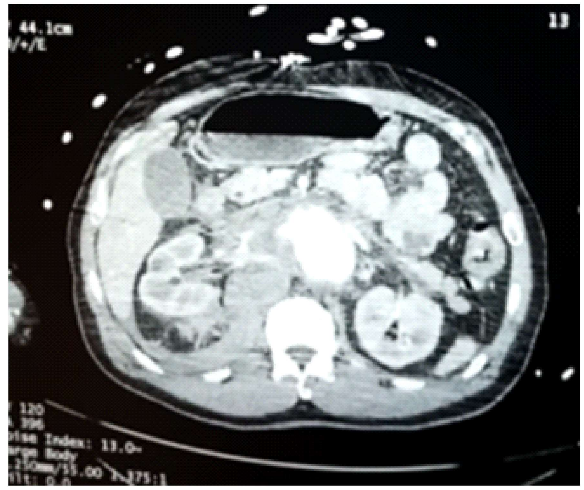

Figure 1A: Abdominal aorta at the renal artery level

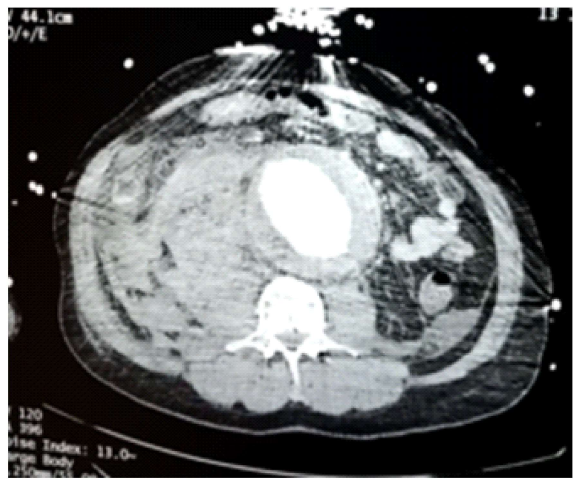

Figure 1B: AAA

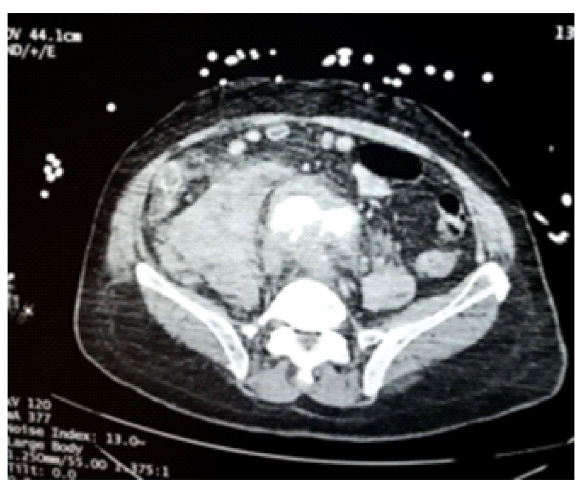

Figure 1C: AAA at the aortic bifurcation

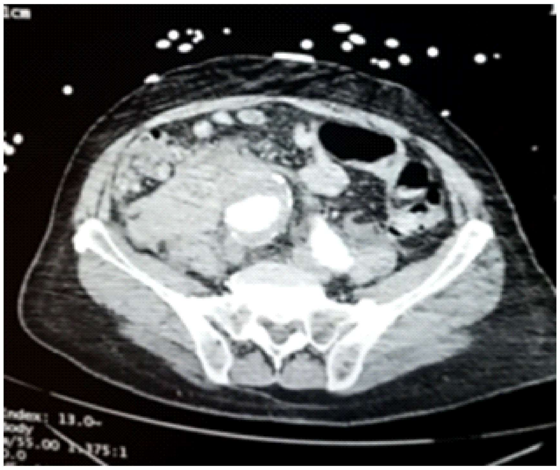

Figure 1D: Right common Iliac neurysm

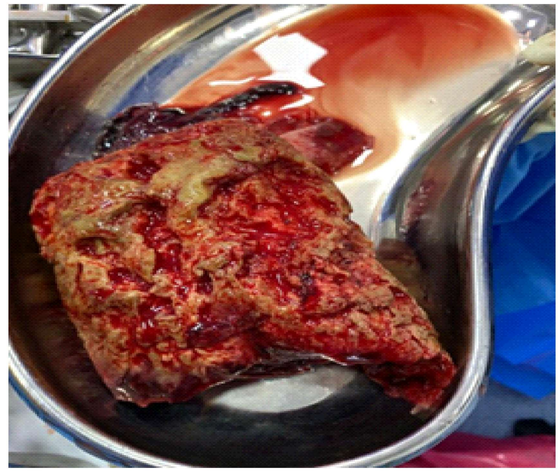

Figure 2B: Thrombus

the right, measuring 1.3cm. Aneurysmal thrombus and perianeurysmal hematoma measuring approximately 5cm.

An Assessment of ruptured abdominal aortic aneurysm was made, and patient was scheduled for an emergency repair of a ruptured abdominal aortic aneurysm. Informed consent was obtained, he was reviewed by anaesthetist and grouping and cross-matching of ten (10) units of blood, 5 units of frozen plasma and 5 units of platelet was done.

Patient had repair of ruptured abdominal aortic aneurysm done via a midline abdominal incision and a right groin incision. Operative findings were: aneurysm extending from perirenal to right Iliac artery, ruptured perirenal abdominal aortic aneurysm ~15cm, Thrombus ~15 x 20cm, Aortic tear (rupture) (Figure 2C), right laterally, ~ 4 x 3cm. Heparin administered

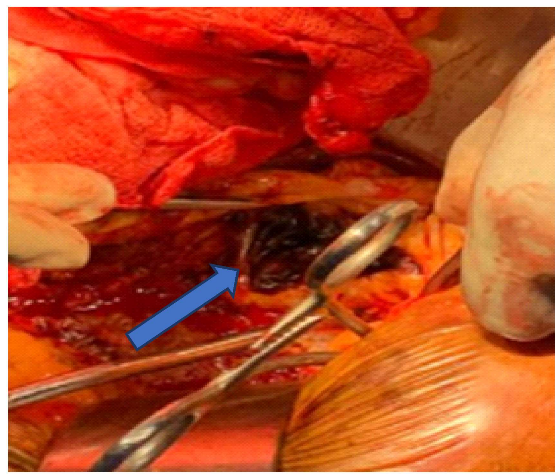

Figure 2C: Tear of the aortic wall (arrow)

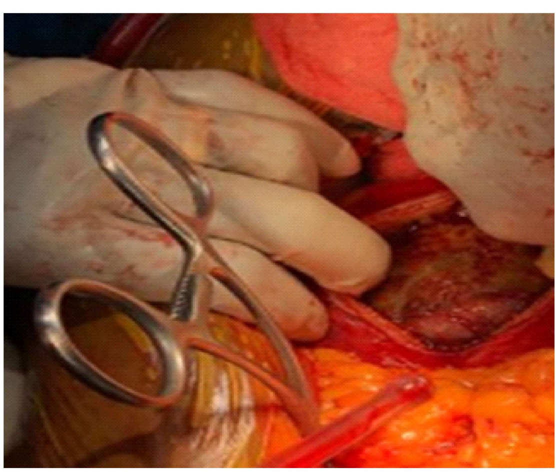

Figure 2A: Aneurysm sac opened, with thrombus within

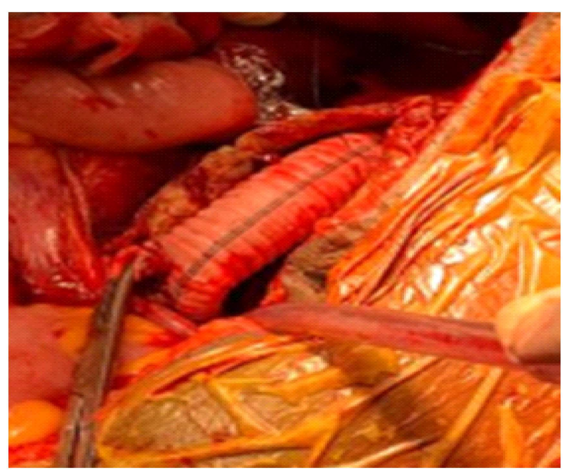

Figure 2D: Trouser graft anastomosed within the aneurysm sac

IV (5,000IU) and proximal aspect of the AAA clamped. The aneurysmal sac was opened (Figure 2A), and clot evacuated (Figure 2B). A size 18 x 9 x 9 PTFE trouser graft (Figure 2D) was then anastomosed proximally to the infrarenal abdominal aorta, while the left limb to the left Iliac artery (end - to - end) and the right limb to the Common Femoral artery (Non-anatomical end - to – side bypass grafting). The right Iliac aneurysmal sac was ligated proximally and distally. The graft was then wrapped with the aneurysmal sac. Hemostasis ensured. The abdomen was closed in routine fashion over 2 inserted Redivac drains. He had eight (8) units of blood transfused intra op. He was then transferred to intensive care unit (ICU) in a stable condition. Wall of aneurysm sent for histology.

Post-operative care included: Continued ventilation and sedation (with Midazolam), pain control with Morphine, inotropes (Adrenaline, Noradrenalin and Dopamin) intravenous antibiotics (Augmentin and Metronidazole), Furosemide infusion at 5mg/hr, close monitoring of vital signs and drains, post-operative FBC, E/U/Cr and regular ABG checks.

Post op investigations were: Full blood count with Hb – 11.0g/dl, WBC – 17.3 x 10^6/ml, Platelet – 130,000/ml; Electrolyte/Urea (U)/Creatinine (Cr): Potassium (K^+) – 3.7 mmol/dl, Sodium (Na^+) – 134, U – 9.7mmol/l, Cr – 245.mmol/L. INR – 1.1. Arterial blood gas (ABG): pH – 7.27, PCO2 – 54.7, PO2 – 260, K – 5.6.

He developed arrhythmia on the 2nd day post op and was commenced on Amiodarone IV, 300mg stat, then 900mg over 23hrs, and reverted to sinus rhythm.

Urinary output improved and was making 45-70mls/hr by the 2nd day post op. Inotropes were weaned off 2nd day post op and he was extubated thereafter. Drains were also removed. On day 3 post op, he commenced oral intake, started sitting out of bed and mobilizing in ICU. His medications were changed to oral, except the antibiotics. His wound was inspected, healing well with edges well apposed.

His pre-discharge blood investigations improved. He was discharged home on the 8th day post op on oral antibiotics, analgesics, Furosemide, antihypertensives, Atovastatin, Aspirin and potassium chloride (Slow K). He was seen at the clinic after 5 days. The wounds had healed and renal function was normal. Histology – inflammatory.

He was rescheduled to be seen again in 2 weeks.

DISCUSSION

Ruptured AAA is the most common and most fatal complication of AAA. As an acute vascular emergency, it requires an immediate life-saving operation with a high mortality rate. 30 to 50% of patients with ruptured abdominal aortic aneurysm die before they reach the hospital, and 30 to 40% of those who reach the hospital alive die without surgical intervention. With an average mortality rate of 45% among patients who undergo emergency repair of ruptured abdominal aortic aneurysm , the overall mortality rate is estimated at 80 to 90[2].

Ruptured AAA occurs more in men, and causes approximately 6,000 deaths per year in the UK[3]. The risks for rupture of an abdominal aortic aneurysm includes aneurysms over 6 cm, (25% annual risk of rupturing)[4], smoking and hypotension. Our patient was male, hypertensive, with significant smoking history and an aneurysm greater than 6 cm.

Abdominal aortic aneurysm can rupture (anteriorly, in 20% of cases) into the peritoneal cavity in which case, it becomes immediately life threatening or it can rupture posteriorly (in 80% of cases) into the retroperitoneal space and patient may be stable. Usually, the classic triad of hypotension, back pain and pulsatile abdominal mass may be present, but this is seen in about half of the patients[5]. Pain is caused by expansion of the aortic wall as well as bleeding into the intravascular thrombotic edge. Our patient had presented to a private hospital with abdominal pain, radiating to the back. His blood pressure was however high (known hypertensive). Thus, a high BP does not exclude the presence of a rupture. He presented to us unconscious, on three inotropic support, was intubated and being ventilated, sedated, and was in acute renal failure. A high index of suspicion, necessitating performing urgent abdominal ultrasound scan and prompt resuscitation at the referring centre, and transfusion with 3 units of blood, were key to keeping the patient alive till he got to us. Early vascular surgeon review also played a key role in the survival of this patient. However, there have been unusual presentations of abdominal aortic aneurysms which includes renal colic, ureteral obstruction, obstruction of the left colon, testicular pain, peripheral neuropathy, hiccoughs, hematuria, right inguinal mass.

The initial management of ruptured AAA includes ensuring 'permissive' hypotension (systolic BP <100mmHg), early review by a vascular surgeon and transferring the patient to an appropriate centre. The applicability of this concept to the treatment of ruptured AAA has been demonstrated[6]. Avoiding normal or supranormal systolic pressures is thought to make thrombus dislocation and recurrent haemorrhage ("clot popping") less likely, thereby lowering retroperitoneal blood loss; at the same time, infusing a lower amount of fluid lessens the harmful effects of haemodilution and the resulting hypothermia and coagulopathy.

Our patient was transferred immediately to the OR from the CT scan room. The primary goal of surgery is to achieve safe, rapid, and effective cross-clamping of the aorta, which can be accomplished through different approaches and techniques. A prospective, randomized trial showed the transperitoneal and left extraperitoneal approaches to be equally safe and effective[7]; We went the route of the transperitoneal approach. It is worth noting that the availability of a PTFE trouser graft may be a challenge in our environment, as this procedure is not commonly done and as such, not often stocked by vendors. Laparoscopic surgery or hand assisted laparoscopic surgery can be performed, however, we do not have this skill presently. This is more cosmetic, but surgical time may be prolonged, with patient exposed to lengthy anesthesia. Emergency endovascular aneurysm repair (EVAR) has been used successfully in selected patients. EVAR was not feasible for our patient as he was in a very critical condition – unconscious, intubated, ventilated, on 3 inotropic support and with acute renal failure. A Cochrane review found insufficient data to evaluate the relative benefits and risks of endovascular treatment for ruptured AAA when compared with open repair[8]. The National Institute for health and care excellence (NICE) still recommends open surgery for ruptured AAAs[9]. In a retrospective review of 17 patients with Aortic aneurysms by Ogunleye et al[10], there were 9 (52.9%) ruptured aortic aneurysm during the study; 1 (5.9%) at presentation, and 8 (47.1%) while on admission awaiting surgical intervention. However, it was not specified what types ruptured. Five patients (29.4%) had corrective surgery; others were managed conservatively with propranolol while awaiting surgical intervention. The 30-day mortality was 64.7%, the operative mortality was 35.3%. It was also not stated if any of the ruptured cases was operated.

Complications from repair of Ruptured AAA includes Intra/post-operative hemorrhage, colonic ischaemia, respiratory insufficiency, renal failure, myocardial infraction, cardiac arrhythmias, congestive heart failure, multi organ failure, paraparesis or paraplegia. Our patient developed cardiac arrythmia 2nd day post-op, which resolved on commencement of Amiodarone.

Learning Points

1. As in any other healthcare setting, the rupture of an aneurysm can be averted by early identification of its presence and appropriate surveillance.
2. Abdominal USS is a cheap, simple, readily accessible tool useful in detection and surveillance.
3. There is an urgent need to raise the awareness of AAAs in our environment and promote screening and surveillance pathways.
4. More so, it can be successfully managed despite our challenges.

CONCLUSION

Ruptured AAA is a clinical condition whose diagnosis can be sinister. A high index of suspicion is necessary inpatients that present with abdominal pain radiating to the back (especially hypertensives). Abdomino-pelvic ultrasound scan can be very useful in these patients. Successful management of these patients depends on prompt review by a Vascular surgeon and immediate transfer of patient to the theater for repair, and availability of ICU facility. Prompt resuscitation should be instituted when necessary.

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