

Indications and Outcome of Surgery in Pleuro-pulmonary Tuberculosis

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Abstract

Background: With the rising incidence of tuberculosis in our country that also faces serious challenges with poverty and human immune-deficiency virus infection, we experience a rise in the referrals for surgical intervention in patients with Pleuropulmonary tuberculosis.

Aim: To study the indications and outcome of surgery in our pleuropulmonary tuberculosis patients.

Methods: Pleuropulmonary tuberculosis patients who needed surgical intervention(s) for their disease in the cardiothoracic surgery unit of the University of Uyo Teaching Hospital over a 24-month period were retrospectively studied. Data on demographic characteristics, socio economic parameters, clinical presentation, radiological/investigation findings, diagnosis, treatment and outcome were collated and analysed.

Results: One hundred and fifty-six patients with pleuropulmonary tuberculosis were diagnosed and treated by the Directly Observed Therapy Unit of the Hospital during the study period, and 33 (21.2%) of them indications for surgical treatment. The patients consisted of 19 males and 14 females (M:F=1.3:1) with age range 2-68 years and mean 36.3 years. Seven indications of surgery in pleuropulmonary tuberculosis were encountered including symptomatic pleural effusion in 39.4%, broncho-pleural fistula (secondary spontaneous pneumothorax) in 21%, empyema thoracis in 12%, emphysematous bulla (9.1%), lung abscess (6.1%), haemoptysis (9.1%), and a case of destroyed lung syndrome (3.0%)

The indicated surgical interventions included closed tube thoracostomy drainage (69.7%), Monaldi tube decompression (9.1%), and thoracotomy and decortication (3.0%). Mortality rate in this series was 3.0%.

Conclusion: Surgery is indicated about 21% of our patients with pleuropulmonary tuberculosis with a mortality of 3.0% and we recommend a high index of suspicion, contact tracing and strict adherence to the modus operandi of directly observed continuous combined anti-tuberculous chemotherapy for pleuropulmonary tuberculosis.

Keywords: Pleuropulmonary tuberculosis; Indications of surgery; Outcome

Introduction

Pulmonary tuberculosis is a disease of poverty, overcrowding, and inadequate nutrition associated with sub-standard public health conditions, which infects about seven per cent of people exposed [1]. There are about three million deaths yearly worldwide from tuberculosis, and approximately one-third of the world's population are infected with tuberculosis, although only 10% may manifest the disease [1]. The reasons for the recent increase in tuberculosis and multi-drug resistant cases are multifaceted; the appearance of acquired immune deficiency syndrome (AIDS) with its immuno-compromised host is a major factor and such patients are said to have 'twin – infection'. Other factors include immigration patterns, some complacency in medical community, and an increase in areas with associated overcrowding and poor sanitation [1]. Furthermore, there have been no new drugs introduced that are highly effective in the treatment of tuberculosis during the past 40 years; rifampicin being introduced in 1971 [1].

Pulmonary tuberculosis is generally a medical condition treated with combined continuous anti-tuberculous chemotherapy [2]. However surgical intervention is indicated when certain complications of pulmonary tuberculosis develop [2]. These complications include persistent cavity in the lung, destroyed lung syndrome, tuberculoma, tuberculous bronchiectasis of lower or middle lobe of lung, massive or recurrent haemoptysis, symptomatic pleural effusion, symptomatic pneumothorax as a result of broncho-pleural fistula, bronchial stenosis, empyema thoracis, symptomatic emphysematous bulla, and to rule out cancer in an old tuberculous scar [1,2].

Practicing in the sub-Saharan Africa where HIV infection and pleuropulmonary tuberculosis burdens are high and rated at public importance [3]. we set out to determine the clinico-pathologic characteristics of our pleuropulmonary tuberculosis patients with surgical complications and outcome of treatment.

Materials and Methods

The sources of information were cardiothoracic surgical case registers, operating theatre registers and patients' case files of the cardiothoracic surgery unit, Department of Surgery and the Directly Observed Therapy (DOT) Unit of Community Health Department of University of Uyo Teaching Hospital, Uyo, Akwa Ibom State, Nigeria, within a 24 month period. Each patient's data were entered into a proforma seeking information on the demography, socio-economic parameters, clinical features, radiological/investigation findings, diagnosis, treatment and outcome.

Patients whose diagnosis of pleuropulmonary tuberculosis could

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not be made were excluded from the study. Of particular note here were the four patients who presented with pericarditis thought to be caused by tuberculosis but whose pericardial fluid and the resected pericardial tissues did not confirm the diagnosis of tuberculous pericarditis. Those who were included had diagnosis of pleuropulmonary tuberculosis made through complete blood count/erythrocyte sedimentation rate, chest radiograph, sputum acid/alcohol fast bacilli staining, Mantoux test, pleural aspirate acid/alcohol fast bacilli staining, and/or pleural biopsy histology. The surgical treatment given to the patients in addition to the anti-tuberculous chemotherapy was noted, while outcome of treatment was measured in terms of patient's survival and degree of lung re-expansion, and graded as complete, incomplete or same.

Data were collated, analyzed and compared by simple proportions and percentages.

This study was approved by the institutional ethical review committee.

Result

Out of the 156 patients with pleuro-pulmonary tuberculosis treated by the DOT Unit of the Community Health Department of the hospital during the study period, there were 33 patients indications for surgical treatment constituting 21.2% of all cases. The patients consisted of 19 males of 14 females (M: F=1.3:1) with age range 2–68 years and mean 36.3 years (Table 1). Table 1 also shows the sex distribution of the patients with the various surgically treated indications of pleuro-pulmonary tuberculosis in the series. There were more males with broncho-pleural fistula, empyema thoracis, emphysematous bulla and lung abscess; while there were more females with pleural effusion, haemoptysis, and the only patient with destroyed lung syndrome was a female. The right lung was significantly involved more than the left lung (17 vs. 11) while in five patients (15.2%), both pleurae were involved.

Variable	Frequency	Per cent
Sex		
Male	19	57.6
Female	14	42.4
Age (years)		
<=10	2	6.1
11-20	3	9.1
21-30	8	24.2
31-40	6	18.2
41-50	10	30.3
51-60	3	9.1
>60	1	3.0
Side of chest affected		
Right	17	51.5
Left	11	33.3
Bilateral	5	15.2
Indications for surgery		
Pleural effusion	13	39.4
Broncho-pleural fistula (spontaneous pneumothorax)	7	21.2
Empyema thoracis	4	12.1
Giant emphysematous bulla	3	9.1
Haemoptysis	3	9.1
Lung abscess	2	6.1
Destroyed lung syndrome	1	3.0

Table 1: Demographic and pathological characteristic of pleuropulmonary tuberculosis patients with indications for surgery.

Variable	Frequency	Per cent
Level of education		
None/primary	12	36.4
Secondary	21	63.6
Employment status		
Un-employed	10	30.3
Gainfully employed	23	69.7

Table 2: Socio-economic status of patient with surgical complication of pleuro-pulmonary tuberculosis.

Presentation	Frequency	Per cent
Difficulty in breathing	32	97
Fever/Internal heat	32	97
Involuntary weight loss	30	90.9
Night sweat	30	90.9
Cough	25	75.8
Coughing out of blood	3	9.1

Table 3: Clinical presentation of patients with surgical complications of pleuro-pulmonary tuberculosis.

All the patients with bilateral disease had tuberculous pleurisy with bilateral pleural effusion.

Seven types of indications of surgery in pleuropulmonary tuberculosis were encountered involving the right side in 17 (51.5%) cases, left in 11 (33.3%) cases and bilateral in 5 (15.2%) cases. Pleural effusion occurred in a total of 13 (39.4%) cases. It was only pleural effusion that occurred bilaterally. Broncho-pleural fistula (spontaneous pneumothorax 2° pulmonary tuberculosis) occurred in 21.2% (7 patients) and empyema thoracis in 12.2% (4 patients). Other surgical indications noted were giant emphysematous bulla (9.2%), lung abscess (6.1%), and a case of destroyed lung syndrome (3.1%) (Table 1).

Table 2 depicts some aspects of socioeconomic characteristics of the patients. Thirty six per cent of them had either primary education or no formal education while the remaining 64% had attended secondary or tertiary education. Also about 30% were not gainfully employed while the remaining 69.7% were gainfully employed. Nine (27.3%) patients had had previous diagnosis of pulmonary tuberculosis with 33.3% having completed a course of anti tuberculous treatment while 66.7% did not complete. Human immune-deficiency virus co-infection rate in this series was 9%.

Table 3 shows the major symptoms complained of by the patients at presentation. Ninety seven percent complained of shortness of breath and fever or 'internal heat' respectively. Another 90.9% complained of weight loss and excessive sweat at night, and 75% had cough while coughing out of blood was the presenting symptom in 9.1% patients.

Investigations which enabled confirmation of diagnosis included sputum acid/alcohol fast bacilli (AFB) staining in 20 patients (60.6%), Mantoux test using purified protein derivative in 26 patients (78.8%), full blood count and erythrocyte sedimentation rate in 30 patients (90.9%), chest radiograph in 30 patients (90.9%), pleural aspirate AFB staining in 5 patients (15.2%) and pleural biopsy histology in 14 patients (42.4%) (Table 4).

Table 5 displays the surgical treatment given to the patients to include closed tube thoracostomy drainage in 23 patients (69.7%), thoracotomy and decortication in one patient (3.0%), Monaldi-tube decompression in 3 patients (9.0%), and watchful waiting in 6 patients (18.2%). The outcome of treatment measured according to the degree of re-expansion of the affected lung was complete in about 80% of

Investigation	Frequency	Per cent
Sputum AFB	20	60.6
Mantoux test	26	78.8
FBC/ESR	30	90.9
Chest radiograph	30	90.9
Pleural aspirate AFB	5	15.2
Pleural biopsy	14	42.4

Table 4: Means of diagnosis.

Treatment	Frequency	Per cent	Degree of lung re-expansion
Tube thoracostomy drainage	23	69.7	complete
Thoracotomy and decortication	1	3.0	complete
Monaldi tube decompression	3	9.1	complete in one patient
Watchful waiting	6	18.1	same/lost to follow-up
Mortality	1	3.0	

Table 5: Surgical Treatment and Outcome.

patients. It was however indeterminate in the five (15.1%) patients who either were lost to follow-up or not treated because of various reasons. In hospital mortality rate was one (3.1%) out of thirty-three patients.

Discussion

In pleuropulmonary tuberculosis surgical therapy is part of a multidisciplinary therapeutic concept. Identifying the optimal point of time for surgery has a strong impact on the further course of the healing process and thus on the prognosis [4]. Indications for surgical therapy are: 1. multi-drug-resistant pulmonary tuberculosis (MDR-TB), 2. late-onset complications (aspergilloma, tuberculosis of the tracheobronchial tree or of mediastinal or hilar lymph nodes), 3. tuberculosis of the pleura [4]. In his study, Freixinet J opined that surgery for pulmonary tuberculosis (PTB) has passed through various stages throughout history, having been the treatment of choice in the past. It has now been relegated to second place for treatment of this disease. One of the most strongly debated surgical indications has been clinical picture of multidrug resistance with the focus of pulmonary tuberculosis activity located in a segment, lobe, or lung. In these cases some authors have described good results with surgical excision. Another important indication is the complications of PTB, among which bronchiectases (provoking pictures of suppuration, superinfections, or hemoptysis) are found, along with known destructive pulmonary sequelae such as destroyed lung, massive hemoptysis, and the presence of a bronchopleural fistula that cannot be resolved with pleural drainage. The presence of a neoplasm in a patient affected by PTB is a surgical indication if the lesion is resectable. The existence of an unidentifiable pulmonary mass or node is a surgical criterion because it might signal bronchogenic carcinoma. A frequent indication for surgery is pulmonary aspergilloma, which in a large percentage of cases is a destructive PTB sequela and generates serious complications, hemoptysis being the most frequent [5].

This study shows that surgery was indicated in 21.2% of our patients with a male : female ratio of 1.3:1. This same sex ratio was found in other related studies and is believed to be a result of the fact that there are more male smokers, alcoholics and social mixers than females; habits known to perpetuate and worsen mycobacterium infection transmission [6,7]. This study also discovers a high level of illiteracy (36%) and unemployment (30.3%) in the patient population. This subset of persons would most succumb to the deceits of medical charlatans under the auspices of trado-medical healers and spiritualists

whose negative impacts on the health of the citizenry have been well documented across the African continent [8,9]. It is also this same subset of persons that would not be able to afford the diagnostic investigations which are usually paid for to enable early commencement of free anti-tuberculous treatment before complications set in.

Involvement of the right lung more than left lung (51.5% vs 33.3%) in this study is not unexpected. Although not all previous studies have included laterality in analysis, the right lung is usually infected by mycobacterium tuberculosis more than the left, and therefore complications arising from pleuro-pulmonary tuberculosis are expected to affect the right more [10].

The presenting symptoms in the patients in this study included breathlessness (97%), weight loss (90.9%), low grade fever/‘internal heat’ (97.0%), night sweat typically drenching (90.9%), cough (75.8%), and haemoptysis in 9.1%. In the study by Erinle, cough occurred in 70.5%, weight loss in 35.9%, fever in 29.6%, haemoptysis in 11.1%, night sweat in 6.4%, and breathlessness in only 5.2% [10]. A possible explanation for these variations is that the Erinle’s study was radiologically based and many of the patients may have been asymptomatic having sub-clinical pulmonary tuberculosis and presenting for chest radiograph for employment, international travel or school admission-related medical examination. Nwofor et al. also noted that breathlessness was the single most important symptom in that it determined the need for and speed of surgical intervention in 72.3% of patients with pleural collection [11].

The various diagnostic investigations, including sputum acid/alcohol fast bacilli staining using Ziehl-Neelsen stain, Mantoux/tuberculin test using the purified protein derivative, full blood count and erythrocyte sedimentation rate, pleural aspirate alcohol/acid fast bacilli staining, pleural biopsy histology, and chest radiograph, were individually suggestive or positive in less than 100% of the patients. The highest yield was in full blood count and erythrocyte sedimentation rate, while the lowest yield was in sputum alcohol/acid fast bacilli staining. This further stresses the magnitude of sputum-negativity in some patients with active pulmonary tuberculosis when other means of diagnosis have to be utilized. This scenario is particularly common in immunosuppressed patients in whom multidrug resistance mycobacterium infection is also common [12]. The pre-operative pleural biopsy was obtained percutaneously using Abram’s biopsy needle. Although the diagnostic yield from pleural biopsy is expected to be higher when the biopsy is obtained through image-guidance or thoracoscopy, Ezemba, et al working in the same region have documented sensitivity of 92% from percutaneous pleural biopsies using Abrams pleural biopsy needle in which tuberculous pleurisy accounted for 22% [13].

Mycobacterium tuberculosis IgG and IgM antibodies’ testing was at the time of the study not available in health facility’s immunology diagnostic laboratory. However this test although not conclusively diagnostic is currently available and is routinely carried out on patients who are on diagnostic workup for tuberculosis. Also six weeks of incubation necessary for Lowenstein-Jensen culture for mycobacterium is a drawback to routine inclusion of culture and sensitivity in the diagnostic armamentarium of tuberculosis. Regional reference laboratories have however been established to cater for the increasing needs of tuberculosis treatment centres in Nigeria for mycobacterium culture and sensitivity testing occasioned by the emergence of multidrug resistance tuberculosis in the country. A few centres in Nigeria also currently have gene Xpert for diagnosis of tuberculosis which utilizes detection of mycobacterium DNA in patient’s sputum.

This study reveals seven types of indications of surgery in our pleuropulmonary tuberculosis. The major indications for surgical intervention in previous studies included hemoptysis, drug resistance, possible neoplasm, and bronchiectasis [14]. Significant and symptomatic pleural effusion was discovered to be the most common indication for surgery for pleuropulmonary tuberculosis in this study occurring in 39.4% of the patients. In two other related studies in Nigeria, pleural effusion constituted 19.2% and 41% respectively [1,10]. In the index study pleural effusion together with empyema thoracis constituted 51.5% of the surgical indications of pleuropulmonary tuberculosis which was higher than the figure in the study in Romania where pleural collection constituted 31.9% [15]. In study analysis exclusively on paediatric pleuropulmonary tuberculosis patients, pleural effusion was present in 57.3%. Some authors have believed that with appropriate anti-tuberculous chemotherapy, it may not be necessary to surgically drain the pleural effusion except to relieve symptoms [16]. Pleural drainage was done in 3.9% in the study by Kerti et al. [1,5]. Broncho-pleural fistula or spontaneous pneumothorax 2° pulmonary tuberculosis was found in 21.2% of the patients. This also formed 11.9% and 5.3% of the indications for surgical intervention in pulmonary tuberculosis in other studies [12,17]. There was no patient with bilateral pneumothorax in this series. This was also the case in other Nigerian studies [10,11]. Some of the patients with spontaneous pneumothorax with broncho-pleural fistula had massive and prolonged air-leak causing prolonged lung collapse. However perseverance on under-water seal drainage of the pleural space enabled complete lung re-expansion on the third and fourth week of therapy without need to recourse to operative closure of the broncho-pleural fistula.

Although standard chemotherapy should be instituted for tuberculous empyema, it is unlikely to clear the pleural space infection in the chronic stage, probably because the penetration of the anti tuberculous agent into pleural cavity is limited [16]. For this reason surgical drainage is often necessary. This may be accomplished with a standard thoracostomy tube or thoracotomy and decortication [16]. Empyema thoracis in the series constituted 12.2%, with only one (3.0%) being in the chronic (fibrothorax) stage needing postero-lateral thoracotomy and pleuropulmonary decortication. The remaining cases of empyema thoracis were in the acute (pre-empyema pleural effusion) and subacute (fibrinopurulent) stages and therefore successfully treated with antibiotic and closed tube thoracostomy drainage which resulted in complete lung re-expansion. This is the standard treatment protocol of empyema thoracis [18]. In similar studies, pleuropulmonary decortications were carried out in 8 cases, [19] and decortication in 10 cases and drainage in four [20].

The cases of destroyed lung syndrome, haemoptysis, and lung abscess were managed conservatively. Recurrence of haemoptysis was prevented by the use of per os antitussive medicine, and lung flooding was prevented by postural advice. Lung abscess was treated with antimicrobial agents, chest physiotherapy and postural drainage in addition to anti tuberculosis agents. Similar cases have been so treated successfully [2].

One of the patients with giant emphysematous bulla was a 45 year old woman who had had multiple unsupervised and incomplete courses of anti-tuberculosis drugs from a primary health care clinic. She was treated surgically with Monaldi tube decompression. There was progressive reduction in bulla size on weekly radiographic assessment. However before complete resolution of the bulla, the patient opted for discharge against medical advice to enable her to attain to social problems at home. The remaining two patients with

giant emphysematous bulla were also treated with Monaldi tube decompression with complete lung re-expansion in one patient.

Human immunodeficiency virus co-infection rate was 9.1% in our study. Prevalence rates of HIV infection from 6.1% - 25% have been found among pleuropulmonary tuberculosis patients in Nigeria [21,22]. This subset of pleuro-pulmonary tuberculosis patients is known to have higher risk of development of multidrug resistant mycobacterium infection with higher complication rate and indication for surgical intervention [23]. A recent study has documented the reluctance of some cardiothoracic surgeons in West Africa to carry out major surgical operations on acquired immune deficiency syndrome patients and therefore pleuro-pulmonary tuberculosis patients with HIV co-infection should be specially treated so that they do not develop complications that would require surgery [24]. Hospital mortality rate in this study was 3.0% which occurred in a 56year old man with giant emphysematous bulla who died from surgical emphysema and respiratory failure on the third post-operative day despite a functioning Monaldi tube and lung function support therapy.

Conclusion

The prevalence of indications for surgical indications in pleuropulmonary tuberculosis in Uyo in this study stood at 21.2%. We recommend a high index of suspicion, contact tracing and strict adherence to the modus operandi of directly observed continuous combined anti-tuberculous chemotherapy for pleuropulmonary tuberculosis. These measures are hope reduce complications that would warrant surgical intervention and improve treatment outcome.

References

1. Pomerantz M (1996) Surgical Treatment of Tuberculosis and Other Pulmonary Mycobacterial Infections. In Baue AE (Ed): Glenn's Thoracic and Cardiovascular Surgery. Stanford Appleton and lange 325-329.
2. Massard G (2004) Treatment of Suppurative Lung Disease European Respiratory Society Monograph 29: 168-180.
3. Watters DA (1997) Surgery for Tuberculosis Before and After Human Immunodeficiency Virus Infection: a Tropical Perspective. Br J Surg 84: 8-14.
4. Branscheid D, Albrecht CM, Diemel KD (2003) Surgical Therapy of Pulmonary Tuberculosis. Internist (Berl) 44: 1406-12.
5. Freixinet J (1997) Surgical indications for treatment of pulmonary tuberculosis. World J Surg 21: 475-9.
6. Allanana JA, Jacob DS, Banwat EB, Egah DZ, Ikeh IE (2009) Acid fast Bacilli in Sputa of Consumers of Local Alcoholic Beverages in Bogoro, Bauchi State. Nig. Med. Pract. 56: 26-30.
7. Classen CN, Warren R, Ricardson M, Hauman JH, Gie RP, et al. (1991) Impact of Social Interactions in a Community on the Transmission of Tuberculosis in a High Incidence Area. Thorax 54: 136-140
8. Ekpe EE, Akpan MU (2010) Poorly Treated Broncho-Pneumonia with Progression to Empyema Thoracis in Nigerian Children. TAF Preventive Medicine Bulletin 9: 181-186.
9. Munyaradzi M (2011) Ethical quandaries in spiritual healing and herbal medicine: A critical analysis of the morality of traditional medicine advertising in southern African urban societies. The Pan African Medical Journal 10:6.
10. Erinle SA (2003) An appraisal of the radiological features of pulmonary tuberculosis in Ilorin. Niger Postgrad Med J 10(4): 264-9.
11. Nwofor AM, Ekwunife CN (2006) Tube thoracostomy in the management of pleural fluid collections. Niger J Clin Pract 9: 77-80.
12. Lardinois D, Furrer M, Mouton W, Gugger M, Ris HB (1997) Surgical aspects of mycobacterioses. Evolution during the last 20 years. Schweiz Med Wochenschr 127: 1961-8.
13. Ezemba N, Eze JC, Anyanwu CH (2006) Percutaneous needle pleural biopsies

- in pleural effusion of uncertain aetiology in a Nigerian teaching hospital. Trop Doct 36: 112-4.
14. Reed CE, Parker EF, Crawford FA Jr (1989) Surgical resection for complications of pulmonary tuberculosis. Ann Thorac Surg 48: 165-7.
 15. Kerti CA, Miron I, Cozma GV, Burlacu ON, Tunea CP, et al. (2009) The role of surgery in the management of pleuropulmonary tuberculosis seven years' experience at a single institution. Interact Cardiovasc Thorac Surg 8: 334-7.
 16. Khatami, K (2002) Pleural Tuberculosis. Shiraz E-Medical Journal 3: 3
 17. Olcmen A, Gunluoglu MZ, Demir A, Akin H, Kara HV, et al. (2006) Role and Outcome of Surgery for Pulmonary Tuberculosis. Asian Cardiovasc Thorac Ann 14: 363-366
 18. Klopp M, Pfannschmidt J, Dienemann H (2008) Treatment of pleural empyema. Chirurg 79: 83-94.
 19. Freixinet JG, Rivas JJ, Rodríguez De Castro F, Caminero JA, Rodríguez P, et al. (2002) . Role of surgery in pulmonary tuberculosis. Med Sci Monit 8: 782-6.
 20. Mouroux J, Maalouf J, Padovani B, Rotomondo C, Richelme H (1996) Surgical management of pleuropulmonary tuberculosis. J Thorac Cardiovasc Surg 111: 662-70.
 21. Anteyi EA, Idoko JA, Ukoli CO, Bello CS (1996) Clinical pattern of human immunodeficiency virus infection (HIV) in pulmonary tuberculosis patients in Jos, Nigeria. Afr J Med Med Sci 25: 317-21.
 22. Erhabor O, Jeremiah ZA, Adias TC, Okere CE (2010) The prevalence of human immunodeficiency virus infection among TB patients in Port Harcourt Nigeria. HIV/AIDS - Research and Palliative Care 2: 1-5
 23. Mohsen T, Zeid AA, Haj-Yahia S (2007) Lobectomy or pneumonectomy for multidrug-resistant pulmonary tuberculosis can be performed with acceptable morbidity and mortality: a seven-year review of a single institution's experience. J Thorac Cardiovasc Surg 134: 194-8.
 24. Kesieme EB, Kesieme CN, Ekpe EE, Delia IZ (2011) Attitude and perception of cardiothoracic surgeons in Nigeria and Ghana to patients with human immunodeficiency virus infection. Journal of AIDS and HIV Research 3: 79-84.