Pneumonectomy in children

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Abstract

Objectives: Surgical literature carries relatively scant information on pneumonectomy in children. We reviewed our experience over 7 years, determined the risk/benefit ratio and compared our experience with reports from the literature. Methods: The records of children undergoing pneumonectomy, 14 years and younger, over a 7-year period from January 1991 to December 1997, are analysed, the techniques used to determine the need for and extent of surgery are studied, whilst the problems and outcome of surgery in this age group are determined. Results: Fifty-nine children, 40 males, 19 females, aged 6 months to 14 years, average age of 7.5 years, underwent pneumonectomy. A history of pulmonary infection/s and a chest radiograph suggestive of lung destruction were indicators for investigation by bronchography and/or computerized axial tomography of the chest (HRCT scan). This determined the nature and extent of disease and the possibility and extent of surgery required. Bronchus blockers (22), five others in combination with the prone operating position, prone position (six) and a double lumen tube in one, were used to protect the healthy lung at surgery. Spill of pus was recognized once with a bronchus blocker and the prone position used in combination. Six intra-operative complications (10.1%) were recognized: bronchial spill (one) without consequence, conversion of bi-lobectomy to pneumonectomy due to pulmonary artery injury (one), cardiac arrest (with resuscitation, one), bradycardia with hypotension (one), excessive bleeding (one) and intra-pleural spill of debris (one), the last without consequence. Seven post-operative complications (11.8%) occurred: one empyema (sterilized), bleeding one, pulmonary infection two, suspected but unproven broncho-pleural fistulae two, prolonged antibiotics in one, reason unrecorded. One pneumonectomy through an empyema was uncomplicated. The main histological features were bronchiectasis (38), active tuberculosis (eight), end-stage lung (five), collapse and pulmonary haemorrhage (one), lobar emphysema (one). Histology unrecorded (one). No death occurred. All patients left hospital well. Conclusions: Careful preparation, often including anti-tuberculosis cover, and timing of pneumonectomy are essential. Meticulous anaesthetic and surgical technique and cooperation are critical. Bronchus blockers functioned well but are not without risk. Attention to detail makes pneumonectomy safe in childhood. © 2002 Published by Elsevier Science B.V.

Keywords: Pneumonectomy; Children; Inflammatory lung disease

1. Introduction

Whilst reviewing an experience of pneumonectomies for inflammatory lung disease (ILD) a surprising number of children were found to have undergone pneumonectomy. Surgery in these children has been previously reported [1].

The literature carries few separate reports of pneumonectomy of any number in children [1–4], most reports being series of mixed pulmonary resections including some pneumonectomies [5–7]. Information on pneumonectomy in childhood is limited; pneumonectomy being infrequently carried out in children [8–10].

After the first successful pneumonectomies in children by Nissen in Europe and Haight in North America in 1931 and 1932, pneumonectomy in children came to be recognized as well tolerated and safe [5,11]. However, Sery with one of the biggest experiences of pneumonectomy in childhood (1963) and later Conlan considered pneumonectomy in childhood to pose grave problems and considered pulmonary resection for suppurative lung disease to be hazardous [3,4]. Children were noted to grow and develop normally after surgery, most of the small numbers of pneumonectomies followed up led vigorous and full lives [2,11,12]. Stiles et al. noted that young children, with more potential for growth, tolerated pneumonectomy well, with less functional disability than adults [11].
The initial indications for pneumonectomy were bronchiectasis and pulmonary destruction, often due to tuberculosis [5,11,13]. Pneumonectomy for cystic fibrosis, a relatively common genetic disorder has been infrequently reported and follow-up of pneumonectomy by 1999 numbered fewer than 20 cases [14]. Congenital lesions, benign and malignant tumours and trauma occasionally necessitated pneumonectomy [6,9,11].

With the introduction of anti-tuberculosis medications in the 1940s, antibiotics and vaccination programmes for pertussis and measles, the need for surgery for ILD was by the 1970s, rarely encountered in developed countries [13,15,16]. Despite the more recent re-emergence of tuberculosis, pneumonectomy in childhood is infrequently performed in developed countries [16,10]. Resectional surgery, mainly lobectomy and lesser procedures, for congenital pulmonary disease sometimes in association with congenital heart disease has become more frequent at younger ages, so as to alter the spectrum of pulmonary resection in childhood [13]. In socio-economically disadvantaged countries such as ours, the clock has stood still; destructive lung disease remains the near sole indicator for pneumonectomy in children. In this series, seemingly the largest reported, we have reviewed our experience to determine the risk/benefit ratio of pneumonectomy, as well as to illustrate and compare the problems we and others have encountered in managing these children.

2. Patients and methods

During the period January 1991 to December 1997, 59 children, 14 years and younger, underwent pneumonectomy in Wentworth and King George V Hospitals, the only Public Service Hospitals performing thoracic surgery in the Province of Kwa Zulu Natal with its population of about 8.5 million people. The records of these patients were reviewed. Forty males and 19 females with an age range of 6 months to 14 years, average age 7.5 years, underwent 24 right and 35 left pneumonectomies (Fig.1). All procedures were elective.

As previously reported many of these patients come from poor socio-economic circumstances [1]. More than 80% were receiving or had received treatment for tuberculosis and one patient was found to be HIV positive. Most were symptomatic with cough productive of purulent sputum. Haemoptysis was a rare sign. Four were referred with or after treatment of empyema with a persistently abnormal chest radiograph (CXR). A few were referred because foreign body inhalation was recorded or suspected; the CXR was abnormal. Parafractional inhalation and complicated measles were documented causes of radiographic evidence of lung destruction.

2.1. Pre-operative assessment

Severity of symptoms, co-morbid conditions, appearance of CXRs and respiratory status were all assessed. Bronchoscopy, used to detect the presence of foreign bodies, stricture, and bronchial compression, also determined the state of inflammation and quantity and source of pus in the bronchi. Microscopy and culture of trap specimens taken at bronchoscopy determined antibiotic usage. Tuberculosis being so common, the specimens were examined and cultured for acid fast bacilli (AFBs) and when found, the patients would be given a full course (6 months) of anti-tuberculosis therapy and then be reviewed. Further investigation was delayed in the face of clinically active disease (fever, malaise and changing serial CXRs), or when profuse purulent secretions were encountered at bronchoscopy. When significant cervical adenopathy was present, and that was uncommon, lymph node biopsy was carried out for diagnosis at time of bronchoscopy. Generally these patients were returned to the referral hospitals for antibiotic treatment, completion of anti-tuberculosis therapy when tuberculosis was proven or probable, and chest physiotherapy.

When disease was stable on clinical and radiological grounds, before high resolution computerized tomography (HRCT) came into standard use, bronchography was carried out. It was always preceded by bronchoscopy and only performed if pus was no more than minimal. Bronchography in 23 patients, bronchography and HRCT in seven as part of a learning experience, and HRCT alone in 35 were used to demonstrate the extent and nature of disease in the affected lung, and most importantly where pneumonectomy was contemplated, the state of the contra-lateral lung. Records of one patient were lost.

Laboratory pulmonary function tests (PFTs) being difficult, if not impossible to perform in small children, were only carried out in older children. Exercise tolerance was, therefore, heavily relied upon.
2.2. Indication for surgery

Symptoms of chronic lung disease and recurrent chest infections were indications for investigation and surgery in those suspected of and proven to have uni-lateral disease amenable to surgery. A persistently abnormal CXR in a relatively asymptomatic child led to investigation and surgery when destroyed or non-functioning lung, as in lobar emphysema, was demonstrated. In a few only, contra-lateral disease was accepted when it was thought that removal of the main burden of disease could significantly improve quality of life. Possibly contra-lateral surgery could be considered later if necessary.

No cases of multi-drug resistant tuberculosis (MDR) were encountered. Patients with lung destruction in HIV disease without the stigmata of AIDS and without immune compromise according to CD4 + cell count, followed the same criteria for surgery as uninfected patients [1].

2.3. Pre-operative preparation

Nearly all patients suffered from ILD, see Table 1. Time was therefore spent on aggressive treatment of infection, extensive physiotherapy and management of diet. Physiotherapy was aimed not only at clearing the airways of secretions, but correcting and maintaining posture.

Only after sepsis was controlled, sputum production minimal or absent, with bronchi no longer inflamed as checked bronchoscopically, and the full course of anti-tuberculosis therapy completed were patients considered ready for surgery. Bronchoscopic findings were critical to assessment and preparation for surgery. Those patients known or suspected to have or had tuberculosis were given anti-tuberculosis therapy peri-operatively until the histology of the surgical specimen became available and a final decision as to further therapy could be made. No patient underwent surgery with a still positive culture for AFBs. Peri-operative antibiotics according to a protocol were administered [1]. Occasionally where purulent secretions remained prolific, planned pneumonectomy was abandoned.

2.4. Surgery

Pre-operative bronchoscopy was always carried out and if the state of the bronchi and pus content were unsatisfactory, the procedure was abandoned. In order to gain airway separation and protection of the contra-lateral lung, Fogarty embolectomy catheters were used as bronchus blockers in 22, the prone or Sellors–Brown position was used in six, or a combination of these was used in five and a double lumen tube used in one. Postero-lateral and posterior incisions were used in the lateral and prone positions. Dissection was carried out in the intra-pleural plane almost exclusively. The main bronchus was cut short, closed with a variety of interrupted sutures including coated polyester (Ethibond, Ethicon, Edinburgh, UK) polypropylene (Prolene, Ethicon, Edinburgh, UK) and polyglactin (Vicryl, Ethicon, Edinburgh, UK) and tested underwater to a pressure of 30 cms of water. The bronchus was covered over with whatever surrounding tissue was available. The hemithorax was washed out either with chloromycetin or povidone iodine and drained with a single underwater drain.

Good venous access was always gained by the Anaesthetist who would ensure the bronchi were kept clear by suction. Most patients had invasive blood pressure monitoring which also allowed regular blood gas analysis. Epidural anaesthesia was used in some.

Every effort was made to remove the endo-tracheal tube either in the theatre or the recovery room. Post-operative bronchoscopy was carried out in order to check the bronchial stump and clear all secretions. The chest drain was almost always removed the following day. No microbiological studies were made on chest tube drainage prior to removal.

2.5. Hospital stay and follow-up

Patients were only discharged once wounds were healed and any complication dealt with. Features of these children were their rapid mobility and shorter ICU stay than adults. As in adults, hospital stay was often dependent on availability of transport to outlying areas, while some could be relatively early transferred to the adjoining medical wards, especially if needing further anti-tuberculosis therapy. Length of hospital stay could, therefore, not be used as an indicator of morbidity. Generally, in the interests of cost-saving, children were early discharged from the follow-up clinic, often after one or two visits only.

Thirty-six of the 59 patients (61%) were followed up at our clinic; a few of the rest were returned to the medical wards of the hospital and would be returned in case of problems. Eleven patients (18.6%), all in good health on discharge from the ward, did not return.

In our opinion as has been pointed out, that should the need arise, most patients will return, this being the only Public Sector Thoracic Unit in the Province [1,15].

3. Results

Mortality and major complications are noted irrespective of when they occurred post-operatively.

3.1. Mortality

No mortality occurred.

3.2. Surgical complications and morbidity

Six intra-operative complications occurred, a complication rate of 10.1% (6/59). A planned bi-lobectomy was converted to a right pneumonectomy after injury of the pulmonary artery. Mal-position of a right-sided central venous pressure (CVP) catheter was complicated by cardiac
arrest. The situation was salvaged by right thoracotomy and drainage of the pleural cavity, internal cardiac massage, removal of the CVP catheter and appropriate drug administration. The child recovered fully but was ventilated postoperatively. Considerable blood loss was incurred by mediastinal dissection of marked lymphadenopathy in one, whilst bradycardia and hypotension complicated mediastinal dissection in another: Both these situations could be corrected satisfactorily. Significant spill of pus into the trachea, despite a bronchus blocker and the prone position, was rapidly recognized and corrected by aspiration. The sixth complication was that of spill of caseous material into the pleural space without consequence.

Seven post-operative complications, (11.86%) included one early empyema which was sterilized by 3 months. Bleeding in one led to a ‘stormy’ post-operative course but was managed without reopening, the patient being discharged by the end of 2 weeks. Two patients in whom bronchus blockers were not used, developed pulmonary infections and required continued intravenous antibiotics. The reason for prolonged antibiotics in a third patient was not stated. Two patients were suspected of having bronchopleural fistulae (BPF), required investigation and observation but were found to have sealed bronchi.

Five children returned with evidence of pulmonary infection between 3 and 7 months after surgery. All received antibiotics. One with wheeze and cough was referred to the Respiratory Clinic and did not return to our clinic. These were not considered as complications of surgery. Apart from these five children, none complained of dyspnoea.

### 3.3. Histology

Histology of the lungs is shown in Table 1. Some specimens showed a variety of features; they were categorized according to the dominant histological feature.

The histology of eight lungs, five left and three right, showed active tuberculosis with AFBs being seen in two. These last two specimens were not cultured to show activity of the AFBs, but the histology fitted the criteria for activity according to the Department of Anatomical Pathology of the Medical School. In a 12-year-old girl undergoing completion pneumonectomy (she had her first operation elsewhere and was reported to have had anti-tuberculosis therapy) active tuberculosis was demonstrated in the lower lobe.

In a 14-year-old HIV positive boy with histology showing fibro-caseous tuberculosis, probably inactive, AFBs were not grown in the tissue cultured.

A broncho-oesophageal fistula was demonstrated preoperatively in a 5-year-old child who was referred after 9 months of anti-tuberculosis therapy, the histological features of lung being those of destruction and bronchiectasis. Mediastinal adenopathy was prominent at surgery, but the cause of the fistula could not be ascertained.

Four bronchial strictures were found prior to surgery, one tuberculous, one related to ventilation, the cause in the remaining two being unknown.

No spinal deformities were noted in these children at the time of discharge. No deformity was noted in those returning, follow-up ranging from 6 weeks to 18 months. The remaining lung generally occupied more space than before surgery with herniation apparent in some, at follow-up.

### 4. Discussion

Although many have recognized pneumonectomy in childhood to be safe there are problems particular to children that require recognition and special management. We had observed over many years prior to this experience that children dealt very well with pneumonectomy.

#### 4.1. Age and policy

While some authors have used 13 years as the age limit on basis of paediatric services offered [4,5], we, a referral service, have somewhat arbitrarily used 14 years. Others have included older patients even up to 18 years – hardly children, to somewhat confuse reports on pneumonectomy in children [2,7,13].

Apart from operating on symptomatic children, it has been our policy to operate on asymptomatic children in the belief that diseased and destroyed lung will but act as a focus for further infection offering the opportunity for damage to the unaffected lung, so as to later render the

Table 1

<table>
<thead>
<tr>
<th>Histology of lungs: major features listed</th>
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<tbody>
<tr>
<td>Bronchiectasis</td>
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<tr>
<td>Active tuberculosis</td>
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<tr>
<td>End-stage lung</td>
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<tr>
<td>Destroyed/infected</td>
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<tr>
<td>Other and unrecorded</td>
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<td>Lobar emphysema</td>
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Fig. 2. HRCT: typical example of shrunken and destroyed left lung for pneumonectomy.
child inoperable (Fig. 2). One patient in whom contra-lateral disease was recognized before surgery – a bronchiectatic shrunken middle lobe – (Fig. 3), returned 4 years later, now asymptomatic, and underwent middle lobectomy through a midline incision. These patients at the time of original surgery should ideally have no symptoms relatable to contra-lateral disease.

4.2. Radiology

Chest X-ray in children is often a good indicator of the extent of lung disease, and while it may be all that is needed in congenital lung disease, must be followed by bronchography and/or HRCT scan in investigation of ILD, if surgery is contemplated. Bronchography in well-prepared patients superbly determined the nature and anatomical extent of disease [15], revealed unexpected disease in the contra-lateral lung and was safe; in cases of congenital heart disease it was used with circumspection. Bronchography was superseded by CT scan, as Dionosil, an excellent contrast medium, was no longer available. Antenatal and postnatal ultrasound have been helpful in diagnosis of congenital lung disease [17]. Echocardiography, CT scan and MRI may be required to complete investigation of patients after birth, where congenital heart disease is suspected.

4.3. Tuberculosis

The diagnosis of tuberculosis in children is often circumstantial. The various indications for pulmonary resection in children for tuberculosis have been extensively described, and further discussion is not intended here [4,5,7,16]. We did not encounter the entity of bronchial compression by tuberculous glands, a situation almost peculiar to the paediatric group, requiring emergency surgery, described in another South African report [4]. With the intention of operating when tuberculosis was inactive we performed elective surgery usually 6 months after the last positive sputum and culture for AFBs and after completion of anti-tuberculosis treatment [1]. Surgery was performed under cover of anti-tuberculosis therapy. Others would not administer peri-operative anti-tuberculosis drugs for post-tuberculous surgery, considering this issue not to have been fully evaluated [4]. Endobronchial disease, much described and discussed, we encountered once, in form of a stricture [4,5].

Surgery for MDR, although not required during this period, would be performed 3 months after the last positive AFB culture, with the patient on the appropriate anti-tuberculosis drug schedule.

4.4. Pre-operative lung function

We have found lung function testing in young children to be very difficult. In children 3–6-years-old, Crenesse and others found only 55% of a selected co-operative group could reliably carry out forced expiratory procedures [18]. Like Conlan and others we have relied on clinical observations of the exercise activities of the younger children [3] and formal studies in those older and those able to co-operate. Blood gas analysis may on occasion give good information. These observations taken in conjunction with bronchographic and/or CT evidence of destroyed or what can be reasonably accepted as being non-functional lung, with no or minimum disease in the contra-lateral lung, we found, led to very satisfactory post-operative outcome. Fischer et al. thought respiratory function studies provided the prime indication for resectional surgery in asymptomatic bronchiectasis [5]. We did not make use of ventilation perfusion scans in this group.

4.5. Pre-operative preparation

We have previously discussed the management of pre-operative empyema and pneumonectomy through empyema (PTE) [1]. In the one instance of PTE, the patient should have had open drainage to remove lung slough prior to surgery, according to our protocol [1]. Fortunately, there was no complication.

As with adults, thorough and if indicated, prolonged preparation is critical to good outcome [1,6]. This allows for improvement in pulmonary status, sputum control, and a better nutritional state.

Removal of an impacted foreign body when distal lung is known to be destroyed is controversial; flooding by contained pus may occur. Suction may prevent this. This does allow for better preparation of the diseased lung, as evidenced by recent experience. However, while removal of the lung with the undisturbed foreign body is less likely to lead to spill, surgery is being performed on a more contaminated lung.
4.6. Lung exclusion

The importance of protecting the contra-lateral lung from spill of infected material and its grave consequences, has long been apparent [19]. Overholt’s secretion-retention prone position and the secretion drainage prone position of Sellors and Brown which allowed drainage of secretion into the trachea from whence it could be aspired were developed [19,20]. Brown discussed numerous other methods [20]. Conlan achieved excellent results using the prone position which we have also found very satisfactory, although surgery may be more difficult [3,4]. We have found Fogarty embolectomy catheters, used to isolate the diseased lung, to work well. They may shift during positioning of the patient or manipulation of the lung to allow spill or obstruction to ventilation. Placement requires some skill. Displacement is less likely in the left lung with its longer mainstem bronchus. Double lumen tubes are suitable in bigger children. Evaluation of the Univent tube in adults did not encourage us to use it in children [21]. Experience would say that no matter which technique is used, vigilance is essential throughout until the bronchus is controlled. Good pre-operative preparation and bronchoscopy reduce the likelihood of spill.

4.7. Surgery

Standard incisions give good access and little morbidity. Mattioli and others used muscle-sparing incisions for lesser resections and felt this would reduce pain and post-operative recovery time [22]. We found epidural anaesthesia to be a valuable tool for post-operative pain. Often hilar dissection is made complex by pronounced adenopathy, which distorts the vasculature. Hand suture closure of the bronchus and cover with surrounding tissue has been satisfactory. No comparative studies between suture and staple closure are available. Post-operative tube drainage of the space acts as a good guide for reopening in cases of bleeding, assists in positioning of the mediastinum, and was standard procedure. When adhesions are minimal, drainage is possibly not necessary after appropriate positioning of the mediastinum at time of closure.

4.8. Complications

Major complications in children are similar to those in adults, but may run a milder course and are not as frequent [1,6]. Complications relate to the nature of the primary disease and its severity acceptable to the surgeon, as well as the technical difficulties encountered at surgery [4,6]. During the first 50 years of childhood pneumonectomy, mortalities of 4.5 and 16.2% were reported in two of the largest series [11,6]. The practicality of pneumonectomy in neonates and infants, and the difficulties of surgery in co-existent congenital cardiopulmonary disease were recognized [6,9,13,23]. Recently mortality rates of 0–5% have been reported [1,3,4].

With single stage pneumonectomy established, the incidence of post-surgical empyema and BPF decreased markedly and is now rarely reported [1,3–5]. One inadequately prepared pneumonectomy through empyema in this series was uncomplicated. Despite careful technique, spill with even fatal consequences is still reported, ranging from 0 to 17.9% [1,3,4]. Reopening for bleeding is rarely reported.

Spinal deformities, particularly scoliosis, and chest deformities are uncommon and when present were said to precede surgery or follow thoracoplasty [2,11,12]. Thoracoplasty is no longer carried out in children. It is our conviction that these problems can be largely avoided by pre- and post-operative physiotherapy and postural training. This may be substantiated by total lack of referral of paediatric patients to the Spinal Unit of our Orthopaedic service, whilst post-pneumonectomy adults have been referred.

Early in the history of pneumonectomy, concern was expressed about the ‘deleterious emphysema’ of the remaining lung and the need to prevent this by thoracoplasty [11]. With moderate over-distension ventilatory function is minimally restricted [2,11,12]. Enlargement of the lung always occurs with some herniation, with measured volumes of the remaining lung greater than predicted [2,11,12].

From a 30 year follow-up study, Laros and Westermann found that lung volumes following pneumonectomy between ages of 6 and 20 years, were still larger than expected and postulated that compensatory growth may well occur as late as early adolescence, either by alveolar increase or hypertrophy [24]. When distention and this mechanical, is extreme, as in the right pneumonectomy or post-pneumonectomy syndrome, marked shift and anti-clockwise rotation of the mediastinum cause compression of the bronchus between aorta and pulmonary artery leading to respiratory distress and even death [9,10,25]. Described mainly in neonates and children when tissue is pliant, it may occur in adults, even after left pneumonectomy, many years after surgery [9,10,25]. Numerous ways aimed at prevention and treatment have been described, including the use of expandable saline-filled prostheses which can be inflated as the child grows [10]. Clear cut predictors of this condition have not been determined [25]. It is a condition to be known and recognized. We would hesitate to insert a prosthesis without clear indication; prophylaxis may in itself lead to complication. ILD may in most children cause sufficient stiffening of mediastinal tissue to prevent this rare event, and may be a reason for our not seeing it.

Oesophageal deviation and other abnormalities have been described but are usually asymptomatic, unlike in adults [2].

4.9. Problems peculiar to our practice

On occasion the unsatisfactory situation arose when consent had to be obtained through an intermediary, parents not being able to afford to travel to hospital with a child. Follow-up is severely limited mainly for financial reasons. The prevalence of tuberculosis and histological reports of
active tuberculosis, despite apparently adequate treatment, are of concern [1]. The reason for anti-tuberculosis therapy prior to referral was not always clear, and possibly tuberculosis is over-diagnosed. Pneumonectomy in HIV children without the facility of post-operative anti-retro-viral drugs (ARVD) is controversial.

4.10. Advances and innovations

Double lumen tubes of smaller size are now available, and placement can be checked by paediatric fibre-optic bronchoscopy, with advantages over Fogarty catheters. Mechanical staplers and video assisted thoracoscopic surgery (VATS) are used in resectional surgery [22,26]. The first VATS pneumonectomy in a child was performed in 1996 by Walker and colleagues [26]. Certainly this would be impractical in most pneumonectomies we would encounter. Pre-natal ultrasound scans have become a valuable investigation where congenital malformations are suspected [17]. Inflatable prostheses used as prevention or treatment of over-distension of lung, allow insufflation as the child grows [10]. Muscle-sparing incisions have been said to reduce recovery time (in lesser resections) [22].

4.11. Observations and conclusions

The pattern of disease in our experience requiring pneumonectomy has remained almost the same over 30 years and despite the increasing population, very little congenital lung disease is seen; all the reasons are not clear. We have performed fewer pneumonectomies in children in the last 4 years; measles eradication and an increase in death rates from HIV disease occurring before the development of surgical disease, may be responsible. Our results compare well with published reports: pneumonectomy in selected and well-prepared children is safe and worthwhile. Protection of the contra-lateral lung, and meticulous surgical and anaesthetic technique are critical. We consider that peri-operative antibiotics, anti-tuberculosis treatment in certain cases, and washout of the pneumonectomy space all contribute to the reduced infection rates. Physiotherapy, for reasons outlined, is essential. Observations over many years and in this group of children, albeit in the short term, show an almost immediate and progressive improvement in quality of life. Lack of prolonged follow-up is clearly a shortcoming. As previously stated, it is essential to maintain high levels of thoracic surgical skills in developing regions [1].

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References


Appendix A. Conference discussion

Mr D. Ngaage (Leeds, UK): I must say that the decision to perform a pneumonectomy in a child, especially in a six-month-old, is a major decision. Unfortunately, like you gave the background, this group did not have access to health care at an early stage.

Do you still see these kind of cases in your practice? Secondly, did these patients have any medical anti-TB therapy and were non-responsive?, or that too was not available to them.

Mr Blyth: Second question first. We did the same to these that had anti-tuberculosis therapy. There were no multi-drug-resistant cases. But what is really beginning to puzzle me, and it is something I have to go and look at when I go back, is a perception I have that we are not seeing children now coming through for pneumonectomy as before. We have done a lot of open lung biopsies on children who are HIV infected, and what I think is happening, these children are dying with HIV disease, because the epicenter of HIV disease is our Province, South Africa. I do not think we will keep seeing them because they are going to die before they develop surgical tuberculosis.