12-30-2019

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Recommended Citation

Wibowo, Hendra; Wardoyo, Suprayitno; and Shinta, Dhama (2019) "Pulmonary Resection in Complicated Primary Pediatric Pulmonary Tuberculosis: An Evidence-based Case Report," *The New Ropanasuri Journal of Surgery*: Vol. 4 : No. 2 , Article 10.

DOI: 10.7454/nrjs.v4i2.1053

Available at: <https://scholarhub.ui.ac.id/nrjs/vol4/iss2/10>

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Pulmonary Resection in Complicated Primary Pediatric Pulmonary Tuberculosis: An Evidence-based Case Report

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Email: merahkuningbiru@gmail.com Received: 26/Nov/2019 Accepted: 21/Dec/2019 Published: 31/Dec/2019
Website: <https://scholarhub.ui.ac.id/nrjs/> DOI: [10.7454/nrjs.v4i2.1053](https://doi.org/10.7454/nrjs.v4i2.1053)

Abstract

Introduction. Paediatric pulmonary tuberculosis incidence was increasing, with many undetected cases. Antituberculosis regimens are known to be the treatment of choice for tuberculosis. Even though pulmonary resection for pulmonary tuberculosis has reduced in daily practice, it remains continues to play an important role in several advanced conditions and complications. Currently, there are no specific practical guidelines concerning surgical indications and approaches for pulmonary tuberculosis. We report a case with complicated primary paediatric pulmonary tuberculosis underwent resection and looking for the literature of the best evidence.

Method. A case report completed with a discussion based on the best evidence. The database used for the literature search were Cochrane, Medline, ProQuest, and ScienceDirect. Keywords for the search were “primary pulmonary tuberculosis”, “surgery”, “Lung resection”, and “children”. Inclusion criteria were studies in English, children under 18 years old as the subject, and full-text articles available. The assessment carried out according to Oxford Centre for Evidence-Based Medicine 2011.

Results. Six cohort studies were analyzed. Surgery indicated for patients with complicated TB that were unresponsive towards treatment. It should be noted that the experiments were done before the standard WHO antituberculosis therapy was applied. Thus, the result may be different from the current application.

Conclusion. Currently, there was no guideline on pulmonary resection. However, surgery yielded better mortality and morbidity in children with complicated pulmonary tuberculosis.

Keywords: *pulmonary, tuberculosis, paediatric, therapy, surgery*

Introduction

In 2014, there was 9.6 million new tuberculosis (TB) cases, with mortality in 1.5 million cases. Out of the new cases, 1 million were paediatric cases. Paediatric pulmonary TB incidence was increasing, with many cases left undetected.¹ Early oral therapy had a better prognosis for paediatric tuberculosis; however, long duration of treatment caused a lot of unfinished treatment, increasing the rate of relapse and complications.²

In paediatric pulmonary tuberculosis with complications, the treatment not limited to the elimination of Mycobacteria but also aimed to achieve normal pulmonary function and prevent further complications.^{3,4} Surgical resection done in complicated tuberculosis with anatomical abnormalities that leading to functional defects and resistance of the antituberculosis drugs. Surgical resection is the only treatment for paediatric pulmonary tuberculosis with persistent bronchopulmonary destruction.⁵ A combination of oral therapy and surgery with appropriate type and timing of surgery may prevent complications and achieving the pulmonary function.

Despite the role and advantages found in the previous studies regarding pulmonary resection, there is no specific guideline concerning the indications and surgical approaches in the management of pediatric pulmonary tuberculosis. Thus, this

study aimed to find out the best evidence regarding the role of pulmonary resection in the management of pediatric pulmonary tuberculosis.

Case Illustration

A nine-month-old boy presented with worsening dyspnea for two days. The patient had been diagnosed with pulmonary tuberculosis and treated with an antituberculosis agent with a fixed dose combination (FDC) regiment for six months. Anteroposterior and lateral chest x-ray revealed radiolucency in the upper right lung, denoting a cavity (Fig 1A). CT scan showed multiple cystic lesions with infiltrates in all lobes on both lungs, suggesting cavities-complicated pulmonary tuberculosis (Fig 1B). In the next three weeks, the right posterolateral thoracotomy with superior right lobectomy performed. Intraoperatively, fibrosis, and multiple cavities found on the superior and middle lobe. The diagnosis confirmed by the pathology exam (Fig 2). Clinically, the condition improved the patient discharged. Polymerase chain reaction (PCR) test for tuberculosis carried out four weeks following surgery showed undetected Mycobacterium tuberculosis. The treatment continued to the twelve-months regiment. The respiratory was at well-function with unlimited daily activities.

Figure 1. A. Anteroposterior projection of chest x-ray showing a radiolucency defect in the upper right hemithorax. B. Axial thoracic CT scan showing multicystic lesion with size in vary in the right hemithorax. The largest size of 7.13 cm in diameter with infiltrate in all pulmonary lobes.

Figure 2. Gross image of the resected superior lobe of the right lung. A. The arrow is showing the cavities. B. The indicator is showing lobulated fibrotic tissues. Pathology finding indicating fibrotic stroma with the distribution of chronic inflammatory cells with vascular proliferation covered by a layer of endothelial cell, the necrotic area surrounded by the lymphocyte, epithelioid cells, and Langhans giant cells, acid fast stain +4. The feature confirmed the diagnosis of pulmonary tuberculosis.

Based on the case reported, a literature search conducted to find out the best evidence on Cochrane, Medline, Proquest, and ScienceDirect using the keywords “primary pulmonary tuberculosis”, “surgery”, “Lung resection”, and “children”. In addition, synonyms were added to broaden the search results, including “lung”, “operation”, and “paediatrics”. Inclusion criteria were articles in English, with children under 18 years old as the subject, and full text articles available. Excluded articles were editorials, molecular or animal studies, letters, short communications, and commentaries. Duplication screening was done, and the final articles were analyzed based on the level of evidence (LoE) following the Oxford Centre for Evidence Based Medicine 2011.

Discussion

From the literature search, six articles were chosen then extracted, as seen in Table 1. Most of the studies were done before the era of multiple antituberculosis regimens became the standard therapy. Ross reported lobectomy and pneumectomy in 1951 on 12 children with primary tuberculosis. Surgery was indicated after conventional treatment of streptomycin (strep) and para-amino salicylic acid (P.A.S.).⁶ Huish reported 29 cases in a limited sample cohort at thoracic surgery hospital, with 16 patients undergoing pneumectomy or lobectomy.⁷

Cameron et al. investigated 48 paediatric pulmonary TB cases with segmental lesion complications from 1949 to 1955. Resection was done on five patients based on bronchoscopy results after adequate oral therapies. The Conservative treatment group was not given routine antibiotics, but bed rested and observed intensively in the ward.⁸ Lees et al. reported 101 paediatric pulmonary tuberculosis cases that went through resection surgery. Primary tuberculosis with complications made up 69.3% of the cases.⁹ Feltis and Campbell reported a prospective cohort on 47 children with pulmonary TB that went through surgeries. Indications for surgery were positive microbiology examination after therapy, persistent cavities, fibronodular disease, atelectasis, and destroyed lung/lobe.¹⁰ A study by Quinlan, et al. observed 41 paediatric TB cases operated on the indications of the persistent caseous lesion and other parenchymal injuries, cavities, bronchiectasis, destroyed lung/lobe, and middle lobe syndrome.¹

All the studies assessed were cohort studies with patients followed through the therapeutically procedure until the outcome was seen.¹³ The level of evidence was four because the cohort studies had no control group, minimal sample counts, nor statistically significant analysis.

The only study directly comparing the outcome of morbidity and mortality between surgery and antituberculosis drugs was the study by Cameron et al.; therefore, the validity parameter could be evaluated completely using this study.⁸ Surgery was done based on indication, there was no randomization, and the essential characteristics of the patients were different in which patients undergoing surgical treatment had the worse disease. Antibiotics were routinely given only to the treatment group. There was no statistical analysis nor blinding, but the objective outcomes (mortality and morbidity) prevented measurement bias.

The importance measured by the number needed to treat (NNT), with NNT of the study, was 15.89 or rounded to 16.¹² For 16 lobectomies done, one lobe collapse or persistent bronchiectasis could be prevented. Despite good validity and importance, the study should be applied carefully. According to Done (1957), antituberculosis drugs were not standardized. Following the study of Done in Liverpool, the Indonesian population with different sociodemographic and race showed different complications.⁸

Other works did not evaluate the control group. Hence, validity could not be assessed. Only one aspect of the importance that could be counted, the experimental event rate (EER), which defined the ratio of a patient with the outcome compared to the total number of subjects. For mortality, ERR ranged from 0 to 13%, while for morbidity, the ratio ranged from 0 to 38%.⁶⁻¹¹

Primary tuberculosis happened after the initial infection of *Mycobacteria*. In children, progressive TB could cause complications such as effusion, bronchial obstruction, and cavities.¹⁵ Complications could cause respiratory distress. Thus, decisions needed to be taken on whether to undergo surgery or to stay with conservative treatment. There was no guideline on the decision-making, creating controversy on the eligibility of the patient and when surgery should be done.¹⁵

Validity defines the reliability of a study. Cameron et al. did not show the essential characteristic of the subjects and intention to treat analysis.⁸ Confounding factors might be affecting the results.¹³ Surgery as a treatment could not be blinded. Therefore, the outcome used should be objective to minimize bias.¹³ From the critical analysis of the six articles, several points could be noted.

Indications for surgery in paediatric primary pulmonary TB with complications differ according to the type of surgery. For pneumonectomy, the indications include (1) multiple cavities that involved >1 lobe, (2) huge cavity that involved ≥ 2 adjacent lobes, (3) huge cavity that involved significant parenchymal lesion and could not be segmentally resected, (4) cavities with nodular disease signs, and (5) main bronchial branch stenosis. For lobectomy, the indications include (1) unilateral cavities limited to a particular area with no improvement after conservative treatment, (2) increasing pressure in cavities, and (3) atelectasis, bronchiectasis, infiltrates secondary to the cavity and endobronchial obstruction. In addition, other indications of surgery include (1) caseating tuberculosis resistant towards conservative therapy, and (2) advanced and irreversible chronic fibroid lung.

Antituberculosis treatment was given adjunct to the surgery to minimize disease activity and was proven to have a better outcome in surgery. A careful selection was needed to treat paediatric patients with pulmonary TB. Cameron et al. found that no reactivation was found in 31 patients with a segmental lesion that was not operated, concluding that surgery to prevent complication was not recommended.⁶⁻¹¹

Mortality in patients with surgery was higher, but the basic characteristics of the groups were different, patients with worse conditions underwent surgery. On the other hand, comparing effectivity of surgery and conservative treatment on children with complicated pulmonary tuberculosis was unethical.⁶⁻¹¹

The reported case had several indications for surgery, such as a young child who was unresponsive towards treatment and had anatomical lesion shown by chest x-ray and CT scan. The modalities called for surgeon evaluation, supported by six articles that had been reviewed. Surgery was done within the range in the articles within three months to 5 years after the onset. Surgery carried out after proper antituberculosis treatment and clinical condition stabilization for three weeks. The literature backed the best time to execute surgery: 1) on antituberculosis treatment for at least six weeks, and 2) surgery was done within three weeks up to 10 months after antituberculosis treatment. We needed to note that all the literature was done before the international formulation of the antituberculosis regiment by WHO.⁶⁻¹¹

Lobectomy was done following literature, which marked that lobectomy was the treatment of choice in complicated primary paediatric pulmonary tuberculosis in a child with an extensive lesion in one lobe.⁶ Other alternative according to Huish included lobectomy with standard dissection or mass ligation technique when the lymphatic node was enlarged significantly.⁷

Surgery was the choice of treatment for complicated pulmonary tuberculosis. In a study by Cameron et al., complications such as collapsed lobe and persistent bronchiectasis were found in patients who went through conservative treatment.⁸ Meanwhile, from 18 cases reported by Breathnach, when surgery not done in the setting of complicated TB, there were sequels of middle lobe syndrome and bronchiectasis.⁵

Even though the studies referred above were conducted before the era of multiple antituberculosis regiments, the current evidence also showed similar results concerning the role of surgery for pulmonary tuberculosis with complications in adults as well as in children. Dewan studied a total of 2,878 adult patients with pulmonary tuberculosis who underwent surgical procedures for various complications, such as persistent sputum-positive status ($n = 98$), recurrent massive haemoptysis or chest infections ($n = 740$), empyema ($n = 2,024$). Meanwhile, the other 18 patients were for diagnostic reasons. The result showed that as many as 65.3% of patients with pre-operative persistent sputum-positive status had post-operative sputum-negative and remained negative after follow-up. Haemoptysis was found to be fully controlled in 93.7% cases and the chest symptoms were found relieved in 98.9% cases. Meanwhile, total control of empyema was achieved in most of the cases. These results suggest the benefit of lung

resection procedure for managing pulmonary tuberculosis cases with complications.¹⁶

Even though the studies conducted in children are much limited in number than in adults, several studies evaluating the paediatric population also revealed similar results. One of 10 patients studied by Salami et al. was a three-year-old patient with pulmonary tuberculosis who underwent right pneumonectomy as well as receiving post-operative anti tuberculosis chemotherapy. The results showed that the patient recovered and had a good outcome.¹⁷ Out of 18 children who underwent pneumonectomy in a study by Kosar et al., four patients had the underlying disease of tuberculosis. Five patients had a history of tuberculosis, with two of which were positive in the acid-fast bacilli exam. The results showed that there was neither intraoperative nor postoperative 30-day period mortality, with postoperative complications occurred in 3 children (16.7%).¹⁸

Another study by Blyth et al. also studied the risk/benefit ratio of pneumonectomy performed in 59 children, of which eight children suffered from pulmonary tuberculosis. The results revealed six intra-operative complications (10.1%) and seven post-operative complications (1.86%), which showed that the surgery was relatively safe and worthwhile.¹⁹ Choudhury et al. also studied 35 children who underwent lung resections, of which one child had pulmonary tuberculosis. Even though it was reported that there were three patient died and several had postoperative complications, it is known that the patient with pulmonary tuberculosis survived and recovered.²⁰

These studies, therefore, suggest that pulmonary resection still yields very gratifying results in many cases of paediatric pulmonary TB, with acceptable rates of complications and adverse events. It is known that children could easily tolerate pulmonary resection, could acquire higher lung volumes post-operative, and have a better nutritional status in the long term.¹⁸

Conclusion

Unilateral cavities on pulmonary lobes and resistance towards treatments were indications of lobectomy. Stabilization was done before the surgery to reduce intra and postoperative risks and morbidities.

Mortality risk in 6 months up to 10 years after surgery ranged from 0 to 13 percent, with one death prevented in every 16 surgeries. Currently, there was no guideline on the typing and type of surgery for complicated primary pediatric pulmonary tuberculosis. Therefore, primary pediatric pulmonary TB with complications should be referred to a thoracic surgeon for the assessment of the need for surgery.

Disclosure

Authors declare no conflict of interest.

Acknowledgement

The authors would like to thank all staff of the Thoracic Cardiac and Vascular Surgery Division, Surgery Department, Faculty of Medicine Universitas Indonesia, Cipto Mangunkusumo Hospital, for general support to this study.

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