



Congenital cystic adenomatoid malformation: a case report

Haryo Aribowo*, Divva Aurelia, Ghifari Farandi

Division of Cardiac, Thoracic, and Vascular Surgery, Department of Surgery, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada/Dr. Sardjito General Hospital, Yogyakarta, Indonesia

ABSTRACT

Submitted: 2019-10-02
Accepted : 2020-07-24

Congenital cystic adenomatoid malformation (CCAM) is a rare condition defined by multiple cysts produced in the lung that occur during the fetal period, with respiratory distress as presenting symptoms. Untreated CCAM may lead to repeated lung infection and pneumothorax. Many surgical techniques have been used to treat CCAM. However, those techniques showed various results. Moreover, less studies were performed to evaluate the effect of those surgical techniques in treating CCAM patients. We reported a management of a rare pediatric case of CCAM referred to the Department of Thoracic and Cardiovascular Surgery, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada/Dr. Sardjito General Hospital. The patient was a 29-day-old male baby who presented with pneumothorax on the right lung due to CCAM. The plan of treatment for the patient was lobectomy until pneumonectomy on the affected lung. During the thoracotomy procedure, we found that all lobes in the right lung were covered with fibrous tissue. Based on this finding, a decortication procedure to remove the fibrous tissue continued by a bullectomy procedure with the insertion of a chest tube were performed. The patient continuously showed improvement in breathing and wound healing, thus making the patient discharged from the hospital on the nineteenth postoperative day. The cause of CCAM is thought to be congenital abnormalities of the bronchiole epithelium that produce multiple cysts. Due to its rarity and lack of research on CCAM, many CCAM patients are misdiagnosed/underdiagnosed. Common surgical methods used in this patient are lobectomy with continuation until pneumonectomy or bilobectomy, if necessary, to prevent recurrence. Parenchymal saving methods can be considered because they have the same outcome as lobectomy. As performed in this patient, thoracotomy decortication continued with bullectomy is adequately capable of alleviating respiratory distress symptoms and is thus described as successful.

ABSTRAK

Congenital cystic adenomatoid malformation (CCAM) merupakan kondisi langka yang di definisikan dengan kista multipel yang terbentuk di paru saat masa fetal, dengan distres nafas muncul sebagai gejala yang mengganggu. Apabila tidak ditangani, kemungkinan komplikasi yang sering muncul berupa infeksi paru berulang dan pneumotoraks. Beberapa teknik operasi dapat digunakan untuk mengobati CCAM namun tidak banyak penelitian dilakukan untuk mengkaji efek teknik tersebut. Namun teknik tersebut menunjukkan hasil yang bervariasi. Selain itu, sedikit penelitian dilakukan untuk mengkaji efek teknik bedah dalam pengelolaan pasien CCAM. Kami melaporkan pengelolaan kasus langka CCAM anak yang dirujuk ke Departemen Bedah Toraks dan Kardiovaskular, Fakultas Kedokteran, Kesehatan Masyarakat dan Keperawatan/RSUP Dr. Sardjito. Pasien adalah bayi laki-laki berumur 29 hari yang menderita pneumotoraks pada paru kanan karena CCAM. Rencana terapi terhadap pasien tersebut berupa lobektomi hingga pneumonektomi pada paru yang terkena. Saat dilakukan prosedur torakotomi, ditemukan semua lobus paru kanan diselubungi jaringan fibroid. Berdasarkan temuan ini, tindakan

Keywords:
congenital cystic
adenomatoid
malformation;
bullectomy;
pneumothorax;
decortication;
thoracotomy;

dekortikasi untuk menghilangkan jaringan fibroid, dilanjutkan bulektomi dan pemasangan *chest tube*. Pada hari ke 19 pascaoperasi, pasien diijinkan pulang karena telah terjadi perbaikan kondisi pernafasan dan luka. Penyebab CCAM diduga abnormalitas kongenital epitel bronkiolus yang menghasilkan kista multipel. Karena kasus CCAM ini sangat langka dan jarang diteliti, banyak terjadi kesalahan diagnosis atau tidak terdiagnosis pada sebagian besar kasus. Metode operasi yang sering digunakan untuk kasus CCAM yaitu lobektomi hingga pneumonektomi atau bilobektomi jika diperlukan, untuk mencegah kekambuhan. Metode penyisihan parenkim dapat dipertimbangkan karena hasil akhirnya sama dengan lobektomi. Seperti yang telah dilaporkan, torakotomi dekortikasi dilanjutkan dengan bulektomi, dapat menghilangkan distress nafas, sehingga dapat dikategorikan sukses.

INTRODUCTION

Congenital cystic adenomatoid malformation (CCAM) is a rare condition in which adenomatoid proliferation of the bronchiole epithelium becomes abnormal and produces multiple cysts in the lung lobes¹ that occur during the fetal period. In between 4-7 weeks of pregnancy,² the CCAM incidence ranges between 1:11.000-35.000 per live birth.^{2,3} Almost 80-95% of the patients were male, and it only occurred unilaterally, but it is possible to occur on both sides of the lungs.^{4,5} Complications that might occur are repeated infection of the lungs, haemo-pneumothorax, haemoptysis, and chronic cough.² Congenital cystic adenomatoid malformation can be diagnosed prenatally using ultrasonography (USG).⁶⁻⁹ The symptoms that might appear during the neonatal period are mainly respiratory distress i.e. grunting, tachypnea, cyanosis, and retraction. In addition, if there are no symptoms, children with CCAM might develop recurrent lung infection due to its problem in cleaning the airway secretion.¹⁰ Recurrent lung infection can cause failure to thrive as well that might present as symptoms in older children. Other symptoms could also appear, such as the use of accessory breathing muscle and cyanosis. CT scan imaging for patients with CCAM provides further characteristics of the lesion and is established as the gold standard imaging modality in the characterization of congenital lung malformations.¹¹

Neonatal therapy is given by considering the location of the lesion and neonatal status. If there is any respiratory distress, surgical therapy is curative¹² and recommended to reduce complications.^{9,13} Many surgical techniques have been used to treat CCAM and generated various results. However, less study was performed to evaluate those surgical techniques and their effect in CCAM treatment. We reported a management of a rare pediatric case of CCAM referred to our department.

CASE

The patient was a 29-day-old male baby who presented with persistent respiratory distress, a referral case from an hospital in Central Java. In the previous hospital, this patient was managed with right pneumothorax as a working diagnosis and received water seal drainage (day 15 from admission) and a series of antibiotics i.e. gentamycin (day 3 from admission) followed by ceftazidime (day 15 from admission) and calcium gluconate (day 3 from admission). After completing these treatments, unimproved condition of the patient was observed.

From anamnesis, it was known that the patient was born through the vaginal route (spontaneous labor) without any complications during labor from a mother with G4P2A1 status. He was born weighing approximately 3.2 kg and 49 cm long. The APGAR status is unknown, but the information from the mother

said that the patient directly cried after he was born. Patients were allowed to be taken home after 24 hours of monitoring at the local Community Health Center (*Puskesmas*). At 23 days old, the patient started to show respiratory distress, was unable to breastfeed properly, and was constantly crying. Because of these symptoms, the parents were taking him to an hospital in Central Java. During hospitalization, the pediatrician suspected that the patient had CCAM and was referred to Dr. Sardjito General Hospital, Yogyakarta for further evaluation and management.

In the early presentation, the patient was active, crying loudly, and had a nasogastric tube and oxygen cannula attached to him. Physical examination found that the patient had tachypnea (60 beats per minute), subcostal retraction, decreasing in lung vesicular sound, and water seal drainage attached to

the right hemithorax. Later, roentgen examination was conducted on the patient, and the result supports the diagnosis of right pneumothorax. The patient was managed with right inferior lobe pneumothorax and suspected CCAM as a working diagnosis. On the next day, reinsertion of active water seal drainage was performed on this patient.

During admission, the patient had a fever on the seventh day of admission and was diagnosed with community acquired pneumonia (CAP). Therefore, cefotaxime and paracetamol were administered. On the day four after reinsertion of active water seal drainage, chest CT scan examination with contrast was performed on this patient, revealing the presence of multiple pulmonary cysts similar to type 1 CCAM on the right inferior lobe of the lung without pneumothorax (FIGURE 1).

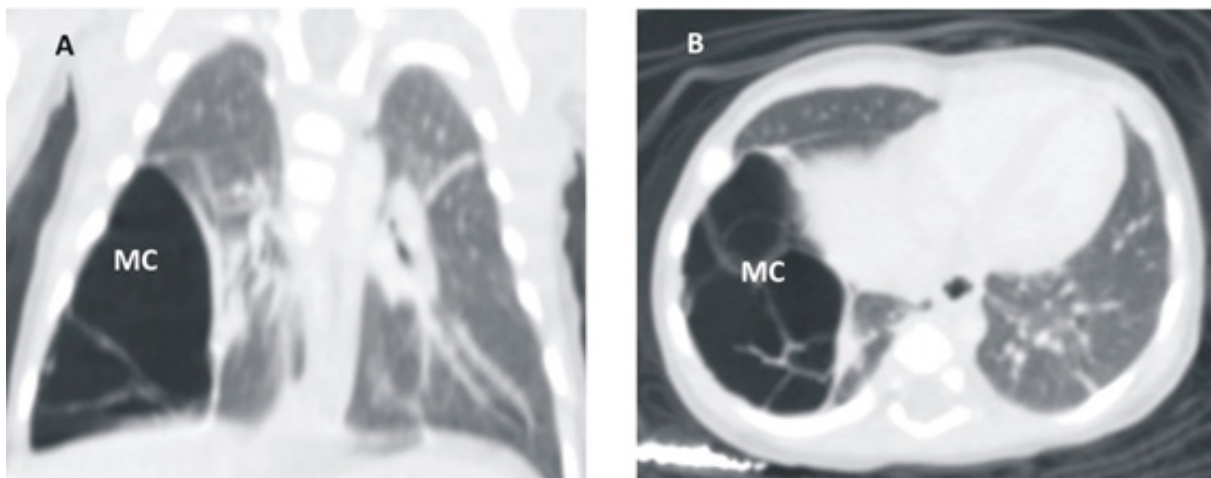


FIGURE 1. A Sagittal view. B. Transversal view. Chest CT scan with contrast revealed multiple cysts on the right hemithorax. MC: Multiple cysts/bullae.

Initial plan management for this patient was lobectomy until pneumonectomy with the consideration that the healthy lung will not be squished

by part of the lung that has CCAM and be able to inflate normally after the affected part of the lung is removed.

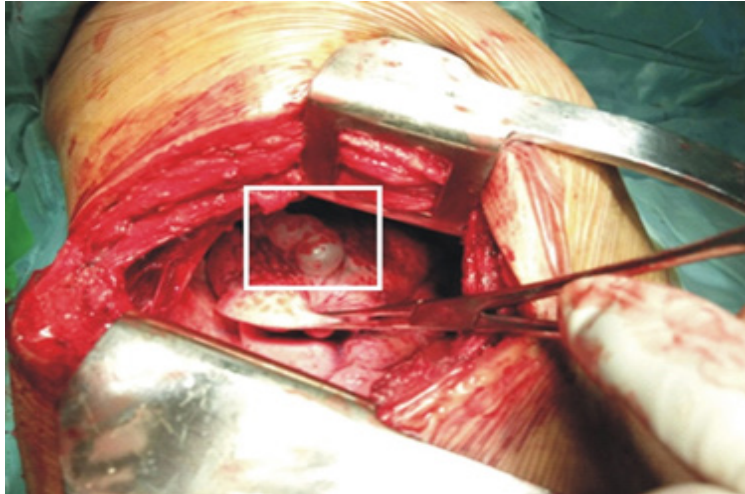


FIGURE 2. Bullae located on the inferior lobe with fibrous tissue covered the entire right lung.

During the inspection of the lung after thoracotomy procedure, we found that all lobes in the right lung are covered by fibrous tissues except the bullae located on the inferior lobe (FIGURE 2). Based on these findings, the patient was treated with decortication procedure on the inferior right lobe of the lung. In the following treatment, the bullectomy and insertion of chest tube on the 5th intercostal space of the right hemithorax were performed. The tissue that was taken from previously procedures was sent to the Anatomical Pathology Department for further analysis. The patients were sent to the Pediatric

Intensive Care Unit (PICU) for 17 days for postoperative monitoring. On the third postoperative day, the histopathological analysis results from the Department of Anatomical Pathology, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada confirmed that the signature of congenital cystic adenomatoid malformation (CCAM) was found in the patient tissue sample. On the sixth postoperative day, chest X-ray was performed on the patient. The result showed minimal right pleural effusion with no sign of pneumothorax on either lung (FIGURE 3).

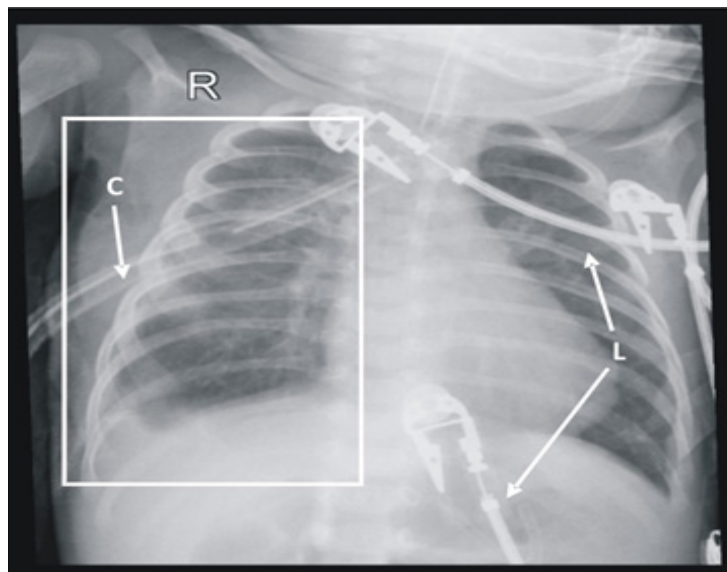


FIGURE 3. Chest X-ray shows minimal right pleural effusion with no sign of pneumothorax on either lung. No bullae were seen in the area of interest. R: Right, C: Chest tube, L: ECG lead.

On the eight-day postoperative follow-up, the chest tube was removed due to minimal product for the past 24 hours, continued with dressing and bandaging of the chest tube insertion site, and extubation on the thirteenth postoperative day due to improvement in breathing. The patient continuously shows improvement in breathing and wound healing, thus making a discharge from the PICU on the sixteenth postoperative day to be transferred to the pediatric ward and discharged from the hospital on the nineteenth postoperative day.

DISCUSSION

Congenital cystic adenomatoid malformation is one of the rare conditions to be found by health care providers, thus making it potentially misdiagnosed/underdiagnosed and lead to the worst condition of the patient. In this patient, he was treated for approximately 2 weeks with a pneumothorax as a working diagnosis according to the babygram. It only showed the presence of pneumothorax. After performing a chest CT scan, the results revealed that the baby had a cyst on his lung.

Congenital cystic adenomatoid malformation can be diagnosed prenatally with the usage of ultrasound,⁶⁻⁹ but the rare exposure of the cases to health care providers makes it potentially misdiagnosed/underdiagnosed. In this case, the mother rarely underwent antenatal checkups and ultrasound examination during the pregnancy. Congenital cystic adenomatoid malformation symptoms usually appear during the neonatal period, even though sometimes patients with CCAM only manifest symptoms during the childhood period until the age of 21 years. Our patient manifested respiratory distress at 23 days old and was diagnosed with CCAM at 39 days old.

In 1997, Stocker *et al.*^{14,15} classified

CCAM into three types, type 1, 2, and 3, depending on the characteristics of the mass and source of the tissue. Type 1 originates from distal bronchus tissue or proximal bronchiole >2 cm in diameter and has multiple thin-wall cysts lined with a ciliated pseudostratified epithelium.¹⁶ One of the characteristics of type 1 CCAM is the presence of mucous secreting cells.¹⁰ Type 2 CCAMs, which arise from the terminal bronchiole, are comprised of cysts <2 cm in diameter lined with ciliated cuboidal or columnar epithelium.¹⁰ This type is associated with another anomaly, such as renal agenesis, abdominal wall defects, central nervous system problems, or abnormalities in the urinary system.⁵ Type 3, the rarest form of CCAM, comprises a large noncystic lesion that potentially shifts the mediastinum.⁶ Then, in 2002, Stocker added two more types of CCAM classification: types 0 and 4.¹⁴ Type 0 arises from tracheal or bronchus tissue, while type 4 arises from alveolar tissue. CCAM has the potential to develop into malignancy, especially in CCAM type 4.¹⁰ In this patient, even though histopathology examination has not been carried out, it can be diagnosed with CCAM type 1 due to its characteristics of the cyst and radiology imaging that supports the presence of multiple cysts more than two centimeters in diameter in the right thorax.

Since the specific pharmacological therapies are not available, the supportive antibiotics are used to treat complicated CCAM patients that have condition such as pneumonia. Besides the antibiotics treatment, oxygen supplementation until mechanical ventilation can be given to those patients. On the fourth day after reinsertion of WSD, the patient developed community acquired pneumonia (CAP). One series of cefotaxime and paracetamol as a treatment was given for complicated CCAM.

Currently, surgical intervention can have curative effects on patients

with CCAM.¹² There are two surgical approaches that can be performed: fetal surgery and postnatal surgery. In this case, the mother of the patient rarely underwent antenatal control (including USG) – therefore making the CCAM misdiagnosed during the prenatal period and only diagnosed at the age of 23 days old with respiratory distress as its symptoms.

The initial option method for this patient was lobectomy, which might be followed by pneumonectomy, to prevent the residual cyst from becoming infected and concomitant malignancy. Lobectomy is one of the option procedures in patients with CCAM confined to one lobe, followed by pneumonectomy or bilobectomy if necessary. Another method to treat CCAM is parenchyma savings through segmentectomy or wedge resection. Most surgeons perform lobectomy compared to atypical resection, such as segmentectomy, to avoid recurrent pulmonary infection,¹⁷ as segmentectomy will have a risk of leaving the CCAM remnants. Some studies reported that there are no differences in outcomes between lobectomy and parenchyma saving procedures.^{12,18}

The surgical approach depends on the size¹⁹ and number of bullae to be removed. One of the main options is video-assisted thoracic surgery (VATS) and open thoracotomy/sternotomy, with VATS being less invasive. To gain access for removing the bullae, thoracotomy with an anterolateral approach was performed on this patient. During thoracotomy, visible bullae on the right inferior lobe of the lung were found. We also observed that the right lung of the patient is covered by inelastic fibrous membrane of the pleura that restrict the expansion of the lung lead to impossibility to perform lobectomy. Based on this condition, the decortication was performed as the first to alleviate the symptoms and improve the lung's

capability to expand improving the lung vital function. After the lung has regained its capability to expand, the patient undergoes bullectomy to eradicate the CCAM and prevent recurrence. One of the indications for bullectomy is severe dyspnea due to giant bullae,²⁰ which can be found in this patient. Postoperative monitoring shows improvements in patients' condition and scheduled for regular follow-up visits.

CONCLUSION

We have described a rare pediatric case of CCAM. The cause of CCAM is thought to be congenital abnormalities of the bronchiole epithelium that produce multiple cysts. Due to its rarity and lack of research on CCAM, many CCAM patients are misdiagnosed/underdiagnosed. Collaboration between obstetrics & gynecology specialists and cardiothoracic surgeons is needed to treat CCAM during the fetal period to prevent poorer prognosis and difficulty in labor. In the postnatal period, if multicystic lung lesions are found in pneumothorax, CCAM should be considered in differential diagnosis, and a surgeon should look to perform resection of the lesion.

Surgical methods of choice in patients with CCAM are lobectomy with the continuation of pneumonectomy or bilobectomy if necessary to prevent recurrences. Parenchymal saving methods can be considered as an option because they have the same outcome as lobectomy. As performed on this patient, thoracotomy decortication continued with bullectomy is adequately capable of alleviating respiratory distress symptoms and is thus described as successful.

ACKNOWLEDGMENTS

We would like to thank the patient who have participated in this study

REFERENCES

1. Hamanaka R, Yagasaki H, Kohno M, Masuda R, Iwazaki M. Congenital cystic adenomatoid malformation in adults: Report of a case presenting with a recurrent pneumothorax and a literature review of 60 cases. *Respir Med Case Rep* 2018; 26:328-32. <https://doi.org/10.1016/j.rmcr.2018.02.002>
2. Gornall AS, Budd JL, Draper E, Konje JC, Kurinczuk JJ. Congenital cystic adenomatoid malformation: accuracy of prenatal diagnosis, prevalence and outcome in a general population. *Prenat Diagn* 2003; 23(12):997-1002. <https://doi.org/10.1002/pd.739>
3. Laberge JM, Flageole H, Pugash D, Khalife S, Blair G, Filiatrault D, et al. Outcome of the prenatally diagnosed congenital cystic adenomatoid lung malformation: a Canadian experience. *Fetal Diagn Ther* 2001; 16(3):178-86. <https://doi.org/10.1159/000053905>
4. Sood M. Congenital Cystic Adenomatoid Malformation of the Lung: A Case Report. *J Nepal Pediatr Surg* 2011; 31(1):64-7. <https://doi.org/10.3126/jnps.v31i1.4162>
5. Annam V, Korishetty SI, Yelikar BR, Hippargi SB, Shivalingappa DB. Bilateral congenital cystic adenomatoid malformation, stocker type III with associated findings and review of literature. *Indian J Pathol Microbiol* 2010; 53(2):331-3. <https://doi.org/10.4103/0377-4929.64324>
6. Gajewska-Knapik K, Impey L. Congenital lung lesions: Prenatal diagnosis and intervention. *Semin Pediatr Surg* 2015; 24(4):156-159. <https://doi.org/10.1053/j.sempedsurg.2015.01.012>
7. Mon RA, Johnson KN, Ladino-Torres M, Heider A, Mychaliska GB, Treadwell MC, et al. Diagnostic accuracy of imaging studies in congenital lung malformations. *Arch Dis Child Fetal Neonatal Ed* 2019; 104(4):F372-F377. <https://doi.org/10.1136/archdischild-2018-314979>
8. Račaitė J, Šumkovskaja A, Arlauskienė A, Pilypienė I, Landsbergytė-Bukauskienė E. Congenital cystic adenomatous malformation: a case report and a literature review. *Acta Med Litu* 2018; 25(2):95-100. <https://doi.org/10.6001/actamedica.v25i2.3762>
9. Kotecha S, Barbato A, Bush A, Claus F, Davenport M, Delacourt C, et al. Antenatal and postnatal management of congenital cystic adenomatoid malformation. *Paediatr Respir Rev* 2012; 13(3):162-70; quiz 170-1. <https://doi.org/10.1016/j.prrv.2012.01.002>
10. Chikkannaiah P, Kangle R, Hawal M. Congenital cystic adenomatoid malformation of lung: Report of two cases with review of literature. *Lung India* 2013; 30(3):215-8. <https://doi.org/10.4103/0970-2113.116272>
11. Chowdhury MM, Chakraborty S. Imaging of congenital lung malformations. *Semin Pediatr Surg* 2015; 24(4):168-75. <https://doi.org/10.1053/j.sempedsurg.2015.02.001>
12. Feng A, Cai H, Sun Q, Zhang Y, Chen L, Meng F. Congenital cystic adenomatoid malformation of the lung in adults: 2 rare cases report and review of the literature. *Diagn Pathol* 2012; 7:37. <https://doi.org/10.1186/1746-1596-7-37>
13. Davies AR, Bapat V, Treasure T. Adult presentation of congenital cystic adenomatoid malformation: successful surgical management. *J Thorac Cardiovasc Surg* 2006; 132(6):1493-4. <https://doi.org/10.1016/j.jtcvs.2006.06.041>
14. Alshamiri KM, Abbod HB. Congenital cystic adenomatoid malformation. *Int J Pediatr Adolesc Med* 2017;

- 4(4):159-60.
<https://doi.org/10.1016/j.ijpam.2017.12.001>
15. Lanza C, Bolli V, Galeazzi V, Fabrizzi B, Fabrizzi G. Cystic adenomatoid malformation in children: CT histopathological correlation. *Radiol Med* 2007; 112(4):612-9
<https://doi.org/10.1007/s11547-007-0166-0>
16. Stocker JT. Congenital pulmonary airway malformation: a new name for and an expanded classification of congenital cystic adenomatoid malformation of the lung. *Histopathology* 2002; 41(Suppl2):424-30.
<https://doi.org/10.1186/1746-1596-7-37>
17. Muller CO, Berrebi D, Kheniche A, Bonnard A. Is radical lobectomy required in congenital cystic adenomatoid malformation? *J Pediatr Surg* 2012; 47(4): 642-5.
<https://doi.org/10.1016/j.jpedsurg.2011.08.002>
18. Kim HK, Choi YS, Kim K, Shim YM, Ku GW, Ahn KM, *et al.* Treatment of congenital cystic adenomatoid malformation: should lobectomy always be performed? *Ann Thorac Surg* 2008; 86(1):249-53.
<https://doi.org/10.1016/j.athoracsur.2008.01.036>
19. Oh BJ, Lee JS, Kim JS, Lim CM, Koh Y. Congenital cystic adenomatoid malformation of the lung in adults: clinical and CT evaluation of seven patients. *Res* 2006; 11(4):496-501.
<https://doi.org/10.1111/j.1440-1843.2006.00878.x>
20. Sakamoto K, Takei H, Nishii T, Maehara T, Omori T, Tajiri M, *et al.* Staple line coverage with absorbable mesh after thoracoscopic bullectomy for spontaneous pneumothorax. *Surg Endosc* 2004; 18(3):478-81.
<https://doi.org/10.1007/s00464-003-8918-y>