Intercostal muscle flap to protect the bronchial stump in pediatric lobectomy for lung abscess



Ann. Ital. Chir., 2013 84: 197-200 pii: S0003469X12018489 www.annitalchir.com

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Intercostal muscle flap to protect the bronchial stump in paeditric lobectomy for lung abscess

Lung suppurative diseases in children are usually responsive to medical treatment or percutaneous drainage. Rarely, pulmonary resection is required for lung abscess in childhood, particularly in presence of co-morbidities. In these cases, a lobectomy is usually performed through an open thoracotomy, with a reported incidence of bronco-pleural fistula up to 9.1% of pediatric series. This consequence is mainly due to the inflammatory condition; however the lack of knowledge of pediatric and thoracic surgeons with this rare condition in childhood can also play a role. In adults with lung cancer, the buttressing of bronchial stump with the additional support of an intercostal muscle (ICM) flap has proved to prevent this complication, as well as to reduce post-operative pain.

We report the first pediatric experience of ICM flap used in 2 immunocompetent children requiring lobectomy for suppurative lung conditions. Our preliminary experience confirms the feasibility of protecting the bronchial stump after lobectomy in children, especially in conditions at risk for bronco-pleural fistula development.

KEY WORDS: Bronchus, Fistula, Lobectomy, Paediatric

Introduction

Lung abscess is an uncommon condition in childhood, with a reported incidence of slightly more than a case each year per single institution in the largest series available in the recent medical pediatric literature ^{1,2}. It develops when an area of parenchymal infection necrotizes and cavitates. *Primary abscess* occurs in a previously well child with normal lung, while *secondary abscess* occurs when it pre-exists an underlying abnormality, both congenital (cystic fibrosis, immunodeficiency, congenital cystic adenomatoid malformation, bronchogenic cyst, or pulmonary sequestration) or acquired (achalasia or cerebral palsy with repeated pulmonary aspiration) ^{3,4}.

Up to 90% of patients can be treated with specific antibiotic therapy ⁴. Aspiration of the abscess and Computed Tomography (CT) or ultrasonography (US) guided position of a pigtail catheter play an important role in the diagnostic and therapeutic algorithm ³. The pediatric surgeon is rarely involved in this process, unless facing children unresponsive to prolonged medical treatment, with underlying co-morbidities, or with lesion too large to be adequately drained. In these cases, a lobectomy is routinely performed through a conventional open thoracotomy ⁵⁻⁸.

Bronchopleural fistula (BPF) is a possibly life-threatening complication after lobectomy. Different homologous tissues have been proposed for its prevention in adults. The buttressing of the bronchial stump with the fashioning of an intercostal muscle (ICM) flap has been proved a valid technical option, further reducing the

Pervenuto in Redazione Novembre 2011. Accettato per la pubblicazione Dicembre 2011

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post-operative pain ⁹⁻¹². When lobectomy is performed for benign congenital lesions in childhood, the incidence of BPF is almost nil, although this problem has never been previously focused in pediatric series of lung suppurative conditions.

We present our preliminary experience with ICM flap in 2 immunocompetent children with streptococcal lobar abscess.

Case reports

Two immunocompetent children (respectively, male 33 months old and female 36 months old) were admitted to hospital for right lower lobe abscess associated to pleural effusion. The male patient had received an empiric antibiotic therapy associated to steroids for several days prior than admission. The female had a 48-hours history of fever, cough, and tachypnea. Both patients presented markedly elevated white blood cells count and evidence of a streptococcal etiology - respectively, polymerase chain reaction (PCR) DNA essay and serum antistreptolysin titre. Pleural fluid obtained by pleural drainage did not identify bacterial overgrowth. Neither sputum nor bronchoalveolar lavage fluid were available for microbiologic studies. Lobectomy of the lower lobe was performed in both cases. In the male, indication to surgery was based on clinical deterioration and persistence of the abscess at CT scan, despite of prolonged broad spectrum antibiotics. The female presented an abscess with a diameter >6cm and an earlier thoracoscopy - performed to treat a related empyema - evidenced a large disruption of the lung parenchima.

In both cases, a preliminary bronchoscopy excluded abnormalities of the bronchial tree.

At the beginning of postero-lateral thoracotomy via the



Fig. 1: The intercostals flap at the end of the harvesting, devoided of its periostium. During the lobectomy, the flap is protected far from the surgical field, with a wet swab (warm saline).



Fig. 2: The flap is approximated smoothly to the bronchial stump, then sutured with interrupted sutures.

5th intercostal space, prior to chest retraction, an ICM flap was fashioned, free from its periostium, as described by Cerfolio ¹⁰: the flap was harvested from the under surface of the overlying rib using an electric cautery. The muscle was carefully dissected starting at its distal end just under the serratus anterior muscle, then it was freed from the underlying rib posteriorly, past the lumbar-dorsal fascia, but not from the undersurface of the overlying rib past this structure, in order to avoid injury to the vein (Fig. 1). It required 5 minutes without significant blood loss. Then a chest retraction was performed at the same intercostal space. After lobectomy, the bronchial stump was closed with mechanical stapling (EndoGIA 30 -3.5mm, United States Surgical – Tyco Healthcare Group LP, Norwalk, Connecticut, USA) and the flap was brought posteriorly and sewn onto the bronchus using interrupted sutures so to keep the muscle aspect in contact with the cut end of the bronchus. These sutures were placed by taking a very small bite on the bronchial stump just proximal to the staple line to prevent injury to the blood supply, then placed through the muscle and tied so to overlie the entire bronchus (Fig. 2).

Both children had an uneventful post-operative period without any air leakage. The use of pain-relief drugs was limited to the first 48 hours. After 4 years of follow up, the thorax is developing without any asymmetry.

Discussion

When lobectomy is performed in adults affected by cancer, a BPF is a life-threatening event (mortality rate up to 72%) with an incidence of 1.2-4.4% ⁹. In this group of patients, BPF is caused by incomplete bronchial closure, impediment of wound healing at the stump, destruction of the stump by residual carcinomatous tissue. Its occurrence is higher in conditions at risk (diabetes, prolonged chemo and radiotherapy, extensive resection, or previous ipsilateral thoracotomy) particularly when the resection is performed at the level of the main or intermediate bronchus. Furthermore, a supposed vascular paucity is thought to play a role in the higher incidence of BPF after lower lobe lobectomy.

Prevention of BPF is based on different bronchial stump suturing (manual suture rather than surgical stapler, the latter reinforced with interrupted stitches just proximal rather than distal to the stapler line). Moreover, its coverage with homologous tissue (pleura, intercostal muscle, pericardial fat, diaphragm, azygos vein, or pericardiophrenic pedicles) has been proposed to reduce the risk. The ICM flap proved to be particularly adequate to this aim: its fashioning is simple, bloodless, and determines a reduction of post-operative pain, avoiding the retraction on the ICM and the nerve that runs in it.¹⁰⁻¹² The risk of BPF has never been adequately focused in childhood. Usually the main indications to pediatric lobectomy are congenital lung malformations, in patients without risk factors for development of fistula. Atypical resections are commonly performed in pediatric oncologic conditions. The mechanical stapling of the bronchial stump in older children (EndoGIA), or its thoracoscopic suturing with polydioxanone in smaller children, showed to be sufficient to prevent bronchial complications ¹³. In children with complicated lung inflammation, the need of a surgical therapeutic option is higher in cases of secondary lung abscess and/or previous history of hospitalization for pneumonia. Cowles et al 6 report that 76% of 21 patients treated with lobectomy for lung abscess had associated co-morbidities and 90% were previously treated for pneumonia. In such a patients, the risk of BPF is reported to be even higher than in adults with cancer (6.7%-9.1%) and it could be attributed to persistent post-operative tissue inflammation ^{1,7}. However, unfamiliarity with these indications to lobectomy for both, the pediatric and thoracic surgeon, can also play a role. These reasons justify the adoption of the same prophylactic concepts that guide the approach to lung cancer in adults.

Conclusion

In our preliminary experience, the ICM flap confirmed a simple and reliable support to prevent BPF in pediatric patient at risk, although this experience is too limited to draw any conclusion about the decrease of BPF incidence and of post-operative pain. The ICM has been proposed to treat different pediatric conditions, such as recurrent tracheo-esophageal fistula esophageal perforation, and diaphragmatic injuries ¹⁴. However, to the best of our knowledge, this is the first description of its fashioning after lobectomy for lung abscess in children.

Riassunto

I processi polmonari suppurativi in età pediatrica sono di solito trattati con terapia medica o con drenaggio percutaneo. La resezione polmonare è necessaria di rado negli ascessi polmonari in età pediatrica, principalmente in presenza di comorbidità. In questi casi la lobectomia è eseguita di solito per via toracotomia, con un'incidenza riportata di fistole bronco-pleuriche fino al 9.1% delle casistiche pediatriche. Questa complicanza è per lo più dovuta allo stato infiammatorio; tuttavia potrebbe svolgere un ruolo anche la poca esperienza di chirurghi pediatrici e toracici in tali situazioni in età pediatrica. Nei pazienti adulti con neoplasia polmonare, il rinforzo del moncone bronchiale residuo con l'ausilio del supporto di un flap di muscolo intercostale (MIC) si è dimostrato utile nel prevenire tale complicazione, così come nel ridurre il dolore post-operatorio.

Riportiamo la prima esperienza pediatrica dell'impiego di flap di MIC utilizzato in due bambini immunocompetenti che hanno richiesto una lobectomia per patologia polmonare suppurativa. La nostra esperienza preliminare conferma la fattibilità di tale protezione del moncone bronchiale in seguito a lobectomia in età pediatrica, specialmente nelle condizioni a rischio di sviluppo di fistola bronco-pleurica.

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Commento e Commentary

PROF. NICOLA PICARDI Ordinario f.r. di Chirurgia Generale

L'esperienza comunicata dagli Autori è di indubbio valore, perchè fornisce elementi di conoscenza non comune per la normale chirurgia di resezione polmonare dell'infanzia, data la rarità delle sue indicazioni.

Naturalmente, dato il tempo trascorso, nella loro bibliografia essi non citano un articolo pubblicato sullo stesso argomento oltre 40 anni fa, che discuteva sull'opportunità di procedere ad una lobectomia in determinate circostanze, e dunque in casi eccezionali. Nell'articolo si evidenziavano due elementi tutt'ora di un certo interesse. Si trattava di un bambino di 7 anni (Mario C. di Ostuni) affetto da suppurazione cronica di bronchiectasie malforma-

Si trattava di un bambino di 7 anni (Mario C. di Ostuni) affetto da suppurazione cronica di bronchiectasie malformative del polmone destro, che venne sottoposto, dopo molte esitazioni a pneumonectomia destra. Nonostante la ricopertura a fine pneumonectomia del moncone bronchiale con un lembo di pleura mediastinica, l'intervento fu seguito dallo sviluppo di una fistola broncopleurica, trattata con mantenimento del drenaggio pleurico e prolungata terapia antibiotica mirata.

di una fistola broncopleurica, trattata con mantenimento del drenaggio pleurico e prolungata terapia antibiotica mirata. Naturalmente una maggiore sicurezza nei confronti della temibile fistolizzazione del moncone bronchiale, nonostante l'accortezza di evitare la formazione di un cul-de-sac, è data attualmente dall'uso della suturatrice meccanica, non disponibile all'epoca della esperienza personale ricordata, ma si può facilmente convenire che la protezione del moncone con lembo muscolare presenti vantaggi aggiunti di sicurezza all'uso della stapler.

Il secondo elemento di interesse è dato dalla documentazione nella bibliografia di quell'articolo della possibilità di "rigenerazione" alveolare nel polmone controlaterale, che si manifesta fino all'età di 14 anni. Pertanto il polmone residuo non solo si espande per lo sbandamento del mediastino, ma acquisisce dunque capacità obiettivamente vicarianti della funzione respiratoria residua. Per pura casualità si ha un riscontro di follow up parimenti interessante, dato che un collega del nostro gruppo chirurgico, in vacanza ad Ostuni circa 10 anni dopo, ha incontrato l'ormai diciassettenne Mario C., ben sviluppato, che non mostrava segni significativi della menomazione polmonare subita.

The experience reported by the authors is of great value, because it provides not common technical insights for the lung resection surgery of childhood, because of the rarity of its indications.

Of course, given the time elapsed, in their bibliography they don't cite an article published on the same subject over 40 years ago, in which the opportunity whether to proceed with a lobectomy in certain circumstances, and therefore in exceptional cases, was discussed.

The article showed two elements still of some interest. It was a child of 7 years (Mario C. of Ostuni) suffering from chronic suppuration of monolateral malformative bronchiectasis of the right lung, which was submitted, after much hesitation, to a right pneumonectomy. Despite covering the end of pneumonectomy bronchial stump with a flap of mediastinal pleura, the intervention was followed by the development of a bronchopleural fistula, treated with manteinance of the pleural drainage and prolonged antibiotic therapy.

Of course, greater security against the fearsome pleural fistulization of the main bronchial stump, despite careful avoidance of the formation of a cul-de-sac, is given by the actual use of a stapler, not available at the time of the remembered experience, but one can easily agree that the protection of the stump with muscle flap offers advantages, adding safety to the use of stapler. The second element of interest is the documentation in the bibliography of that ancient paper of the possibility of alveolar "regeneration" in the contralateral lung, which occurs up to the age of 14 years. Therefore, the remaining lung expands not only for the disbandment of the mediastinum, but also for the regenerative parenchyma, thus acquiring objective vicarious residual lung function. By chance the follow-up was also interesting, casually enriched by the meeting of a fellow of our surgical group, on holiday in Ostuni about 10 years later, where he met the now seventeen year old Mario C., well-developed, which showed no signs of a significant suffered pulmonary impairment.

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