Clinical Case

Massive pulmonary atelectasis in infants of 1st and 8/12 years of age: Report of a case

Summary

Background: an exhaustive search of the descriptors in Mesh was carried out , using original national and international articles from Pubmed, Medlineplus, LILACS journals, in Spanish in English. The problem raised is given because conventional chest physiotherapy (CFT) continues as one of the main interventions in the treatment of pulmonary atelectasis, however; Why is FTC still used in the management of pulmonary atelectasis if there is not enough evidence to demonstrate its effectiveness as a therapeutic intervention?

Method: in the present study, qualitative methodology will be used to present a clinical case of an infant younger than 1 year and 8 months, who developed massive right pulmonary atelectasis without the slightest clinical suspicion of a foreign body (FB) in the right bronchus, which since the Initially it was managed with FTC maneuvers, without the expected result and development of complications inherent to the intervention.

Results: In this case report, an early diagnosis of the reason why the infant developed right pulmonary atelectasis is required, managed with an intervention without sufficient evidence of its effectiveness for the resolution of the present respiratory complication and without the diagnosis of the true cause of the same.

Keywords: Conventional chest physiotherapy, respiratory physiotherapy, respiratory therapy, foreign body.

Volume 16 Issue 3 - 2024

Dalila Balderas-Vázquez,[1] Erik Javier Mendoza-Mejías[2]

[1]Profesor adjunto al curso de la especialidad de anestesiología, México

[2]Profesor auxiliar al curso de la especialidad de anestesiología, Instituto Mexicano del Seguro Social, México

Correspondence: Dalila Balderas-Vázquez, Profesor adjunto al curso de la especialidad de anestesiología, México, Email balderas.dalil37@gmail.com

Received: June 23, 2024 | **Published:** June 28, 2024

Introduction

The term atelectasis comes from the Greek *atēlez* (imperfect) and *ektaziz* (expansion), referring to the collapse, localized or generalized, of the lung tissue.[1] Atelectasis alters both lung mechanics by decreasing lung compliance and gas exchange, increasing pulmonary vascular resistance, causing overdistension of attached alveolar units and lung injury. The elasticity of the lung is affected directly proportional to the duration of the collapse. In both infants and children, there is a greater susceptibility to the development of atelectasis due to the smaller caliber of the airway and the greater weakness of the chest wall, which determine a lower capacity to avoid collapse.[2]

Several modalities are commonly used by physical therapists (PTs) to facilitate the mobilization of lung secretions in infants and children, however, there is little support of high-quality scientific evidence for this intervention. For many decades, after their introduction to the medical community, they are normally combined with gravity-assisted positioning (postural drainage or [PD]), being traditionally called "conventional chest physiotherapy" (CFT).[3-5]

In several hospitals in developed countries, intubated and mechanically ventilated (MVA) patients in pediatric intensive care units (PICU) routinely receive FTC to reduce the occurrence of complications such as bronchopulmonary infections, nosocomial pneumonia, for re-expansion. of collapsed lung segments or lobes (atelectasis)[5-13] and may perhaps facilitate early discontinuation of AVM. However, routine use is not supported by evidence; in fact, it can cause deleterious effects.[6-22]

Clinical case

Infant, 1 year and 8 months old, previously healthy, without drug allergies, who on 05-19-22 presented with hyaline rhinorrhea, sneezing, productive cough (not emetic or dyspnea), without cyanosis, general state of attack, beak febrile (not quantified), going to a private (general) doctor who prescribes; Ambroxol, Prednisolone and Cephalexin, with partial improvement. Subsequently, on 05-23-22, he was taken for evaluation in the pediatric emergency service of the General Hospital Zone #3 of the Mexican Social Security Institute of Aguascalientes; normocephalic, reactive pupils, nasal passages with hyaline rhinorrhea, congestive, hyperemic pharynx, hyaline secretion, with respiratory difficulty (RR: 40x') characterized by intercostal retraction, use of accessory muscles, wet cough, polypnea, saturation (90%) without support of 02 supplemental, with respiratory deficiency, transmitted rales, diffuse bilateral wheezing. Hemodynamically stable (BP: 95/65) and tachycardia (HR: 148x'), rhythmic heart sounds, without an audible murmur (Figure 1). A rapid test for SARS-CoV2 was performed (negative), and nebulized was performed with partial improvement, however, the presence of significant hypoxemia was confirmed ($Sp0_2$: 80%), orotracheal intubation (OTI) and arterial blood gases were performed (**Table 1**). He is evaluated by the pediatric intensive care service (PICU) which decides his admission, where he remains under aminergic support for 24 hours. In the PICU, it is connected to pressure-controlled mechanical ventilatory assistance (MVA) (Inspiratory pressure: 18, PEEP 6, FiO_2 60%), oximetry 94-96%, RR 30x'. The ventilator variables are changed by desaturation report with the following variables FiO_2: 80%, Pi: 15, Fi02: 0.5, RR: 34, I:E ratio : 1.0:2.1, FTC is indicated, Severe RDS is considered with PAFI 96mmHg and chest x-ray (Figure 2). On 5-25-22; Moderate bronchospasm began at midnight, with wheezing in the right hemithorax, persistence of decreased respiratory sounds and desaturation of 97 to 90%. Bronchodilator treatment (inhaled and systemic corticosteroid) and bronchial hygiene measures were adjusted and reversed. After 48 hours without resolution of the atelectasis with the FTC maneuvers (Figure 3), an evaluation by pulmonology for fiberoptic bronchoscopy was requested, which was performed on 05-26-2022 with a flexible bronchoscope, reporting:

1. CE in the right main bronchus (BPD) with total obstruction,
2. Moderate endobronchial hypersecretion,
3. Foreign body aspiration (Figure 4), confirmed and complicated with pneumonia, however, given the current diagnosis and the severity of the patient, extraction is necessary. The foreign body was detected shortly with a rigid bronchoscope, so He was transferred to a private hospital to resolve the removal of a fragmented wheal from the BPD (Figure 5), with resolution of the pneumonia 7 days after being in the PICU (Figure 6), and he went home.

Figure 1 First emergency x-ray upon arrival, both hemithoraxes re-expanded (05-23-2022).

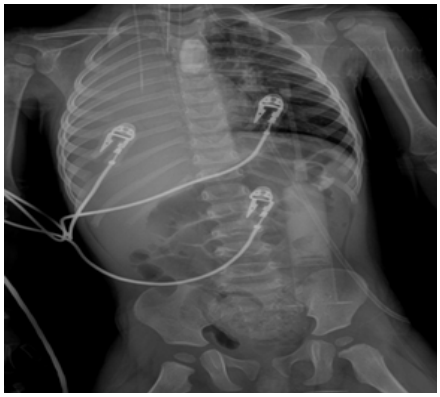

Figure 2 Total atelectasis of the right lung 10 hours later (05-24-2022).

Figure 3 48 hours later with physiotherapy maneuvers and bronchial washings, without resolution.

Figure 4 Flexible bronchoscopy is diagnostic of foreign body, without being able to resolve the extraction.

Figure 5 Fragments of the bean which was performed by rigid bronchoscopy on 05-27-2022.

Figure 6 X-ray with re-expansion of the right lung after foreign body extraction complicated with pneumonia.

Discussion

In the context of the PICU, it is understood that mucociliary clearance is compromised in intubated patients, due to a combination of factors.[23,24] Therefore, all intubated and mechanically ventilated infants and children will require endotracheal suctioning to maintain

Citation: Balderas-Vázquez D, Mendoza-Mejías EJ. Massive pulmonary atelectasis in infants of 1st and 8/12 years of age: Report of a case. *J Anesth Crit Care Open Access*. 2024;16(3):73–76. DOI: 10.15406/jaccoa.2024.16.00593

the patency of their airways, but only a small proportion of them are likely to benefit from TMS.[6,25] The European recommendations of the Consensus Conference on Pediatric Mechanical Ventilation establish that chest physiotherapy for airway clearance cannot be considered a standard of care.[27,28]

Considering the lack of evidence supporting the routine use of secretion mobilization techniques (SMT) in ventilated infants and children, as well as the potential for serious complications in this highly vulnerable (and often clinically unstable) population, manual TMS It is not routinely indicated in ventilated infants and children.[23,29]

Complications attributed to conventional chest physiotherapy and endotracheal suction in infants and children include changes in blood pressure, cardiac arrhythmia, increased intracranial pressure and decreased cerebral oxygenation, hypoxia, increased metabolic demand and oxygen consumption, gastroesophageal reflux, pneumothorax, atelectasis and even death.[6-33] In a randomized clinical trial comparing non-standardized "thoracic physiotherapy" and endotracheal suction with endotracheal suction alone, in sedated and mechanically ventilated infants and children, the thoracic physiotherapy group showed greater compliance, tidal volume, and space. alveolar death, without changes in gas exchange, based on blood gas analysis.[32-34] However, it is worth noting that up to a third of patients in both groups deteriorated after the intervention, and the authors were unable to identify the groups that were more or less likely to respond to physical therapy.[32-34]

In a randomized, single-blind study in 40 patients, to determine the effectiveness of FTC and suction (in 24 subjects) versus suction alone (in 16 subjects) to improve ventilatory parameters and arterial blood gas analysis. The conclusion of the research revealed that there were no significant differences in ventilatory parameters and arterial blood gas results in both groups.[23]

Within TMS in mechanically ventilated patients, manual hyperinflation is usually performed by applying a series of deep manual insufflations with brief inspiratory holds, followed by a rapid release of the bag to increase expiratory flow and mimic a cough.[5] Given the lack of evidence supporting manual hyperinflation in critically ill infants and children, and the potential for harm, it has been recommended that this practice not be considered an acceptable component of standard TMS for ventilated infants and children.[24]

In the present case, we see a 1 year and 8 month old infant who developed atelectasis due to foreign body aspiration (FEA), which has a high incidence in infants and young children since they use their mouths to explore their environment.[35] This can lead to high morbidity and mortality if not diagnosed and managed in time.[36,37] The most common types of ACEs in children are seeds, peanuts, food particles, and toys. Bronchial foreign body aspiration (BFA) tends to lodge in the right main bronchus. Inflammation and edema in the airway mucosa are observed by organic ACEs. Late diagnosis causes granulation at the site of obstruction with recurrent or persistent pneumonia.[38,39] The gold standard for the diagnosis and pediatric management of EAC is rigid ventilatory bronchoscopy and removal. Complications of EAC may include severe laryngeal edema, bronchospasm, atelectasis, pneumonia, lung abscess, and bronchial hemorrhage. The progression of EAC can lead to a variable degree of respiratory distress, chronic cough, recurrent pneumonia, and even death.[40,41]

Conclusion

FTC for airway clearance cannot be considered a standard of care in children on mechanical ventilation. Because until now the evidence has been inconsistent, a standardized intervention pattern has not been designed, and the insufficiency of controlled and randomized clinical trials to determine the effectiveness of the present intervention, the routine use of the techniques of mobilization of secretions or FTC in pediatric patients connected to ventilatory support. A correct assessment of the causes of atelectasis is necessary before deciding to use this therapeutic tool, since, in the context of the pediatric patient on mechanical ventilation, the present intervention in a condition unfavorable for carrying it out, may bring more deleterious effects than beneficial ones.

Acknowledgments

None.

Conflicts of interest

None.

References

1. Torres Borrego J, López– Silvarrey Varela A, Rueda Esteban S. Atelectasias. Middle lobe syndrome. *Protoc pediatrician diagn.* 2017;1:103–113.
2. Carnevalli L, de Souza A, Cordeiro F, et al. Thoracic Block Technique Associated with Positive End–Expiratory Pressure in Reversing Atelectasis: *Case Rep Pediatr.* 2015;2015:4.
3. De Boeck K, Vermeulenh F, Vreys M, et al. Airway clearance techniques to treat acute respiratory disorders in previously healthy children: Where is the evidence?. *Eur J Pediatr.* 2008;167(6):607–612.
4. Mcllwaine M. Physiotherapy and airway clearance techniques and devices. *Paediatr Respir Rev.* 2006;7S1:S220–222.
5. Stiller K. Physiotherapy in intensive care: towards an evidence–based practice. *Chest.* 2000;118:1801–1813.
6. Argent AC, Morrow BM. What does chest physiotherapy do to sick infants and children? *Intensive Care Med.* 2004; 30(6):1014–1016.
7. Postiaux G, Zwaenepoel B, Louis J. Chest physical therapy in acute bronchiolitis: an updated review. *Respir Care.* 2013;58(9):1541–1545.
8. Ciesla ND. Chest physical therapy for patients in the intensive care unit. *Phys Ther.* 1996;76(6):609–625.
9. Hess DR. The evidence for secretion clearance techniques. *Respir Care.* 2001;46(11):1276–1293.
10. Main E, Castle R, Newham D, et al. Respiratory physiotherapy vs. suction: The effects on respiratory function in ventilated infants and children. *Intensive Care Med.* 2004;30(6):1144–1151.
11. Ntoumenopoulos G. Questioning chest physiotherapy. *Chest.* 1997;112(1):292–293.
12. Oberwaldner B, Evans JC, Zach MS. Forced expirations against a variable resistance: A new chest physiotherapy method in cystic fibrosis. *Pediatric Pulmonology.* 1986;2(6):358–367.
13. Wallis C, Prasad A. Who needs chest physiotherapy? Moving from anecdote to evidence. *Arch Dis Child.* 1999;80(4):393–397.
14. Asher MI, Douglas C, Airy M, et al. Effects of chest physical therapy on lung function in children recovering from acute severe asthma. *Pediatr Pulmonol.* 1990;9(3):146–151.
15. Button BM, Heine RG, Catto–Smith AG, et al. Chest physiotherapy, gastro–oesophageal reflux, and arousal in infants with cystic fibrosis. *Arch Dis Child.* 2004;89(5):435–439.
16. Chalumeau M, Foix– L'Helias L, Scheinmann P, et al. Rib fractures after chest physiotherapy for bronchiolitis gold pneumonia in infants. *Pediatr Radiol.* 2002;32(9):644–647.

17. Chaneliere C, Moreux N, Pracros JP, et al. Rib fractures after chest physiotherapy: A report of 2 cases. *Arch Pediatr.* 2006;13(11):1410–1412.

18. Harding JE, Miles FK, Becroft DM, et al. Chest physiotherapy may be associated with brain damage in extremely premature infants. *J Pediatr.* 1998;132(3):440–444.

19. Oberwaldner B. Physiotherapy for airway clearance in paediatrics. *Eur Respir J.* 2000;15(1):196–204.

20. Reines HD, Sade RM, Bradford BF, et al. Chest physiotherapy fails to prevent postoperative atelectasis in children after cardiac surgery. *Ann Surg*. 1982;195(4):451–455.

21. Wallis C, Prasad A. Who needs chest physiotherapy. Moving from anecdote to evidence. *Arch Dis Child.* 1999;80(4):393–397.

22. Zidulka A, Chrome JF, Wight DW, et al. Clapping or percussion causes atelectasis in dogs and influences gas Exchange. *J Appl Physiol.* 1989;66(6):2833–2838.

23. Morrow BM. Airway clearance theraphy in acute paediatric respiratory illness: A state–of–the–art review. *S Afr J Physiother.* 2019:75(1);a1295.

24. Morrow BM. Chest physiotherapy in the Pediatric Intensive Care Unit. *J Pediatr Intensive Care.* 2015;4(4):174–181.

25. Morrow BM, Argent AC. A comprehensive review of pediatric endotracheal suctioning: Effects, indications, and clinical practice. *Pediatr Crit Care Med.* 2008;9(5):465–477.

26. Kneyber MCJ, de Luca D, Calderini E, et al. Recommendations for mechanical ventilation of critically ill children from the Paediatric Mechanical Ventilation Consensus Conference (PEMVECC). *Intensive Care Med.* 2017;43(12):1764–1780.

27. Shkurka E, Wray J, Peters MJ, et al. Chest physiotherapy for mechanically ventilated children: a survey of current UK practice. *Physiotherapy.* 2003;119:17–25.

28. Krause MF, Hoehn T. Chest physiotherapy in mechanically ventilated children: A review. *Crit Care Med.* 2000;28(5):1648–1651.

29. Asher MI, Douglas C, Airy M, et al. Effects of chest physical therapy on lung function in children recovering from acute severe asthma. *Pediatr Pulmonol.* 1990;9(3):146–151.

30. Button BM, Button B. Structure and function of the mucus clearance system of the lung. *Cold Spring Harb Perspect Med.* 2013;3(8):a009720.

31. Chalumeau M, Foix–L'Helias L, Scheinmann P, et al. Rib fractures after chest physiotherapy for bronchiolitis or pneumonia in infants. *Pediatr Radiol*. 2002;32(9):644–647.

32. Reines HD, Sade RM, Bradford BF. Chest physiotherapy fails to prevent postoperative atelectasis in children after cardiac surgery. *Ann Surg.* 1982;195(4):451–455.

33. Main E, Stocks J. The influence of physiotherapy and suction on respiratory deadspace in ventilated children. *Intensive Care Med.* 2004;30(6):1152–1159.

34. Wallis C, Prasad A. Who needs chest physiotherapy? Moving from anecdote to evidence. *Arch Dis Child.* 1999;80(4):393–397.

35. Vázquez D, Mendoza E. Foreign body in the right bronchus in an infant. *J Anesth Crit Care Open Access.* 2023;15(1):47–49.

36. De Leonardis D, Serrana I, Rocha S. Aspiration of foreign bodies in the pediatric hospital emergency room. Management of ten pediatric cases. *Arch Pediatric Uruguay.* 2016;87(2):100–107.

37. White A. The Washington Manual of Pediatrics. In: Wolters Kluwer, St. Louis 2nd, 2016:12–34.

38. Paradis J, Dixon J, Tieu HB. The role of bronchoscopy in the diagnosis of airway disease. *J Thorac Dis.* 2016;8(12):3420–3426.

39. Clinical practice guide. Extraction of foreign bodies from the airway in children from 2 to 12 years of age in the third level of care: Quick reference guide. Master Catalog of Clinical Practice Guidelines. 2011:1–10.

40. Juan L Antón-Pacheco, Rubén Martín-Alelú, María López. Foreign body aspiration in children: Treatment timing and related complications. *International Journal of Pediatric Otorhinolaryngology.* 2021; 144:110690.

41. Shlizerman L, Mazzawi S, Rakover Y. Foreign body aspiration in children: the effects of delayed diagnosis. *Am J Otolaryng.* 2010;31(5):320–324.