PNEUMOTHORAX RELATED TO MECHANICAL VENTILATION: SILENT ENEMY

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PNEUMOTORAKS UDRUŽEN SA MEHANIČKOM VENTILACIJOM PLUĆA

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Received / Primljen: 14.01.2016.

Accepted / Prihvaćen: 07. 03. 2016.

ABSTRACT

Pneumothorax is well known and described complication in intensive care unit patients (ICU). Incidence of this complication is higher in patients with underlying pathology. As it can be occult, it is of the most importance to think of it in patients on mechanical ventilation. In this case report we will present ventilator-related pneumothorax in infant: clinical presentation, diagnosis and management

Keywords: *pneumothorax, mechanical ventilation, pediatric patients*

SAŽETAK

Pneumotoraks je dobro poznata komplikacija kod bolesnika u jedinicama intenzivnog lečenja. Incidenca ove komplikacije je veća kod bolesnika na mehaničkoj ventilaciji. Pneumotoraks može biti klinički teško prepoznatljiv u početku, ali veoma je važno misliti na njega kod bolesnika na mehaničkoj ventilaciji. Prikazaćemo slučaj deteta sa pneumotoraksom udruženim sa mehaničkom ventilacijom pluća, kliničku sliku, dijagnozu i terapijski pristup.

Ključne reči: *pneumotoraks, mehanička ventilacija, pedijatrijski bolesnici*

INTRODUCTION

Pneumothorax is well known and described complication in intensive care unit patients (ICU). It can be classified as spontaneous, traumatic or iatrogenic. Iatrogenic pneumothorax has been reported in up to 3% of adult patients admitted in ICU.^{1,2} Estimations were made that the incidence in mechanically ventilated patients is 4%-15%.^{3,4} Pneumothorax is potentially lethal complication and if not recognized and treated, it can progress to tension pneumothorax and increase morbidity and mortality of ICU patients.

CASE REPORT

A 42 days old male infant, TM 3,8kg, with postnatal made diagnosis of Truncus arteriosus communis, ventricular and atrial septal defect and interrupted aortic arch was admitted to pediatric cardiac intensive care unit after complete correction of congenital heart defect. Previously he was operated and had divided colostomas. He was treated for sepsis and other nosocomial infections and had one episode of rightsided pneumothorax. From the day he was born, he was on mechanical ventilation, never took a breath

on his own. After the operation his sternum stayed opened as a standard procedure, to relieve pressure on the heart. Measured pressure in pulmonary artery was 70% of systolic pressure. Initial ventilator settings were: PCV, FiO₂ 85%, P_{insp} 23-25cmH₂O, PEEP 5-6cm H₂O, T_{insp} 0,7s, RR 26/min, achieved V_t 8ml/kg. The goal was to achieve PaO₂ > 80 mmHg, normocarbia and pH 7,45-7,50. He was continuously sedated with midazolam, analgesia was provided with continuous infusion of fentanyl and muscle relaxation achieved by intermittent boluses of rocuronium. Inotropic support and afterload reduction was made by milrinone, diuresis was regulated by continuous infusion of furosemide. On the first postoperative day sternum was closed without impact on hemodynamics and lung function.

The child was stable in following days with average TA 86/33/51 mmHg, HR 130/min, CVP 11-12cm H₂O, diuresis ≥ 1ml/kg/h, SpO₂ 98%, FiO₂ 80%, blood gas analysis (BGA) pH 7,51, PaO₂ 90 mmHg, PaCO₂ 35 mmHg, HCO₃ 28, BE 4,8, Hgb 12 g/dl, SaO₂ 98%. On auscultation of lungs one could hear equal breathing sounds on both sides with lot of crackles. In the evening on the third postoperative day sudden desaturation

Picture 1. First postoperative day

Picture 2: Third postoperative day : pneumothorax on right side, more than 20% of cavity

Picture 3: Reexpansion of the lung after 12 hours

occurs with SpO₂ 80%, FiO₂ 80%. Desaturation was followed by increase in blood and central venous pressure - TA 95/36/56 mmHg, HR 156/min, CVP 14-15 cmH₂O. BGA showed respiratory acidosis (pH 7.26, PaO₂ 51

mmHg, PaCO₂ 83mmHg, HCO₃ 26.3, BE 5.3, SaO₂ 77%, Hgb 11.8mg/dl), auscultation of lungs confirmed slightly decreased, symmetrical breathing sounds. On manual ventilation with 100% oxygen lungs were stiff, bolus of fentanyl was given, and after aspiration mucus plug was evacuated. The episode resolved in 30 minutes, and child was stable again but maximal measured saturation on FiO₂ 100% oxygen was 93%. This made attending ICU doctor unsatisfied and alert to reassess after 30 minutes again. This time on auscultation breathing sound was diminished on right side. Radiography was made and diagnosis of pneumothorax was obvious. Complete right lung was collapsed leaving more than 20% of cavity filled with air. Immediate chest tube was inserted

Satisfactory reexpansion was achieved after 12 hours, with significant improvement in oxygenation, BGA : SpO₂ 98%, FiO₂ 60%, pH 7.53, PaO₂ 110 mmHg, PaCO₂ 36mmHg, HCO₃ 30, BE 6.8, SaO₂ 99%, Hgb 11.2 mg/dl.

DISCUSSION

In critical illness, pneumothoraces may be difficult to diagnose if they have atypical presentation and are complicated by underlying disease in unconscious patients.^{5,6} Unrecognized pneumothorax in patients on mechanical ventilation could rapidly progress to tension pneumothorax which is more common in this patient population, occurring in 30%-97% of all pneumothoraces.⁷⁻⁹ If barotrauma is complication of mechanical ventilation, the mortality rates are high, ranging from 46%-77%.^{4,7-9} Having this data in mind, pneumothorax should not be an issue in patients on mechanical ventilation. In another words, awareness of this lethal complication should be present at all times especially in those who have underlying disease, since barotrauma has been more related to changes in lung parenchyma and lung compliance than ventilator settings alone.¹⁰

The diagnosis of pneumothorax includes patient's history, examination, and radiological investigations. In our patient, data of prolonged mechanical ventilation, sepsis, nosocomial infections, recent cardiopulmonary bypass with its effect on lungs and history of previous pneumothorax alerted us to be more careful. Therefore, we applied, as described above, lung protective strategy during mechanical ventilation and performed repeated auscultation of the chest. Often reassessment of this child and high level of awareness of pneumothorax possibility made diagnosis prompt. Once suspected, pneumothorax confirmation with chest X ray should be made, since it's reliable, cheap and easy to perform diagnostic tool. According to British Thoracic Society : "Standard practice is to place a chest tube for any pneumothorax occurring during mechanical ventilation, due to the risk of positive pressure expanding the pneumothorax into a tension pneumothorax" implying that size of pneumothorax is not determinant of management itself.¹¹

CONCLUSION

As in all other diseases and conditions we deal with in everyday practice, prevention of pneumothorax comes in the first place. Applying lung protective strategies decrease incidence of pneumothorax but doesn't exclude one, and should be always applied according to recommendations. Besides this, recognition of risk factors (e.g. underlying pathology) is important also in reducing possibility of this serious complication. In pediatric population, risk factors related to pneumothorax are: extremely low birth babies (ELBW), premature babies, neonates delivered by cesarian section, neonates with RDS, aspiration of meconium syndrome, children with underlying lung pathology, cardiothoracic procedures and prolonged mechanical ventilation and previous episodes of pneumothorax. There is no definite consensus how to treat pneumothorax in conscious patients, especially one that is < 15% of thorax cavity, but there has definite recommendation has been made to decompress pneumothoraces in patients on mechanical ventilation.

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