Postoperative acute respiratory failure in a patient with extremely severe idiopathic scoliosis: a case report and review of perioperative management.

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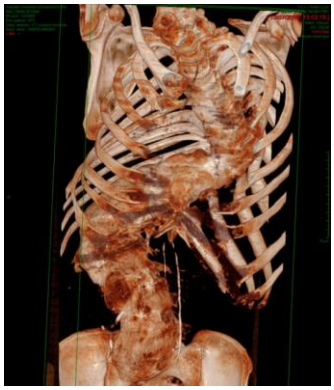
I. Introduction

Idiopathic scoliosis (IS) is the most frequent type of scoliosis. It usually self declares during late childhood. IS must certainly be distinguished from neuromuscular scoliosis, resulting from neurologic or muscular diseases such as spina bifida, or muscular dystrophy, and thus being part of a more severe clinical picture with many other comorbidities.

We report the case of a postoperative acute respiratory acidosis in an adult patient with extremely severe IS, and further discuss its best perioperative anesthetic management.

II. Case Report



A 43-year-old man (50kg, 168cm, ASA III) coming from Cameroon suffered from extremely severe idiopathic scoliosis (IS). CT scan revealed a sigmoid-shaped scoliosis with severe cervical and lombar curves (Cobb angles of respectively 80° and 90°) associated with global ankylosis of the spine. To stabilize the severe ongoing compression of the spinal cord at the C7-D1 level, an orthopedic surgical procedure was scheduled to carry out a posterior decompressing cervical laminectomy. The patient was well known in the hematology department for a partial deficiency in antithrombin, causing a portal vein thrombosis, and therefore portal hypertension with grade III esophageal varices, hypersplenism, and thrombopenia (< 50.000 platelets/µL).

At preoperative evaluation, the patient presented in a wheelchair and showed major impairment of mobilization with amyotrophia. Cardiopulmonary auscultation was normal. Ascites presence was obvious, although lower limb edema was absent. Mouth opening displayed an inter-incisor gap of more than 4cm with Mallampati class III. Nevertheless, head extension and neck flexion were severely restricted. Blood test revealed thrombopenia with a platelet count of 34.000/µL, hemoglobin concentration at 9.7g/dL, a white blood cell count of 1390/µL, normal kidney function, and normal values of electrolytes. No pulmonary function tests (PFT) were performed.

On the day of surgery, no sedative premedication was given.

In the operating room, the patient was already equipped with a 20-gauge peripheral intravenous line. Routine monitoring (electrocardiogram, pulse oxymetry and non-invasive blood pressure monitoring) was initiated.

After adequate pre-oxygenation, intravenous anesthesia was slowly induced using midazolam 1 mg, lidocaine 80 mg, titrated propofol 200 mg, and sufentanil 10 µg. After checking ease of manual ventilation, neuromuscular relaxation was achieved using atracurium 50 mg. Direct laryngoscopy was attempted (despite the evident immobility of the neck and head) and showed a grade III Cormack and Lehane view of the larynx. As difficulties in intubation were foreseen, the King Vision™ video-laryngoscope was already ready for use. It allowed us performing oro-tracheal intubation easily. Arterial line, in order to monitor blood pressure invasively, and additional large-bore intravenous catheter were then placed. Special care was given to proper positioning of this seriously deformed patient in the prone position. A Mayfield frame was used to fix the cervical column.

Anesthesia was maintained using sevoflurane. The patient was ventilated using a volume-controlled mode (tidal volume of 400-450 ml, respiratory rate of 12–14/min) with inspired fraction of oxygen of 0.45, inspiratory-to-expiratory ratio of 1:2, and positive end-

expiratory pressure of 4 cm H_2O. Initial arterial blood gas showed a pH of 7.45, $PaCO_2$ of 36.5 mmHg and estimated HCO_3^- of 25 mmol/L. Total intraoperative sufentanil dose consisted in the initial 10 µg administered upon anesthesia induction. The operation lasted 2 hours, and occurred uneventfully. No morphine was given. The patient was then put back in the supine position, with extreme caution, and recovery was initiated.

Despite complete neuromuscular recovery, the patient took a long time before being capable of an effective spontaneous breathing without respiratory support. At first, although respiratory rate was normal, tidal volume remained very low (50-100mL) along with persisting high values of end tidal CO_2 ($ETCO_2$ 60-70mmHg). Arterial blood gas analysis pointed out a pH of 7.19 and $PaCO_2$ of 73mmHg. The patient needed almost one hour of BiPAP ventilatory support before being able of ensuring adequate tidal volume, with $ETCO_2$ approaching 50 mmHg without respiratory support. Extubation of the trachea occurred after obtaining a fully awake patient, responding to commands.

Comment [BV1]: Please define at first use.

The patient was then admitted to the post-anesthesia care unit. Thirty minutes after, arterial blood gas analysis showed a pH of 7.30 and $PaCO_2$ of 55mmHg. Even though the patient maintained full consciousness and was well-oriented (Glasgow Coma Score of 15/15), gas exchange, on the other hand, kept deteriorating (7 hours after extubation, pH was 7.23, and $PaCO_2$ 63mmHg).

Decision was made to transfer him to intensive care unit (ICU), where non-invasive positive pressure ventilation (NPPV) was immediately initiated. Despite NPPV, acute respiratory acidosis was still persisting 12 hours after extubation (pH 7.15, $PaCO_2$ 85 mmHg) while the patient remained completely conscious. Afterwards, respiratory status finally started to recover, with improving results of arterial blood gas.

The patient was discharged from the ICU 36 hours later, with latest results of arterial blood gas revealing chronic respiratory acidosis with moderate hypoxemia (pH 7.35, $PaCO_2$ 54 mmHg, HCO_3^- 29 mmol/L, PaO_2 79 mmHg). The patient left the hospital 10 days later.

III. Discussion

Perioperative anesthetic management of scoliosis remains discussed matter of debate, particularly for idiopathic scoliosis (IS). For all types of scoliosis, incidence of postoperative pulmonary complications (PPC) ranges from 3 % to 20.5 % in patients with moderate to severe restrictive pulmonary disease (1;2).

Preoperative assessment is widely debated in the literature. Pathologic preoperative pulmonary function tests (PFT) seem to be one of the most described risk factors showing an obvious correlation with PPC (2;3). The forced vital capacity (FVC) ratio (with $\leq$ 65% used as pathologic thershold), by indicating the level of pulmonary function restriction, can predict PPC.

Comment [BV2]: What does this mean ? What dose ?

However, for patients with IS, the role of preoperative PFT still remains controversial (4). These patients, contrarily to neuromuscular scoliosis patients, are usually otherwise healthy, and rarely need mechanical ventilation during the postoperative phase. Moreover, a study including 702 IS adolescents showed no difference between the PFT of patients who had at least one complication and those who did not (4).

In the present case, scoliosis was extremely severe with a double major curve (Cobb angles reaching 80° and 90°) complicated by ossification of his whole spine. Steepness of Cobb angle has also been correlated with PPC (2). In addition, the patient had portal hypertension with ascites at the time of surgery, which might have worsened his highly suspected restrictive pulmonary dysfunction.

Consequently, in light of the severity of his scoliosis and of major comorbidities, preoperative PFT could have been valuable.

Furthermore, no correlation could be found between the results of preoperative arterial blood gazes and incidence of PPC, apart from a tendency to increased complications with the presence of decreased PaO_2 (1). Nevertheless, in view of last results of arterial blood gazes of our patient in the ICU, without oxygen or any respiratory help, preoperative arterial blood gazes would have probably helped us in our management, by revealing a very likely chronic respiratory acidosis with moderate hypoxemia.

Although the effects of preoperative pulmonary rehabilitation in patients with severe scoliosis have never been investigated, respiratory muscle training was shown to improve inspiratory muscle strength in restrictive thoracic disorder patients (5), as well as in patients undergoing elective cardiothoracic or upper abdominal surgery, therefore reducing the risk of PPC (6). In the present case, the patient presented amyotrophy, as a consequence of chronic immobilization, which certainly did not spare respiratory muscles. Again, he might have been a good candidate for preoperative respiratory rehabilitation.

There is currently very little evidence concerning prophylactic non-invasive ventilation (NIV) applied during the preoperative period (7). Although it is not clear whether postoperative NIV is useful in preventing acute respiratory failure, the benefits seem otherwise well proved in the ICU setting. NIV prevents post-extubation acute respiratory failure and re-intubation in patients at high risk of deterioration (8). Moreover, a randomized controlled trial including ICU patients with chronic respiratory disorders and hypercapnia showed a decrease in the incidence of acute respiratory failure when administering early NIV after extubation (9). Insofar as our patient was suffering from multiple comorbidities and having $PaCO_2$ higher than 45 mmHg after extubation, he fulfilled the criteria suggested by this review to benefit from early NIV right after extubation (9). In confirmed cases of acute respiratory failure after lung-resection surgery and abdominal surgery, NIV is an effective treatment (7;8).

Finally, severe scoliosis is often responsible for intubation difficulties, all the more in our patient whose cervical spine was fixed from C2 to C7. The King Vision™ video-laryngoscope is a new device which shows the glottic structures through a camera. This device allowed an easy oro-tracheal intubation in the present case. Surprisingly, there are currently no published data comparing this new device to direct laryngoscopy in real life. One study using cadaver and manikin models with difficult airway scenario showed a lower Cormack-Lehane view and a higher success rate of intubation by paramedics (10).

In conclusion, perioperative anesthetic management of IS remains controversial during both the pre- and postoperative periods. However, in case of severe IS, anesthetic strategy must be very thorough and driven carefully. PFT and arterial blood gazes are recommended in order to be entirely aware of the patient's respiratory status preoperatively. Pulmonary rehabilitation before surgery shows promising results and could definitely play an interesting role during the perioperative period in those patients. NIV may be effective to prevent and treat acute respiratory failure. The King Vision™ video-laryngoscope should be early considered in any case of impossible cervical spine mobilization.

IV. References

(1) Liu J., Shen J., Zhang J., Zhao H., Li S., Zhao Y., Qiu G., Roles of preoperative arterial blood gas tests in the surgical treatment of scoliosis with moderate or severe pulmonary dysfunction. *Chin. Med. J.*, **125(2)**, 249-252, 2012.

(2) Seo H., Kim H., Ro Y.-J., Yang H.-S., Non-neurologic complications following surgery for scoliosis. *Korean J. Anesthesiol.*, **64(1)**, 40-46, 2013.

(3) Lao L., Weng X., Qiu G., Shen J., The role of preoperative pulmonary function tests in the surgical treatment of extremely severe scoliosis. *J. Orthop. Surg. Res.*, **8**, 32-36, 2013.

(4) Carreon L., Puno R., Lenke L., Richards S., Sucato D., Emans J., Erickson M., Non-neurologic complications following surgery for adolescent idiopathic scoliosis. *J. Bone Joint Surg. Am.*, **89(11)**, 2427-2432, 2007.

(5) Budweiser S., Moertl M., Jörres R., Windisch W., Heinemann F., Pfeifer M., Respiratory muscle training in restrictive thoracic disease: a randomized controlled trial. *Arch. Phys. Med. Rehabil.*, **87(12)**, 1559-1565, 2006.

(6) Mans C., Reeve J., Elkins M., Postoperative outcomes following preoperative inspiratory muscle training in patients undergoing cardiothoracic or upper abdominal surgery: a systematic review and meta analysis. *Clin Rehabil.*, 2014.

(7) Jaber S., Michelet P., Chanques G., Role of non-invasive ventilation (NIV) in the perioperative period. *Best Pract. Res. Clin. Anaesthesiol.*, **24(2)**, 253-265, 2010.

(8) Mas A., Masip J., Noninvasive ventilation in acute respiratory failure. *Int. J. Chron. Obstruct. Pulmon. Dis.*, **9**, 837-852, 2014.

(9) Ferrer M., Sellarés J., Valencia M., Carrillo A., Gonzalez G., Badia JR., Nicolas J., Torres A., Non-invasive ventilation after extubation in hypercapnic patients with chronic respiratory disorders : randomized controlled trial. *Lancet*, **374(9695)**, 1082-1088, 2009.

(10) Murphy L., Kovacs G., Reardon P., Law J., Comparison of the King Vision video laryngoscope with the Macintosh Laryngoscope. *J. Emerg. Med.*, **47(2)**, 239-246, 2014.

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