CASE REPORT

Prone ventilation in a patient with severe ARDS having a floating sternum

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SUMMARY

Prone ventilation is used to manage patients with refractory hypoxia in the critical care unit. Complex chest trauma and chest drains have been a considered relative contraindication to prone ventilation. To the best of our knowledge, it is hitherto unreported in patients having traumatic floating sternum and acute respiratory distress. We present a brief case report of a patient with floating sternum (complete disruption of sternum) managed successfully by prone position ventilation.

BACKGROUND

Prone ventilation is controversial in sternotomy and in patients after cardiac surgeries. Information about prone positioning of the patients with complex chest traumas is sparse. Through this write up we wish to demonstrate that a patient with complete disruption of sternum, chest drains and haemodynamic instability can be managed in the prone ventilation safely.

CASE PRESENTATION

A 45-year-old man was admitted with respiratory distress to the emergency room after a high impact road traffic accident. Glassgow Coma Scale (GCS) on arrival was 15, without evidence of head injury. There was paradoxical breathing with anterior flail and emphysema over chest wall. Invasive mechanical ventilation was initiated and chest drains inserted on both sides for haemothorax evidenced on point of care ultrasound. CT thorax demonstrated pulmonary contusion with major disruption of sternocostal joints (figure 1). Thoracic epidural analgesia along with systemic analgesics was initiated for pain control. The patient was on epidural bupivacaine and fentanyl infusion for analgesia which was monitored with Visual Analogue Scale (VAS) score <4. The patient was sedated with Inj. midazolam infusion with Richmond Agitation and Sedation Scale (RASS) score monitoring. Patient had normal urine output (≥1 mL/kg/hour) throughout the first 3 days and there was no episode of hypotension.

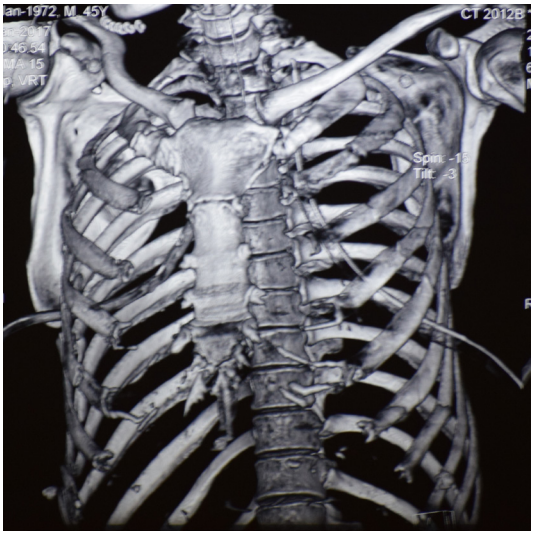

Figure 1 Reconstructed chest CT.

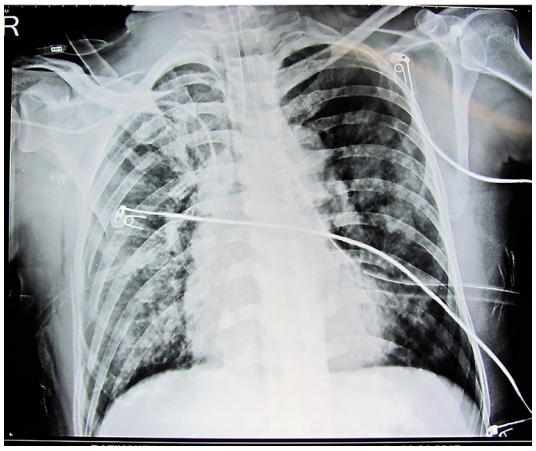

Figure 2 CXR with features of acute respiratory distress syndrome (ARDS).

By the third day of ICU stay, the patient developed severe hypoxia, hypotension and became irritable. He was sedated and paralysed. The acidosis, refractory hypoxia and acute respiratory distress did not improve in spite of optimal lung protective ventilation (figure 2, tables 1 and 2). The cumulative fluid balance was 1.6 L (excluding insensible loss). The point of care ultrasound of chest was used to assess cardiac function, lung B lines, fluid responsiveness and vena caval distensibility, suggested a non-compromised heart without evidence of fluid overload. Hypotension was managed with intravenous fluids and infusion of noradrenalin initiated at the rate 0.05–1 mcg/kg/hour and titrated to affect.

Prone ventilation was initiated as the last resort (extracorporeal membrane oxygenation [ECMO] facility is not available at our centre).

There are no guidelines for proning patients with chest trauma. The methodology followed was as done in the PROSEVA trial,[1] which is a standard protocol on our unit. (https://www.youtube.com/watch?v=E_6jT9R7WJs.) Infusion of the

Table 1 Ventilator modes at different time

Time	Mode	TV set	TV delivered	PEEP	Plateau	PIP	FiO2	RR/min	P/F	SpO2
T (–2)	VCV	300	240–280	12–14	34–37	45–50	100	24	54	72%
T (–1)	VCV	320	300–320	14–20	32–34	45	100	24	55	71%–75%
T0	VCV	350	300–350	20	32–34	43	100	24		71%–75%
T4hr	VCV	360	350–400	18	30–34	40	60	22	131	92%
T8hr	VCV	360	360–400	16	28–30	35	60	22		99%
T16 hr	VCV	400	400	16	25–30	35	55	20	257	99%

(T (–2) before sedation and paralysis, T (–1) after 4 hours of sedation and paralysis. T0- immediately after proning, T4h, T8hr, T16hr- corresponding hour after proning). FiO2, fraction of inspired oxygen; PEEP, positive end expiratory pressure; PIP, peak inspiratory pressure; P/F, PaO2/Fio2; RR, respiratory rate; SpO2-peripheral oxygen saturation; TV, tidal volume; VCV, volume control ventilation.

Table 2 Corresponding arterial blood gas (ABG) at different time interval

Time	pH	PaCo2	PaO2	HCO3	Lactate	MAP	FIO2	P/F
T (–2)	6.83	146.7	54.4	9.6	1.9	55–65	100	54
T (–1)	7.03	110	55	10.1	1.8	65	100	55
T4hr	7.08	80.1	78.8	20	2.4	65–70	60	131
T16hr	7.27	47.7	141.6	22.4	1.9	70	55	257

(T (–2) before sedation and paralysis, T (–1) after 4 hours of sedation and paralysis. T0- immediately after proning, T4hr, T16hr- corresponding hour after proning).

noradrenalin was continued targeting the mean arterial pressure of 65 mm Hg and above. The patient showed gradual improvement in oxygenation and haemodynamic with prone ventilation for 16 hours (tables 1 and 2). The noradrenalin infusion was tapered off by 10 hours. There were no position-related complications.

INVESTIGATIONS

Chest CT scan, chest X-ray, ABG.

DIFFERENTIAL DIAGNOSIS

Ventilator-associated pneumonia. However, lab parameters and culture reports did not support this diagnosis.

OUTCOME AND FOLLOW-UP

The patient maintained haemodynamic and oxygen saturation (SpO2) after the single episode of proning with high PEEP and FiO2. Over the next 2 days though the P/F ratio stays in between 220 and 300. He maintained good saturation in supine position with PEEP 6–10 and FiO2 between 40% and 60%. Over the next week he underwent tracheostomy for difficult weaning due to an unstable sternum. He was discharged at 6 weeks,completely recovered.

DISCUSSION

Improvement in oxygenation in the prone position is thought to result from a reduction in intrapulmonary ventilation perfusion mismatch, ventilator induced lung injury and better drainage of secretions.[2] Complex chest trauma has been considered a relative contraindication to prone positioning. A few cases of flail chest have shown benefit from prone positioning.[3 4] It is hitherto unreported in patients with a floating sternum where the haemodynamic effects of the sternum on the heart may be an added concern. In our case, we found improvement in haemodynamic and oxygenation possibly attributed to the additional sternal splinting.

Patient's perspective

Thank God for saving my life, I do not remember much of what my family and doctors tell me. But I am happy to be alive!

Learning points

- Chest trauma with a floating sternum is not a contraindication for prone ventilation in the event of refractory hypoxaemia.
- It may improve haemodynamic parameters, possibly due to sternal splinting.

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