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Case Report

Immediate Massive Subcutaneous Emphysema: A Rare Complication of Percutaneous Dilatational Tracheostomy: A Case Report

Mohammed Ageel Ahmed[1], Bander Mohammed Gohal[2], Jubran Ali Sahli[3], Abdulmohsen Mohammed Folos[4], Mohammed Mohsen Saleh[5], Abdullah Abdulgadir Al-Ageel[6]

[1]French Board of anesthesiology & critical care, Department of anesthesiology faculty & critical care, Jazan University, Saudi Arabia

[2]Deputy nursing director, King Fahd Central Hospital, Jazan, Saudi Arabia, King Fahd Central Hospital, Prince Sultan RD, Abu Arish

[3]Nursing director, King Fahd Central Hospital, Jazan, Saudi Arabia, King Fahd Central Hospital, Prince Sultan RD, Abu Arish

[4]Department of critical care, King Fahd Central Hospital, Jazan, Saudi Arabia, King Fahd Central Hospital_ Prince Sultan RD, Abu Arish

[5]Department of critical care, King Fahd Hospital, Jazan, Saudi Arabia, Prince Sultan RD, Abu Arish

[6]Medical Resident, AlRawdah primary health care, Jazan, Saudi Arabia, 3512 AlRawdah, Jazan, Saudi Arabia

***Corresponding Author:**
Mohammed Ageel Ahmed
Email: abulayan2009@yahoo.com

Abstract: Percutaneous tracheostomy (PCT) has rapidly emerged in recent years; it is proven to be safe and less time-consuming when compared to surgical technique. In critical care settings, the use of PCT has been widely accepted and some authors consider it the gold standard method. Although PCT is relatively a safe procedure, it still can be associated with some serious complications. Massive percutaneous emphysema is a rare complication of PCT, which might be life-threatening. We report a patient with Guillian-Barre syndrome (GBS), who was admitted to an intensive care unit and required prolonged ventilation. Bedside PCT was performed and ended with the development of an immediate diffuse massive surgical emphysema and desaturation, followed by cardiac arrest regardless of the treatment measures.

Keywords: Percutaneous tracheostomy, Subcutaneous emphysema, Bronchoscope, Complication, Gullian-Barre syndrome

INTRODUCTION

GBS is a common neuromuscular disease, which in some cases requires intensive care unit admission due to acute muscle weakness and flaccid paralysis [1-3], needing airway protection and ventilator support. Neuromuscular respiratory failure affects 25% of patients with GBS [4].

In a recent review of the literature, the mortality rate of ventilated GBS patients was evaluated and found to range from 8.3% to 20% of overall ICU-admitted GBS patients [5]. Long-term ventilation in an ICU is indication for tracheostomy; its purpose is to secure a definitive airway and provide ventilatory support. Percutaneous tracheostomy (PCT) is a procedure frequently done in intensive care settings because it carries fewer complications in comparison to the surgical technique; moreover, some authors consider it the method of choice in ICU settings [6]. Since its introduction by Sheldon at 1957 [7], it had rapidly progressed; several techniques to perform this procedure have been developed, including the use of surgical dissection for the purpose of tracheal exposure [8,9], as well as the use of a forceps or dilator to create the intra-tracheal access [10,11].

Studies showed that performing PCT by a well-trained experienced operator would decrease its complication rate and improve its safety [12]. The use of bronchoscopy as an assistant device aims to improve the procedure's safety; nevertheless, its routine use is still controversial [13,14,15]. Although one study showed no advantage in using a bronchoscope in lowering PCT complications in trauma patients [16], performing a blind tracheal puncture resulted in 24% inaccurate tracheostomy tube placement, as shown in a cadaveric study [17].

Despite the fact that PCT is a safe procedure [18,19,20], it still carries several perioperative complications ranging from minor to major. Minor complications include: self-control bleeding, accidental extubation, desaturation, decannulation, mild surgical emphysema, and tracheal ring fracture; while major

complications include pneumothorax, posterior tracheal wall puncture, massive bleeding, false tracheostomy passage, and esophageal perforation [20,21]. Nevertheless, minor bleeding was reported to be the commonest perioperative PCT complication [22,23]. Massive subcutaneous surgical emphysema is a rare perioperative complication of PCT, which might occur secondary to the tracheal wall laceration, tracheostomy tube misplacement, or barotrauma [24-29]. Posterior tracheal wall lacerations, which were found to be the most common cause of PCT-related surgical emphysema, along with subcutaneous tracheostomy tube misplacement, can be prevented by using intraoperative bronchoscopic guidance [30,31].

CASE DESCRIPTION

We present a 55-year-old female patient, 158 cm in height and 81kg weight (BMI; 32kg/m^2), not known to have any chronic medical illness, who was admitted to the critical care unit as a case of GBS with progressive ascending paralysis, bilateral lower motor neuron fascial nerve lesion, and bulbar dysfunction, indicating an elective orotracheal intubation. She received intravenous immunoglobulin (IVIG) (0.4g/kg/day) for five consecutive days, but the patient did not show any sign of neurological improvement. Later, the decision was taken to perform a bedside percutaneous tracheostomy at the day 16 of her admission to the critical care unit.

The patient met the criteria for the percutaneous procedure. A neck ultrasound scan and duplex showed no underlying vessels, and the trachea was at 1.5 cm depth from the skin. Anesthesia was then provided with an intravenous fentanyl bolus (1mcg/kg), continuous infusion (1mcg/kg/hr), along with midazolam (5mg), and a rocuronium (0.6mg/kg) bolus. Ventilation was 100% oxygen with continuous patient monitoring. The airway was managed by an experienced respiratory therapist and the procedure was performed and assisted by intensive care doctors. The blind landmark-based technique used a size 7 tracheostomy tube (Cuffed Blue Line Ultra® Tracheostomy Tube PORTEX®, Smith medical, USA).

The procedure ran smoothly and there was no intraoperative complication apart from minor bleeding. Then, ventilation through the tracheostomy tube was performed and chest auscultation revealed bilateral adequate air entry. After that, the endotracheal tube withdrawn totally, dressing was applied to the tracheostomy tube and fixed using fixation bandage. The patient was then connected to mechanical ventilation.

A few minutes later, the patient started to show low SpO_2 level. Ventilation with a bag-valve-mask device was performed, along with suctioning, which came out with an insignificant blood clot. Despite implementing these strategies, there was no frank amelioration in the SpO_2 value. The patient was connected back to the mechanical ventilator. Nevertheless, the patient continued to show low SpO_2 value despite 100% oxygen ventilation, and the ventilator gave a high peak airway pressure alarm. Rapid assessment commenced and chest auscultations did not reveal any sign of bronchospasm, and there was a significant bilateral decrease in air entry. Mechanical obstructive factors were ruled out. When the heart rate started to slow, the tracheostomy tube was immediately removed and orotracheal intubation was performed. Atropine (0.5mg) was given and then chest compression started. Massive diffuse subcutaneous emphysema was discovered, immediate bilateral needle thoracostomy was done and then, bilateral chest tubes inserted. Resuscitation based on ACLS guidelines continued for 60 minutes without regaining electrical cardiac activity, then the patient was declared deceased.

DISCUSSION

In this case, GBS and its progression was the principle pathology demanding the ICU admission, intubation, and mechanical ventilation. The main treatments of GBS are immunotherapy and supportive treatment [1,2,3,32]. This patient received IVIG and showed no improvement. Around 25% of GBS patients develop respiratory failure, which requires intubation and mechanical ventilation. The commonest complication seen in ventilated GBS patients is the bedsore (40%), followed by ventilator-associated pneumonia (VAP) 30.2%. A study done by Azim *et al* showed that 64% of their patients' required prolonged ventilation (>2weeks), and among them 85% will end up with a tracheostomy. [33] .

The advantages of PCT are that it's quick, cost-effective [19,34], easy to perform, is a small skin incision, limited tissue trauma, low infection rate, can be performed at the bedside [20,21], and is associated with a low complication rate. PCT can also be associated with serious complications, including death. Simon et al. showed that PCT-related death occurs in 1 per 600 PCT; 31% among them resulted from perioperative hemorrhage, while 29.6% resulted from airway complications [35].

Our patient was fit to undergo bedside PCT. We did the ultrasonography and there were no vessels or thyroid tissue crossing our field. The use of neck ultrasonography improved the results of this procedure and provided more information about the underlying tissue and structures. Alansari *et al* summarized the role of ultrasound in PCT, which includes: land-marking, choosing the appropriate size, identifying vulnerable structures, and locating the puncture site [36]. We were not able to perform this procedure under direct bronchoscopic control due to material maintenance. The use of a bronchoscope as an adjunct to PCT since its

introduction by Marelli *et al* [37], is proven to lower the incidence of complications by avoiding the injury's adjacent structures, including the neck vessels. It also lowers paratracheal insertion, confirming mid-tracheal puncture and clearance of the posterior tracheal wall penetration [12,18,38,39]. Nevertheless, bronchoscopy has its own inconvenience as it impairs ventilation and PEEP effectiveness, and it requires three clinicians to perform the procedure [12,20,39].

Though the routine use of bronchoscopy to guide PCT is still debatable [13,14,15], and there is no consensus about the indications for bronchoscopic guidance during PCT so far [8,13,15], we still recommend its routine usage to assist PCT. There are some surgical modifications that improve the proper tracheostomy tube positioning, either by a limited surgical dissection for tracheal wall palpation or more extensive dissection with direct tracheal visualization. Both techniques allow proper insertion of the catheter introducer needle without bronchoscopic control in about 90% of cases in a prospective study performed by Laisaar *et al* [40].

At the end of the procedure, the acute increase in peak airway pressure along with desaturation and the massive subcutaneous emphysema made our aim to secure the airway by orotracheal intubation and bypass any possible tracheal wall injury. Also to perform a bilateral needle thoracostomy, then bilateral intercostal tubes aimed to decompress any possible tension pneumothorax and decrease the subcutaneous emphysema. In several reports, subcutaneous emphysema in PCT most commonly resulted from tracheal wall injury [25,30,31,41], though posterior tracheal wall laceration is still the commonest cause of PCT-related surgical emphysema, especially when no bronchoscopic guidance is used. Still, there are some etiological causes such as displacement of the tracheostomy tube in the subcutaneous tissue. Both causes can be prevented and controlled early if the bronchoscope is used [30, 31]. Ventilation-related barotrauma could also be a cause of subcutaneous emphysema in this case; though the rapid progression of events makes it less likely. In our case, we could not establish a clear responsible cause as the events' progression ere too fast.

CONCLUSION

PCT is relatively a safe procedure, though certain precautions should be applied in order to prevent serious complications. Bronchoscopic usage during this procedure is of extreme importance, along with the operator's experience, as both can prevent complications.

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