TRACHEOTOMY AND ROLE OF LOW POSITIVE PRESSURE VENTILATION DURING PREOXYGENATION IN A PATIENT WITH LARGE LARYNGEAL NEUROENDOCRINE CARCINOMA

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Small cell neuroendocrine carcinoma of the larynx is a rare epithelial origin neuroendocrine carcinoma. Its endolaryngeal growth may lead to airway obstruction and consequently endanger patient life. Managing the airway in this case poses great challenge for the anesthesiologist. The aim of this case report is to present alternative airway management in case of the possible unsuccessful endotracheal intubation. Emergency tracheotomy in sedoanalgesia and local anesthesia is successfully performed in patient with large neuroendocrine carcinoma of the larynx. Midazolam and remifentanyl used for sedoanalgesia may lead to respiratory depression. Therefore, pressure support preoxygenation was performed in order to prevent hypoxia, which could occur during the period of apnea. In conclusion, this regimen of preoxygenation prior to tracheotomy in sedoanalgesia and local anesthesia could be an appropriate alternative to general anesthesia and endotracheal intubation, especially in case of large endoluminal tumor that almost completely obstructs the airway.

KEY WORDS: neuroendocrine carcinoma of the larynx, preoxygenation, positive pressure ventilation preoxygenation, tracheotomy

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BACKGROUND

Neuroendocrine carcinomas of the larynx are rare and account for approximately 0.6% of all malignancies of the larynx (1). According to the World Health Organization, neuroendocrine carcinomas of the larynx are classified into those of epithelial or neural origin. Paraganglioma is a sole type of neural origin neuroendocrine carcinoma. Epithelial origin neuroendocrine carcinomas of the larynx are divided into typical carcinoid, atypical carcinoid and small cell neuroendocrine carcinoma (2-4).

Although the larynx is one of its most common extrapulmonary sites, small cell neuroendocrine carcinoma is an unusual laryngeal carcinoma accounting for slightly less than 0.5% of carcinomas (5, 6). This tumor most often presents in the sixth and seventh decade,

more frequently in men who are heavy cigarette smokers. Approximately 50% of patients present with cervical lymph node metastases, whilst widespread tumor metastases occur in 73% of patients due to biological aggressiveness of the tumor (6). Widespread metastases are located in the skin, lung, liver and bone. Two- and five-year survival rates are 16% and 5%, respectively (6). Symptoms depend on the size and location of the tumor, and may include stridor, dyspnea and dysphonia caused by narrowing of the glottis plane and compression of the inferior laryngeal nerves. Dyspnea and airway obstruction are caused by endolaryngeal growth of the tumor. The diagnosis is based on the histopathologic appearance of the tumor. Combined adjuvant radiation and chemotherapy offer the best hope of survival (6).

Patients undergoing emergency tracheostomy due to acute breathing difficulty caused by obstruction of the larynx pose the greatest airway challenges to the anesthesiologist. Therefore, adequate preoxygenation prior to managing the airway must be achieved. Adequate preoxygenation of the lungs can be achieved with an appropriate flow of 100% oxygen into the breathing system maintaining an effective face-mask seal until the end-tidal oxygen fraction is 0.87-0.9 (7). When conducted properly, preoxygenation increases oxygen reserves and duration of apnea without desaturation (DAWD), defined as the delay until the SpO_2 reaches 90%. Therefore, preoxygenation provides valuable additional time to secure the airway, especially when difficult airway management is anticipated (7,8).

Various methods of preoxygenation prior to elective surgical procedures have been proposed in modern literature. The most often used technique is three minute tidal breathing of 100% oxygen (9,10). This technique can provide non hypoxic period of up to 5 minutes (10). On the other hand, usage of low positive pressure ventilation during preoxygenation can extend the duration of apnea without desaturation to almost 12 minutes (11,12).

In this article, a case of successful use of low positive pressure ventilation during preoxygenation prior to tracheotomy is reported.

CASE REPORT

A 65-year-old man was admitted in our hospital due to breathing difficulty, which could immediately endanger his life. Two months before, the patient was admitted to our hospital complaining of mild dyspnea, dysphonia, and odynophagia. At the time, the patient had a longstanding cigarette use history combined with alcohol abuse. He had no known environmental exposures. Upon examination *via* indirect laryngoscopy, he was found to have a supraglottic tumor that had spread to the right vocal cord and aryepiglottic fold. Excisional biopsy of the tumor was performed and the patient was diagnosed with small cell neuroendocrine laryngeal carcinoma. The patient was presented at the interdisciplinary tumor board and a decision was made that no surgical treatment was indicated, therefore the patient received adjuvant radiation therapy. After having received radiotherapy, initial regression of the tumor growth was observed. Clinical plan was to continue physical examination with flexible endoscopy assessment after one month, but due to acute breathing difficulty the patient was admitted earlier.

On admission to the hospital, indirect laryngoscopy was performed. Examination revealed severe obstruction of the larynx caused by tumor that had spread to both the left and right side of the supraglottis, affecting both vocal cords and causing complete paralysis of the larynx. The lumen of the larynx was assessed to be 3 mm in width (Fig. 1). According to this examination and due to breathing difficulty and inspiratory stridor, emergency tracheostomy was indicated.

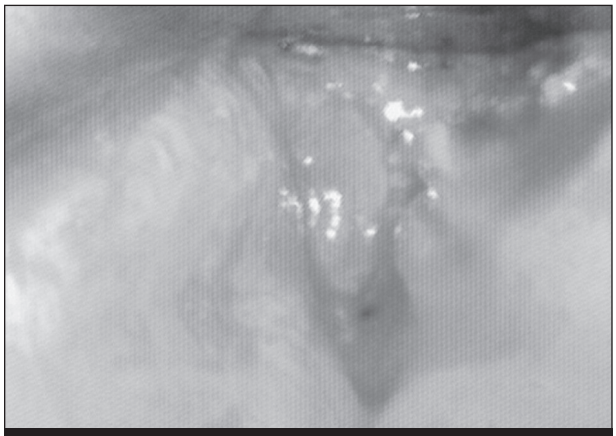

Fig. 1. *Neuroendocrine carcinoma of the larynx almost completely obstructing the airway*

Considering dimensions of the tumor, its endoluminal and extraluminal growth, as well as its metastatic spread to the neck, the patient was assessed to be difficult for airway management. Difficult and potentially unsuccessful laryngoscopy and endotracheal intubation, difficult ventilation *via* supraglottic device and difficult front of the neck access (Fig. 2) were the reasons for not to conduct tracheotomy in general anesthesia. Therefore, the anesthetic plan was made and the decision was reached between the surgeon and the anesthesiologist in charge of the case to perform tracheostomy under sedoanalgesia and local anesthesia using noninvasive mechanical ventilation *via* face mask. Administration of low positive inspiratory pressure and positive end-expiratory pressure ventilation before and during sedoanalgesia would provide adequate oxygenation during tracheotomy, especially in case of possible respiratory depression.

Fig. 2. *Difficult front of neck access to the airway*

The patient's actual body weight was 53 kg, height 174 cm (body mass index 17.5). In the operating theatre, the patient was placed in 30° head-up position. Routine monitoring was initiated, including electrocardiography, noninvasive blood pressure and pulse oxymetry (SpO_2). An intravenous line was secured on the upper limb using a 17-gauge cannula. Baseline values of heart rate, blood pressure and SpO_2 were recorded. Application of the specially designed face mask (Hans Rudolph Inc. 7500 series V2 oronasal mask®) was done by the anesthesiologist in charge of the case (Fig. 3).

Fig. 3. *Specially designed facemask (Hans Rudolph inc. 7500 series V2 oronasal mask® used for preoxygenation*

Preoxygenation was immediately initiated with low positive inspiratory pressure (5 cm H_2O) and positive end-expiratory pressure (5 cm H_2O), which the patient tolerated well. Measured variables included inspired oxygen concentration, end-tidal oxygen concentration (ETO_2), and end-tidal carbon dioxide ($ETCO_2$). Tidal volume, respiratory rate, as well as minute volume of breathing were monitored. Fresh gas flow was adjusted in order to overcome minute volume of breathing to avoid rebreathing fraction, therefore we used 15-20 L *per* minute fresh oxygen flow. Measurements were recorded using Maquet (Sweden) flow-i anesthetic and respiratory gas monitor. Side-stream respiratory gases were sampled from a sampling port interposed between the filter and the Y-piece of the anesthetic circuit. A criterion of successful preoxygenation was end-tidal oxygen concentration (ETO_2) of minimum 90%. We achieved 93% ETO_2 within 5 minutes and 22 seconds (Fig. 4). Following successful preoxygenation,

Fig. 4. *Adequate preoxygenation achieved in 5 minutes and 22 seconds*

administration of sedoanalgesia was initiated. Midazolam was administered intravenously in a dose of 0.1 mg *per* kg and remifentanil was continuously administered intravenously in a titrating dose of 0.15 to 0.5 μg/kg/min. Local infiltration of lidocaine 2% solution was performed by the surgeon. Tracheotomy was successfully performed in 12 minutes and 24 seconds (Fig. 5).

Fig. 5. *Successfully performed tracheotomy*

Respiratory depression started after 7 minutes from the initiation of sedoanalgesia and lasted for 2 minutes and 14 seconds. During the period of apnea, the patient was mechanically ventilated using low positive inspiratory

pressure *via* face mask. The patient started breathing spontaneously after lowering the dose of remifentanil given continuously. During the period of apnea, there was no onset of arterial hemoglobin desaturation of oxygen; measured SpO_2 was 100% throughout the procedure. Furthermore, there was no hemodynamic instability (Fig. 6).

Fig. 6. *Hemodynamic stability during the procedure*

DISCUSSION

Small cell neuroendocrine carcinoma of the larynx is a rare malignant tumor of the larynx, the endoluminal and extraluminal growth of which may lead to the obstruction of the airway and difficult airway management in case of emergency tracheostomy.

In this case presentation, according to the local protocol, the first choice for difficult airway management was to perform awake fiberoptic intubation (AFOI), but the patient was uncooperative and refused our proposal. Another option was to perform induction of general anesthesia following endotracheal intubation using video laryngoscope and placing small endotracheal tube (3 mm internal diameter). Induction of general anesthesia and following respiratory depression and possibility of having the 'can't intubate can't oxygenate' scenario, it was assessed to be a high-risk situation. Therefore, we decided to perform tracheotomy in sedoanalgesia and local anesthesia.

Analgosedation is providing cooperation with the patient and protects physiologic reflexes, thus providing rapid awakening and increasing operative efficiency (13). In this case, usage of dexmedetomidine with remifentanil would be the preferable sedoanalgesia technique because it is not associated with respiratory depression when given in therapeutic doses. Dexmedetomidine is an α_2-adrenergic receptor agonist that has anxiolytic, analgesic and sedative properties (14-16). Unfortunately, dexmedetomidine is not registered medication in our country, therefore we decided to perform sedoanalgesia with midazolam and remifentanil despite the possibility of oversedation to lead to respiratory depression. Antaa *et al.* (17) did not find any difference comparing dexmedetomidine and midazolam in terms of sedation initiation values. In this case presentation, the time for targeted sedation was 7 minutes after administrating midazolam, which was the time when we could not get verbal response from our patient, and at the same time respiratory depression occurred. Therefore, in order to create oxygen reserve to prevent hypoxia during apnea period, we decided to apply noninvasive mechanical ventilation before the administration of medications.

Preoxygenation is needed especially in patients with oxygen transport limitations and those in whom difficult intubation and/or difficult ventilation are anticipated (18). Preoxygenation prolongs the period of non-hypoxemic apnea increasing safety during airway management (7-12).

Adequate preoxygenation is achieved when all three compartments (alveolar, vascular and tissue) are saturated with oxygen. Failure to breathe 100% inspiratory oxygen, inadequate time for preoxygenation, and the presence of leak under the mask can all result in inadequate alveolar oxygenation. In order to overcome these problems, tight fit must be achieved between the mask and the patient's face, which is why we used specially designed face masks (Hans Rudolph Inc. 7500 series V2 oronasal mask®). Furthermore, sufficient fresh gas flow of oxygen must be provided to avoid rebreathing in the circuit (therefore we used 15-20 L *per* minute fresh oxygen flow). Also, adequate time for preoxygenation must be provided in order to achieve end-tidal oxygen concentration 90%. During apnea, oxygenation depends on the oxygen reserves available in the body.

Various preoxygenation techniques and regimens are described and used worldwide (9-12). Arab *et al.* (11) proved that the use of pressure support ventilation (PSV) to pre-oxygenate patients during ear, nose and throat pan-endoscopy was associated with a longer duration of non-hypoxemic apnea and that this method was also associated with a shorter preoxygenation time and greater preoxygenation success rate. They conclude that this approach may be of value in patients at risk of poor ventilation and suggest that PSV could be performed as a first-line treatment prior to general anesthesia to prevent any unforeseen intubation problems. Gander *et al.* (19) found that the application of positive end-expiratory pressure during induction of general anesthesia in morbidly obese patients increased non-hypoxemic apnea duration by 50%. Positive end-expiratory pressure (PEEP) can increase functional residual capacity (FRC) of the lungs and prevent atelectatic areas, which may occur after breathing 100% oxygen. Furthermore, Hignett *et al.* (20) demonstrated that FRC of patients increased significantly in the 30° head-up position in comparison with supine position.

CONCLUSION

Usage of pressure support ventilation with low inspiratory pressure and positive end-expiratory pressure combined with 30° head-up position during preoxygenation prevents hypoxia and provides adequate time to secure the airway. Therefore, this regimen of preoxygenation prior to tracheotomy in sedoanalgesia and local anesthesia could be an adequate alternative to general anesthesia and endotracheal intubation, especially in case of large endoluminal tumor which almost completely obstructs the airway.

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SAŽETAK

TRAHEOTOMIJA I ULOGA VENTILACIJE NISKO POZITIVNIM TLAKOM ZA VRIJEME PREOKSIGENACIJE KOD BOLESNIKA S VELIKIM NEUROENDOKRINIM KARCINOMOM LARINKSA

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Sitnostanični laringealni tumor je rijedak neuroendokrini tumor epitelnog podrijetla. Endoluminalni rast tumora može dovesti do opstrukcije dišnog puta te ugroziti život bolesnika. Uspostavljanje dišnog puta u ovakvom slučaju je velik izazov za anesteziologe. Cilj ovoga rada je prikaz alternativnog rješenja uspostavljanja dišnog puta kod bolesnika s velikim endoluminalnim tumorom larinksa u slučaju postojanja visokog rizika za bezuspješno izvođenje endotrahealne intubacije. Urgentna traheotomija u analgosedaciji i lokalnoj anesteziji uspješno je učinjena kod bolesnika s velikim neuroendokrinim karcinomom larinksa. Za analgosedaciju korišteni su midazolam i remifentanil koji mogu dovesti do respiratorne depresije. Kako bi se preveniralo hipoksiju koja može nastati tokom apneje bolesnik je adekvatno preoksigeniran uz pomoć pritiskom podržane ventilacije. Zaključak: Primjena analgosedacije i lokalne anestezije uz prethodnu preoksigenaciju potpomognutu inspiracijskim i endekspiracijskim pritiskom adekvatna je alternativa općoj anesteziji i endotrahealnoj intubaciji u slučaju izvođenja traheotomije, naročito kod bolesnika s velikim endoluminalnim tumorom.

KLJUČNE RIJEČI: neuroendokrini tumor larinksa, preoksigenacija, pritiskom podržana preoksigenacija, traheotomija