



Revista Colombiana de Anestesiología

Colombian Journal of Anesthesiology

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Case report

Prophylactic percutaneous dilatational cricothyrotomy, prior to surgical tracheostomy: Case report[☆]



Santiago Medina-Ramírez^{a,b}, Juan Camilo Posada-Upegui^{c,*},
Lina María Hoyos-Fajardo^a, Diomer Avendaño-Quintero^a

^a Anesthesiologist, Hospital Universitario San Vicente Fundación, Medellín, Colombia

^b Professor, Anesthesiology Department, Universidad de Antioquia, Medellín, Colombia

^c Third year resident of Anesthesiology and Resuscitation, Universidad de Antioquia, Medellín, Colombia

ARTICLE INFO

Article history:

Received 31 May 2015

Accepted 5 February 2016

Available online 12 April 2016

Keywords:

Tracheostomy
Airway management
Airway obstruction
Anesthesia, general
Case report

ABSTRACT

Introduction: Percutaneous dilational cricothyrotomy is considered a quick technique to access the airway during urgent situations, especially “cannot intubate/cannot ventilate” scenarios; nevertheless it can also constitute a technique to temporarily and preventatively secure the airway in cases of glottic or supraglottic obstruction, in patients in whom interventions of the obstructive lesion or definitive procedures for airway control will be done.

Clinical case: This is a report of a 90 year old patient with symptoms of dyspnea and dysphagia, with a multilobar, friable lesion, with areas of necrosis, suggestive of carcinoma, with involvement of left vallecule, epiglottis and glottis, with 90% occupation of the latter. It is decided to make an urgent tracheostomy. At the time of surgery, in the face of the imminent risk of obstruction, loss of the airway patency and death during the surgical intervention, it was decided to make a percutaneous cricothyrotomy previous to the tracheostomy. There were no complications associated with the airway neither during the procedure nor in the perioperative period.

Conclusion: Percutaneous dilational cricothyrotomy is a quick procedure and can become a valuable tool in securing the airway in cases of critical supraglottic obstruction in patients who will be taken to surgery and carry a risk of loss of permeability of the airway; in this article we make a report of a successful case of its utilization and we review the available evidence on the preventive use of cricothyrotomy and the outcomes in this context.

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[☆] Please cite this article as: Medina-Ramírez S, Posada-Upegui JC, Hoyos-Fajardo LM, Avendaño-Quintero D. Realización de cricotiroidotomía percutánea por dilatación de manera profiláctica, previa a traqueostomía quirúrgica: reporte de un caso. Rev Colomb Anestesiología. 2017;45:16-20.

* Corresponding author at: Calle 6C Sur # 83 A-69, Urbanización Colinas del Rodeo, Medellín, Colombia.

E-mail address: camilopsd@gmail.com (J.C. Posada-Upegui).

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Realización de cricotiroidotomía percutánea por dilatación de manera profiláctica, previa a traqueostomía quirúrgica: reporte de un caso

R E S U M E N

Palabras clave:

Traqueostomía
Manejo de la vía aérea
Obstrucción de las vías aéreas
Anestesia general
Informes de casos

Introducción: La cricotiroidotomía percutánea por dilatación es considerada una técnica de acceso rápido a la vía aérea en situaciones emergentes, principalmente en situaciones de “no intubación/no ventilación”, sin embargo también puede constituir una técnica para asegurar de manera preventiva y temporal la vía aérea en casos de obstrucción de la misma a nivel glótico o supraglótico, en pacientes a quienes se realizarán intervenciones de la lesión obstructiva o procedimientos definitivos para control de la vía aérea.

Caso clínico: Se presenta el caso de una paciente de 90 años con cuadro de disnea y disfagia, con una lesión tumoral multilobular friable y con áreas de necrosis, sugestiva de carcinoma, con compromiso de vallécula izquierda, epiglotis y glotis, con ocupación del 90% de ésta última. Se programa para traqueostomía urgente y ante el riesgo inminente de obstrucción, pérdida de la vía aérea y muerte durante la intervención quirúrgica, se decidió realizar una cricotiroidotomía percutánea previa a la traqueostomía. No hubo complicaciones relacionadas con la vía aérea durante el procedimiento ni en el transoperatorio.

Conclusión: La cricotiroidotomía percutánea por dilatación es un procedimiento rápido y puede ser una herramienta valiosa para asegurar la vía aérea en casos de obstrucción crítica supraglótica en pacientes que serán llevados a intervención quirúrgica y tienen riesgo de pérdida de la permeabilidad de la misma, en este artículo se reporta un caso exitoso de su utilización y se revisa la evidencia existente sobre el uso preventivo de la cricotiroidotomía y los desenlaces obtenidos en este contexto.

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Introduction

According to ASA's Closed Claims Project, adverse outcomes related to respiratory events are one of the main causes of “anesthesia-related lesions”. There were three mechanisms accounting for most respiratory adverse events: difficult intubation (23%), inadequate ventilation (22%) and esophageal intubation (13%).¹ The analysis of claims against the UK National Health System between 1995 and 2007 showed that 12% of the anesthesia-related claims were due to airway (AW) problems or breathing, accounting for 53% of fatalities during this period of time.² There are three potential scenarios when managing the airway: the first is that the AW is easily controlled using facemask ventilation, but tracheal intubation fails; the second scenario is less frequent because the patient cannot be ventilated using a facemask, but can be successfully intubated; the third case is cannot intubate – cannot ventilate and hence is a real problem. According to the literature, between 0.05 and 0.35% of patients belong in this latter category.³ So in the cannot intubate – cannot ventilate situation, percutaneous cricothyrotomy is the technique of choice suggested under the difficult airway algorithms, based on the fact that it may be easily and quickly done. However, cricothyrotomy may also be used as a technique to preventively and temporarily secure the airway in case of glottic or supraglottic obstruction, in patients undergoing obstructive lesion procedures or definite procedures for airway control.

Clinical case

90-year old female patient, housewife, admitted to the San Vicente Foundation University Hospital because of a 20-day course of asthenia, subjective fever, progressive dysphagia for liquids and solids, dyspnea, coughing with greenish expectoration and 24 kg loss of body weight in the last 4 months. The patient's upper GI tract endoscopy report describes an oropharyngeal tumor lesion suggestive of carcinoma. The patient has a history of heavy smoking and COPD with no spirometric classification, ipratropium, bromide, beclometasone and salbutamol treatment; 92% environment oxygen saturation on admission. Paraclinical tests on admission: CBC, glucose, renal function, ionogram, TTP, TP and INR within the normal range. The neck CT reported a large heterogeneous mass involving the left supraglottic region, extending into the midline and with involvement of the aryepiglottic folds, significantly obliterating the airway lumen.

The physical examination shows a patient without respiratory distress, desaturation or stridor; however, the patient is dysphonic, partially edentulous with the remaining teeth in poor condition, no trismus or mouth opening limitation, Mallampati III.

The patient was admitted for endoscopic gastrostomy; additionally, the ENT team did indirect laryngoscopy, visualizing a 70% airway obstruction leading to the need of tracheostomy that the patient refused. Then the decision was made to do a fibrolaryngoscopy for proper lesion

characterization. The procedure was done the next day and identified a friable multilobular tumor lesion, with some bleeding-prone areas and other necrotic segments occupying the left vallecula and obstructing 90% of the area, mostly on the left side and blocking the view of the epiglottis. The glottis is 90% occupied by the tumor lesion, with evidence of adequate mobilization of the right vocal fold. This findings point to the impending risk of an upper airway obstruction so the patient is again educated again about the risks of not doing the procedure and finally she agrees to the tracheostomy. A nasogastric tube is placed as a temporary measure for enteral feeding.

After three days the patient is transferred to the OR for a surgical tracheostomy. Based on the prior fibronasolaryngoscopy reporting 90% airway obstruction, the idea to attempt direct laryngoscopy intubation was dismissed and initially a neonatal kit was used for fibrobronchoscopy under topical anesthesia and translaryngeal-glossopharyngeal block, but it was impossible to advance to the glottis due to the presence of a giant hypopharyngeal mass. So the decision was made to do a percutaneous cricothyrotomy prior to the tracheostomy based on the high risk of losing the airway and patient dying during the procedure. A cricothyrotomy cannula was placed uneventfully under basic ASA monitoring, using Melker's kit and Seldinger's technique. Upon securing the airway anesthetic induction was performed and surgical tracheostomy under general anesthesia with transverse cervical incision 1 cm below the cricoid cartilage. There were no transoperative complications. The oxygen saturation at the end of the procedure was 98% and the postoperative evolution was good. The patient was scheduled for laryngeal lesion biopsy the day after but she refuses to undergo the procedure and after 8 hospitalization days she asked to be discharged.

The Ethics Committee authorized the research at the Hospital Universitario San Vicente Fundación.

Discussion

Dilatational percutaneous cricothyrotomy is a key component of the emergent airway management algorithms.⁴⁻⁸ This procedure allows for airway access between the lower anterior margin of the thyroid cartilage and the anterosuperior margin of the cricoid, the area considered as the most accessible area along the respiratory tree below the glottis.⁹

In contrast to tracheostomy, percutaneous cricothyrotomy has the advantage of being simpler, safer and fast technique, less invasive and the probability of bleeding is lower^{10,11}; this is why the technique is emphasized during training and education of medical staff.¹² Using Seldinger's technique for this procedure means additional safety by reducing the probability of misplacement if needle or cannula and injuring the nearby vessels.¹³

In addition to the "no intubation/no ventilation", there are some situations when cricothyrotomy could be a salvage option: three failed endotracheal intubation attempts, including at least one by an experienced anesthesiologist, failed fiberoptic intubation techniques, or inability to secure the airway after 10 min into the rapid sequence induction and the

administration of the anesthetic agent. Other indications for percutaneous cricothyrotomy arise at the ER department or in the pre-hospitalization environment for immediate airway control of multiple trauma patients, maxillofacial, cervical, or spine trauma, when naso/orotracheal intubation has not been possible or is contraindicated; finally, it is indicated for surgical procedures involving the trachea, the larynx, the epiglottis and the base of the tongue.^{10,12}

A less conventional indication though equally valid for the use of percutaneous cricothyrotomy is in patients with glottis or supraglottic lesions with considerable airway obstruction that will undergo surgery and are at risk of losing the airway patency. In a series of cases collected in a 22-month time period at a hospital where 21,915 general anesthesia cases were done with tracheal intubation of 15,377 patients, emergency tracheostomy was avoided in 11 patients with very difficult airway; these patients were managed with prophylactic transtracheal catheter (alternate cricothyrotomy versus dilatational) and pulmonary jet ventilation, that ensured adequate oxygen supply during tracheal intubation and greatly facilitated the patient's management.¹⁴ Nguyen et al., reported in two cases of emergent, pre-hospital percutaneous cricothyrotomy in 2009 in patients with severe upper airway neoplastic obstruction. In both of them the Seldinger technique was used and adequate patient ventilation was achieved. One of these patients underwent surgical definitive tracheostomy upon admission to the hospital.¹⁵ More recently, Duwat et al., reported doing percutaneous cricothyrotomy on two "cannot intubate/cannot ventilate" patients in the OR, prior to surgical tracheostomy. In one of them the Melker kit was used, while in the second one Quicktrach I was used. Both patients survived using the percutaneous technique and were able to undergo surgery uneventfully.¹⁶

In our setting the most widely available devices are the Melker Emergency Cricothyrotomy Catheter Set, Cook Critical Care, Bloomington, IN, and the Quicktrach II (VBM Medical, Noblesville, IN). However, more devices are available for this purpose. The anesthesiologist if more familiar with Melker's because it uses the Seldinger insertion technique that is routinely used in other procedures in the practice of anesthesia and this improve enhanced recall and theoretically higher success rates. A "crossover" trial on fresh cadaveric specimens showed that inserting the metallic guidewire did not increase the time to ensure the airway versus the surgical approach.¹⁷ Quicktrach II is designed for simple insertion without guidewire, through a sharp trocar-type device that creates a lumen through the cricothyroid membrane and hence shortens the insertion time; however, more difficulties and complications have been reported with this type of sets, including failure to access the airway, multiple cannulation attempts, false passages, posterior tracheal wall injury, mediastinal lesion, pneumothorax and severe bleeding.¹⁰

A recent systematic review compiled the results from several trials comparing commercial kits based on the Seldinger technique against others using a different technique; when comparing Melker set against Quicktrach 1 and 2, no significant differences were identified in the success rates to secure the airway using any of the above devices.¹⁸ The mean time to secure a patent airway using Melker set ranged from 13 to

78 s; however, times vary based on the patient and operator experience.¹⁸ Most of these trials have few patients and are extremely heterogeneous (animal and human models, cadavers, dummies, etc.), which makes it difficult to reach accurate conclusions.

In terms of relative or absolute contraindications, percutaneous cricothyrotomy is a procedure that requires extreme caution in children less than 10 years of age and should not be performed in those aged less than 6. Preexisting laryngeal pathologies such as cancer, acute or chronic inflammation, or epiglottitis, lead to higher morbidity when undergoing cricothyrotomy. A distorted neck anatomy as a result of a disease or trauma may prevent the use of the technique.¹¹ Within the context of a prophylactic cricothyrotomy, there is a need to adequately determine the extension of the obstructive lesion through imaging studies since the involvement of the thyroid cartilages or the cricoid precludes doing this procedure prior to a surgical tracheostomy.

The rate of complications reported ranges from 10 to 40%; early complications include the inability to secure the airway, bleeding, inappropriate or failed placement of the cannula, subcutaneous and mediastinal emphysema, vocal folds injury, bronchoaspiration or laryngeal disruption.¹⁰ Long term complication are beyond the scope of this article. Among the pediatric population, the rate of complications is higher, with pneumothorax being the most frequent complication (5–7%).¹¹

Conclusions

Percutaneous dilatational cricothyrotomy is a life-saving rapid procedure in patients with previously failed intubation attempts and in whom facemask ventilation is not an option. Furthermore, this procedure may be a valuable tool to secure the airway in case of critical supraglottic obstruction in patients undergoing surgery and at risk of losing the patency of the airway – a no ventilation/no intubation scenario. This approach is supported by the existing literature with positive outcomes for patients. Hence, this is a context wherein the possibilities to perform a cricothyrotomy are good with a high probability to succeed.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Funding

The authors did not receive sponsorship to carry out this article.

Conflicts of interest

The authors have no conflicts of interest to declare.

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