INCIDENCE, CHARACTERISTICS AND MANAGEMENT
OF FAILED INTUBATION IN 28,092
SURGICAL CANCER PATIENTS

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Abstract

Failed intubation is a very rare event and has been poorly assessed. This is a retrospective study based on a computer clinical database assessing 28,092 anaesthetics. Data were obtained through sequential query language extraction. The incidence of failed intubation defined by the impossibility to perform tracheal intubation by the anaesthetist in charge was 0.16% (25 cases). It decreased to 0.04% (6 cases) after the contribution of a second anaesthetist and dropped to 0.02% (3 cases) after the intervention of a cervicofacial surgeon. Most of the patients with failed intubation had a history of cervicofacial tumors generally located in the oropharynx or mouth (17 patients). Eight patients out of 25 were scheduled for non-cervicofacial cancer surgery. Sixteen out of 25 had transient desaturation (range 80-93%). Three out of 17 cervicofacial cancer patients who could not be intubated with the help of the second anaesthetist or the surgeon had their airway controlled by rescue transtracheal jet ventilation (RTTJV), laryngeal mask (LM), or emergency tracheotomy. All scheduled procedures were carried on and no complications occurred. This study highlights the necessity to seek help very early as most failed intubations (76%) were resolved with the help of a second anaesthetist; however, the importance of cooperation with surgical teams was even greater. When anaesthetists failed to intubate, cervicofacial surgeons resolved the situation in 50% of the cases.

Keywords: failed intubation, difficult intubation, cancer surgery

Introduction

While multiple studies have assessed difficult intubation and related procedures1-5, hardly any of these studies have described the circumstances of occurrence and the solutions implemented during intubation failures.

According to several studies, the incidence of difficult intubation is between 0.1 and 2.4% in general surgery, 3-7% in obstetrics, 10-20% in cervicofacial surgery. In the latter group of patients, intubation is difficult due to specific anatomical features6,7. In 1996, it was estimated that difficult intubation was directly or indirectly responsible for a third of incidents attributed to anesthesia8. Difficult intubation was the first cause of mortality and morbidity in relation to anesthesia, and in two-thirds of cases, patients died or suffered from severe neurologic damage. Specific algorithms

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for difficult intubation are published by many Society of Anesthesiologists to overcome this critical situation for the vast majority of patients.\textsuperscript{1,3,8,9}

The failed or impossible intubation defined by the inability of an anesthesiologist to introduce the tube into the trachea is a very rare event, and thus, very few publications are available. The incidence varies from 0.08 to 0.1\%\textsuperscript{10}. This situation is not critical as long as oxygenation and ventilation can be maintained. It can be disastrous when it becomes difficult to oxygenate the patient. Otherwise, patients are woken up and the surgical procedure is cancelled. The cancellation or delay of a new intervention may be detrimental to the health of the patient, especially cancer patients.

The purpose of this study was to evaluate the situation of failed intubation on a very large number of surgical cancer patients: incidence, type of surgery, and respective maneuvers performed by the anesthesiologists and/or surgeons to overcome this challenge and their related complications.

Materials and methods

This is a four-year, descriptive, retrospective, single-center study that includes 28,092 consecutive anesthesia procedures in a cancer hospital between 1 January 2007 and 31 December 2010. Our Institutional review board authorized our department to extract information from the database for quality assurance program and subsequently publish general results (Avis n° 92012/33465). Our team is frequently faced with situations of difficult intubation and oxygenation problems since cervicofacial tumor patients represent more than 25\% of the general population of patients that we support.

During this period, the available difficult airway management devices or techniques were: classical Macintosh curve, straight blade Miller laryngoscope along gum elastic bougie, fiberoptic intubation, Intubating Laryngeal Mask Airway ILMA (Fastrach\textregistered) and the RTTJV, using a 14 G tracheal catheter via a Seldinger technique (Leadercath Vygon France) and a jet-ventilator with an automatic control of tracheal pressure to avoid pulmonary barotrauma.

All data were extracted from a computer database using sequential query language (SQL), in which all anesthetic interventions/events were prospectively indexed by anesthesia providers in addition to the automatic recording of clinical parameters during and after anesthesia in post-anesthetic care unit (PACU). All monitors and respirators are connected to the database (ARK system Datex GE\textregistered). Intubating conditions are systematically reported: tube diameter, number of laryngoscopies, the name of the operator, maneuvers performed (laryngeal manipulation, gum elastic bougie, intubating ILMA, fiberoptic intubation, inter-cricothyroid puncture, RTTJV, failed intubation and complications; second and third operators are also called for help (second anesthetist and cervicofacial surgeons). At the time of the study, newer devices such as Air Trach, C-Trach or video laryngoscopes were not available. Before leaving the Post-Anesthetic Care Unit (PACU), the anesthesia record is printed and saved in a database (Sybase).

The folder “intubation” of the database has four possible entries: Easy Intubation, Difficult Intubation, failed or impossible intubation, and RTTJV. During anesthesia, the “failed intubation” field was checked when the senior anesthetist in charge was not able to perform the intubation, thus leading him to call for help.

To identify these categories of patients, the query «failed intubation» was made in the “intubation” folder. Therefore, all patients with a failed intubation by a single operator (the anesthetist in charge) were identified and extracted. Each computerized anesthesia record was analyzed to reconstruct the history of events by analyzing vital signs, trends stored by monitors and other indexed events such as drug injections, other interventions and additional comments.

The following information were extracted from the database and preoperative anesthesia consultation records:

- Demographic characteristics: age, gender, body mass index (BMI).

- Risk factors for difficult intubation according to the expert conference SFAR\textsuperscript{2} were history of difficult intubation, Mallampati score greater than II, thyromental distance of less than 6 cm, mouth opening of less than 35 mm, limitation of mandibular protrusion, limitation of neck mobility.
- Risk factors of difficult mask ventilation, cervicofacial pathology, including prior cervicofacial cancer surgery and neck irradiation or facial burns.
- Risks factors for upper airway obstruction11.

Intraoperative events are ones such as the use of neuromuscular blocking agents, type of muscle relaxants and time of injection, type of surgery, duration of intubation defined by the time between the injection of anesthetics for induction and adequate insertion of the endotracheal tube, presence of hypercapnia (PetCO₂ >43 mmHg) measured just after intubation, occurrence of oxygen desaturation of less than 95%, and the presence of mask ventilation difficulties. Manual mask ventilation was identified as difficult when airway pressure was above 25 mmHg and/or the occurrence of desaturation episodes during face mask ventilation.

- Finally, all methods used to control the airway were identified (laryngeal maneuvers, gum elastic bougie, LMA, ILMA, RTTJV, fiberoptic intubation, call for help of a second anesthetist and/or cervicofacial surgeon, and finally, tracheotomy).

Statistical analysis

Quantitative variables were expressed as mean ± standard deviation, and percentage. All calculations were performed with GraphPad PRISM © version 5.01 software.

Results

A total of 28,092 general anesthesia procedures were performed from 2007 to 2010. Different types of procedures performed in our institution were respectively 28% for head and neck surgery, 26% for breast surgery (the majority were under laryngeal masks), interventional radiology procedures (14%), general surgery (7%), gynecological surgery (7%), and thyroid surgery (4%).

The head and neck cancer surgery activity included 74% of surgical procedures in the oral cavity, oropharynx, nasopharynx or facial, and 26% of surgical procedures on the larynx or laryngopharynx. Between 2007 and 2010, 14,270 (51%) patients were intubated and laryngeal masks were used in 6511 (23%) cases. Intubation was considered as difficult in 7% (n = 1989) of intubated patients regardless of the technique used.

Gum elastic bougie was used in 1394 cases, and fiberoptic intubation in 595 cases. Finally 1991 (7%) patients had TTJV mainly for cervicofacial endoscopy, and very few for difficult intubation and rescue oxygenation (6 cases).

The “failed intubation” query in the folder «intubation» originally identified 32 records between 2007 and 2010. The detailed analysis of cases through the anesthesia records revealed seven cases out of 32 in which the intubation sequence was, in fact, easy (intubation duration of less than 10 minutes, normal insufflation pressure, lack of desaturation). These seven cases probably are the subject of an input error by the anesthesia providers in charge of the patient.

Therefore, our final series include 25 patients, and the incidence of failed intubation with a single operator was 0.16% for this period. In all of these cases, a second operator (a second anesthetist and/or surgeon) was called for help. However, the absence of identification of the second anesthesiologist did not permit the assessment of his experience. Among these 25 patients, 17 patients had a history of cervicofacial cancer while the remaining eight did not have any (Figure). Difficult intubation was predicted in 16 patients in the anesthesia consultation (1 for the group “non-cervicofacial” versus 15 for the cervicofacial group).

The non-cervicofacial group: (n = 8)

These eight patients had a mean age of 63.0 ± 11.8 years and a body mass index of 27 ± 5 Kg/m². During the induction of anesthesia, they all received a propofol bolus in addition to remifentanil (TCIV). A non-depolarizing neuromuscular blocking agent was administered to all patients at induction.

One patient scheduled for nasal intubation (skin tumor of the lip) was converted to orotracheal intubation with the help of a second anesthetist, combining the Maneuver Backward, Upright, Right Pressure (BURP maneuver) and using gum elastic bougie. The others were intubated by orotracheal
route with the help of a second anaesthetist reiterating conventional maneuvers or by using the Fastrach®. The airway support duration was 20 ± 7.5 minutes, attesting to the difficulty of the procedure.

The absence of identification of the second anesthesiologist did not permit the assessment of his experience. However, the intervention of a second anesthetist solved the difficulty for all eight patients. Four patients had oxygen desaturation between 82 and 93%. The mean lowest SpO₂ was 87% ± 5. Three of them showed a moderate and transient hypercapnia. No patient had complications.

The cervicofacial group (n = 17)

These patients had a mean age of 63 ± 10, a gender ratio (M/F) of 3/1, and a BMI of 24 ± 6 kg/m². Among 17 patients, 15 had oropharyngeal tumors and nine had a previous history of cervical radiotherapy. Five patients were scheduled for fiberoptic intubation under target-controlled remifentanil (TCI). In these patients, two out of five were intubated by the second anesthesiologist with a Miller straight blade laryngoscope and the Backward Upward Rightward Pressure (BURP) maneuver, and the surgeon performed two fiberoptic intubations—one nasal and one oral, and one emergency tracheotomy. The remaining 12 had propofol, remifentanil TCI for induction, while three out 12 had muscle relaxants. Six out of 12 could be intubated by the anesthesia team with the presence of a second anesthesiologist. The methods used were BURP, gum elastic bougie, and two ILMA respectively (with a total of five orotracheal intubations and one nasal). Finally, six patients could not be intubated by the anesthesia team; five of them had also difficult ventilation, justifying the use of a RTTJV to maintain oxygenation. The cervicofacial surgeon could intubate three of them, one orotracheal with hypopharyngoscope, and two others with fiberoptic nasal intubation. Therefore, in this population, the number of “failed” intubations after using traditional and new techniques with the help of a second or third operator, including a cervicofacial surgeon, was three out of 25. For these three patients, surgery was not cancelled and was performed using RTTJV in one case, laryngeal mask in another case, and after tracheotomy in the last one. The mean duration of intubation was 30 ± 17 min. extreme values (11 and 43 minutes). Twelve patients experienced desaturation between 80 and 94%. The average lowest SpO₂ was 87% ± 6. Six out of 17 patients showed a moderate and transient hypercapnia. Finally, intubation difficulties did not induce any complications.

Discussion

This study shows that failed intubation has been a very rare incident (only three patients in four years) in a busy cancer hospital, including cervicofacial
surgery). In addition, the intervention of a second anesthetist and/or the cervico-facial surgeon, mostly for cervico-facial cancer patients, was of great help; the latter possibly recognized pathologic oropharyngeal airways better and used other devices with a better glottic visualization such as hypopharyngoscope.

As a very rare event, the failed or impossible intubation is reported in very few publications. In this single-center, retrospective study, the incidence of difficult intubation was 1.6% of all of intubated patients. This incidence drops to 0.02% when considering patients who could not be intubated by the anesthesiologist in charge, the anesthesiologist who was called for help, or by the cervico-facial surgeon. The rate of failed intubation found in the literature varies from 0.08 to 8%, which is in agreement with the incidence found in our population. In a retrospective study, Langeron et al. found an incidence of 0.8% for 1374 patients, which was much higher than other studies; however, the definition used for the failed intubation was not specified.

Because of the surgical recruitment, our anesthesia team is frequently confronted with difficult airway situations. Thus, the algorithm of difficult intubation and oxygenation is almost a daily practice. A majority of our series of patients with failed intubation, with or without neck cancer, who could not be intubated by the first anesthetist in charge were intubated with the help of a second anesthetist, highlighting the importance of the call for help in case of airway management difficulty. The French society of anesthesiologists (SFAR) recommends an early call for help in difficult intubation situations. However, the call for help does not guarantee a more experienced anesthetist. In our database, the name of the second operator could not be indexed, and therefore the level of experience of the second operator was not assessed. This shortcoming is now corrected in our new Anesthesia Information Management System which has been installed since 2011, and any new operator is authenticated. We believe that the high rate of success in the presence of the second anesthetist was less related to their technical skill set, but mostly to their availability to discuss and “think” about the case with the team in charge, and to a lesser extent—the presence of two supplementary “trained hands”, contributing to a decrease in general stress and fatigue which are not be helpful in such situations.

Another interesting finding from this study is the lack of a serious complication of failed intubation. Sixteen out of 25 patients presented an episode of transient desaturation without detectable clinical consequences. This is mostly due to an adequate cooperation between anesthesia and surgical teams in critical situations, combined with the experience of our anesthesia team in RTJV. In this series of patients, difficult intubation was predicted in the anesthesia consultation in 16 out of 25 patients (two for the group “non-cervico-facial” versus 14 for the “cervico-facial”), and airway management was adapted to these anticipated difficulties. The fiberoptic intubation failures for patients in the ENT group (five in our series) can be complicated by desaturation. However, this technique remains the most relevant for this type of patients. On the other hand, the failures of the laryngeal mask are observed when the disease affects the larynx or hypopharynx, and not the oropharynx or oral cavity, as demonstrated by Giraud et al., who said that in patients with limited mouth opening after oral radiotherapy, the laryngeal mask could be an alternative to intubation.

Contrastingly, in patients with post-radiotherapy cervical sclerosis, the ILMA should be avoided because of an increased rate of failure. Nevertheless, the prediction of difficult intubation is the least reliable in the latter types of surgery. However, suggestions about whether a video laryngoscope could have been useful in some cases is legitimate. We had no experience of these devices at the time of the study, but an increased failure rate is observed in cervico-facial cancer population of patients. All six patients who were classified as failed intubation by the anesthesia team had former or active head and neck cancer. Arne J. et al., in their study of 1,200 patients, demonstrated that the presence of a cervico-facial malignancy multiplied the risk of difficult intubation by six times. They did not, however, report failed intubation in their series, possibly due to the low incidence of this event. In this study, patients undergoing cervico-facial surgery or endoscopy were 34 times more likely to have failed intubation in comparison to other patients. Therefore this sub-category of patients should be
considered at risk, whether the tumor is treated or not. The difficulties encountered in patients with laryngeal and hypopharyngeal cancer are highly correlated to the tumor volume, and patients with high tumor volume are frequently symptomatic. This is not the case for tumors of the tongue base, which are frequently asymptomatic; in such cases, upper airway obstruction occurs just after anesthetic induction after muscle relaxation. Radiotherapy may be responsible for secondary infiltration of the levator muscles of the jaw, and a non-resolving trismus under general anesthesia. In addition, a lack of extension of the cervical spine, by decreased mobility of the neck after neck dissection or cervical radiotherapy, is responsible for visualization difficulty of the glottis. This can also be explained by a filling of the vallecula by edema, fibrosis or tumor infiltration. Finally, the incompressibility of the premandibular space due to infiltration of the base of tongue by a secondary tumor, or radiation therapy, prevents the forward movement of the tongue by the blade of laryngoscope.

This series of patients also highlighted the methods used by the medical and surgical teams to handle this event, which could lead to serious consequences. The call for help in this setting is always justified, especially in a teaching hospital: it concerns a staff anesthetist or cervicofacial surgeon. Collaboration with surgeons is required to use the retro molar way, which is no longer in the anesthesiology residency program nor the emergency tracheotomy. The use of RTTJV was often necessary to ensure satisfactory oxygenation. However, we agree that this technique is specific to our setting and cannot be generalized unless all staff are familiar with it; nevertheless, scalpel cricothyroidotomy remains indicated in the latest recommendations of Difficult Airway Society (DAS). The absence of complications is explained by two factors: proven difficult airway management algorithm, and cervicofacial surgeons being rapidly available. Even in an experienced center, failed intubation could be possible, and this risk must be anticipated in the algorithm. Since the incidence is very low, maintaining the level of competence in the use of certain techniques greatly helps—such as the routine use RTTJV for practicing cervicofacial endoscopy in specialized centers such as ours. However, scalpel cricothyroidotomy is now indicated in the new guidelines of the DAS. This technique does not solve all the cases, and the knowledge of other techniques is essential as Fastrach® or fiberoptic intubation, but newer techniques such as videolaryngoscopic intubation probably need to be mastered. This study is in accordance with recent guidelines, suggesting that anesthesiologists should not isolate themselves in case of failed intubations, and most importantly, declare and record all failed intubations. However, we also believe that difficult intubation strategies should be adapted to the resources available in each institution. A multicenter sharing of clinical databases would be useful to expand the patient population, including obesity or trauma.
References


