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# Unassisted percutaneous tracheostomy: A new flow chart decision making based on simple physical conditions

Nicolás Avalos[a,b,*], Rodrigo Cataldo[a], Luis Contreras[a,b]

[a] Instituto Chileno de Cabeza y Cuello, Chile
[b] Hospital FACH, Chile

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ABSTRACT

*Introduction:* Percutaneous dilatation tracheostomy (PDT) has several advantages over traditional surgical tracheostomy. However, it is still performed using bronchoscopy guidance.
*Objective:* To suggest the safety of unassisted PDT, without bronchoscopy guidance, based on bed–side screening flow chart evaluation.
*Material and methods:* 180 consecutive UCI patients referred to tracheostomy were submitted to Avalo's Screening Chart (ASC), in order to decide surgical technique.
*Results:* 161 patients were referred to unassisted PDT (un PDT) and 19 to surgical tracheostomy (ST) due to nonfulfillment of ASC steps. 10 patients submitted to unassisted PDT presented early complications, 8 presented mild bleeding and 2 false tracts. None of 6 months follow up patients presented long term complications.
*Conclusion:* The authors suggest unPDT is a safety surgical method in UCI patients who were submitted and approved to an easy anatomical and clinical screening chart (ASC).

## 1. Introduction

The term “Tracheostomy” refers to the surgical opening of the anterior wall of the trachea, followed by the fixation of the same wall to the neck's skin [1]. The principal cause of indication for tracheostomy derivate from the prolonged use of mechanic ventilation, reducing the need of sedation, the airway's resistance and improving its care [2].

The number of patients that require ventilation has increased in the last decades, reaching a reported incidence of 314 for every 100.000 habitants, with an incidence of tracheostomy for prolonged mechanic ventilation of 24.2 for every 100.000 habitants [2]. The mortality of the procedure is about 0,6%, being the principal causes hemorrhage and loss of airway and false tract [3].

There are two principal surgical techniques for creating a tracheostomy, surgical tracheostomy (ST), which implies the dissection of pretracheal tissues and the insertion of a tracheostomy cannula, while the trachea is directly observed, and the percutaneous tracheostomy (PT), which implies the introduction of a tracheal cannula through blunt dissection of pretracheal tissues, using the Seldinger technique as a guide [1].

The PT is usually done at the patient's bed head, in the Intensive Care Unit (ICU), performed by physicians that aren't surgeons [4]. This had advantages over the surgical tracheostomy (ST) [5,6] and is because of this that international guides recommend PT over ST in critical patients [1,7–8], Between the different modalities of PT the one assisted by fibrobronchoscopy (FBC) or by ultrasound (US) and the unassisted PT stand out, but studies highlight the advantages of assisted PT over the unassisted one because of a lower rate of complications, but there's a more elevated cost and difficulties regarding organization [9].

The objective of this study is to evaluate the safety of unassisted PT (without FBC or US) in patients selected by a new flowchart of patient's selection based on clinical parameters of easy measurement.

## 2. Material and methods

This study was designed as a prospective cohort. Patients over the age of 18 were included, admitted consecutively in the ICU of a tertiary reference center (Clínica Tabancura – Santiago de Chile) between December 2010 and January 2015, with indication of tracheostomy (because of the need to protect and access the airway to eliminate secretions, prolonged mechanic ventilation, superior airway obstruction and reduction of dead space to facilitate the weaning of the mechanical ventilation) [1]. All patients were evaluated using the Avalos Flowchart of Selection (AFS), being excluded all patients who didn't meet the test's requirements (Fig. 1).

The AFS consists of two steps. In the first step, four general clinical

* Corresponding author.
*E-mail address:* contacto@cabezaycuello.cl (N. Avalos).

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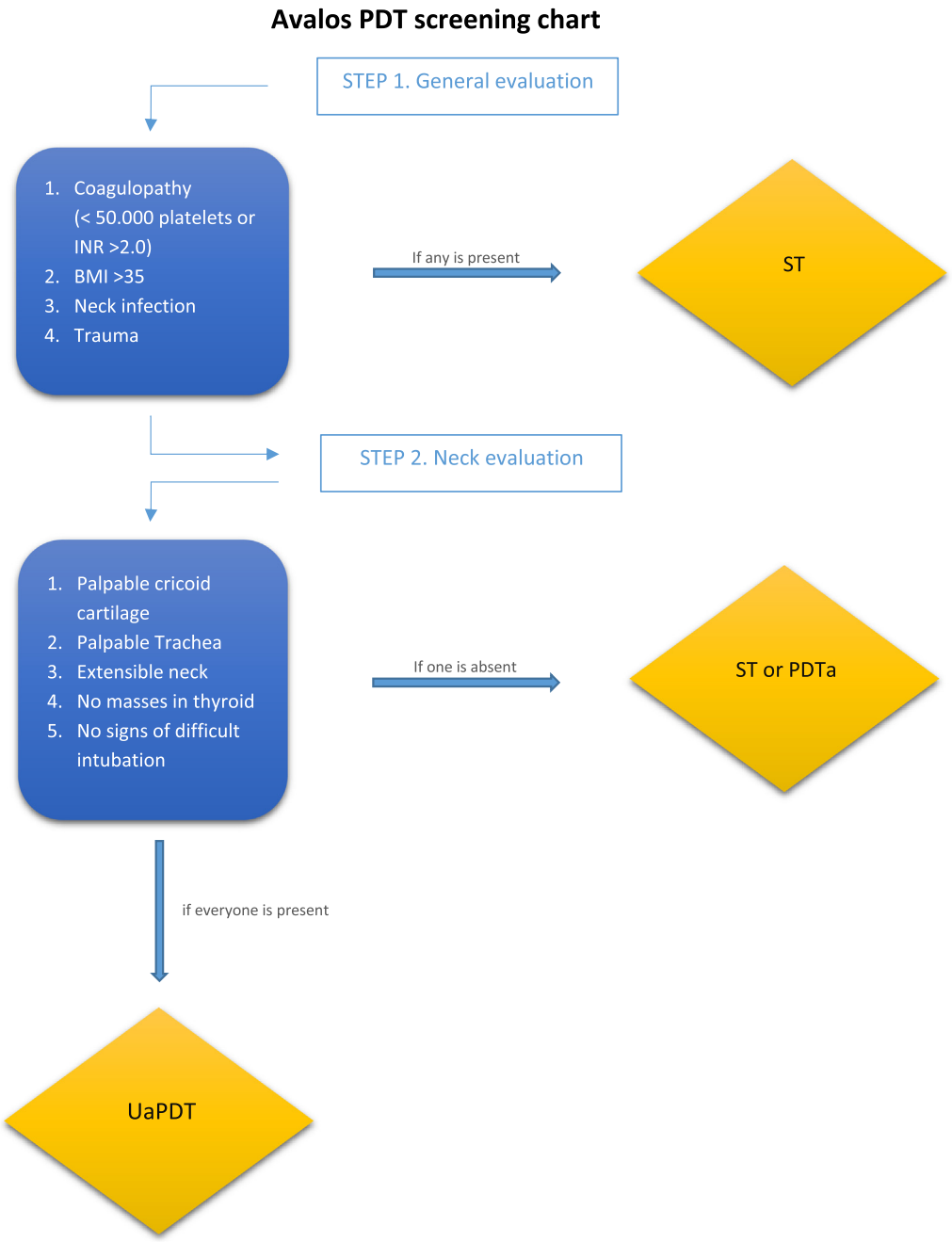


**Fig. 1.** Avalos PDT screening chart. ST: surgical tracheostomy; PDTa: percutaneous dilatational tracheostomy assisted; UnPDT: unassisted percutaneous dilatational tracheostomy.

parameters are evaluated which are coagulopathy, defined as a platelets' recount lower than 50.000 o INR higher or equal to 2, body mass index higher or equal to 33, cervical infection and cervical trauma; if the patient displays any of these parameters, a ST is done; if none of these parameters are exhibited, they continue to the next step. In the second step, five local clinical parameters are evaluated where are included palpable thyroid cartilage, palpable cricoids cartilage, extensible neck, no palpation of thyroid masses, and absence of difficult intubation signs (oral opening lower than 3 cm, the distance between thyroid cartilage and the chin lower than 6 cm, distance between the chin and the sternum lower than 12 cm, cervical immobility, craniofacial malformations, macroglossia and oropharyngolarynx tumour or infections processes) [10]; if any of these parameters are displayed, an assisted PT is done or a ST. If none of these parameters are exhibited, an unassisted PT is performed.

In the study, the PT was performed without assistance of bronchoscopy or ultrasound by one of the surgeons of the team (Head and Neck Surgeon, Nicolás Ávalos), using the Ciagla Blue Rhino ® percutaneous tracheostomy introducer set (Cook Medical Incorporated, USA), without assistance of an anaesthetist, at the patient's bed head (one operator only). All surgical teams were thoroughly trained in bronchoscopy techniques and all procedures were performed with a video flexible bronchoscopy as backup.

Early and late complications were observed. The early period was defined as up to 7 days after the procedure. The late period was defined between 8 days and up to 6 months after the procedure.

In the period after hospitalization, a clinical check-up was done until the 6 following months after the procedure.

## 3. Results

180 consecutive patients were referred for tracheostomy, 86 men and 94 women. The age range was between 18 and 82 years, with an average of 53 years. After applying the AFS, 161 patients were elected to perform unassisted PT. Of the 19 patients who were withdrawn from the study, 8 of them presented coagulopathy (< 50.000 platelets or INR > 2.0), 4 patients displayed non extensible neck, and 7 of them shown indirect signs of difficult intubation.

Early complications were presented on 10 patients (5.55%), eight of them due to bleeding of the surgical wound; they were all resolved with wound exploration and skin suture. No intravenous blood transfusions were needed. No airway bleeding was observed and there was not desaturation within the first 24 h after the procedure. Two patients presented with a false tract that required reintubation and percutaneous tracheostomy was achieved at the second attempt. The patients did not present bleeding or desaturation in the following 24 h. They were no life threatening complications or others early complications.

Long term complications were evaluated until 6 months after the procedure in surviving patients. No symptoms or signs of airway resistance were observed, as well as voice changes, dysphagia, tracheal stenosis, esophageal stenosis or tracheoesophageal fistula after the clinical evaluation performed periodically until 6 months' post-procedure.

## 4. Discussion

The inclusion criteria were elected according to the directions of international guides, [1,2,7], being the ICU medic who made the decision of performing a tracheostomy and applied the AFS. The criteria of exclusion are implicit in the application of the AFS, were accepted criteria by international guides are included [1,7–8], but they're ranked and standardized with the test application, such as coagulation disorders, short neck, obesity, neck's soft tissue infection, impossibility of extending the neck, growth of the thyroid gland, cervical tumors, pulsatile blood vessels in the pretracheal region, cervical radiotherapy, among others [1,11–14].

After the test application, the choice between the different surgical techniques can be made according to the exclusion criteria. There are diverse surgical approaches for the performance of a tracheostomy, were ST and PT (both assisted and unassisted) stand out. The international guides [1,7–8] recommend the performance of PT over ST due to a lower risk of stoma infections (Risk Ratio (RR) 0.24, 95% Confidence Interval (CI) 0.15 to 0.37) [15], diminution of unfavorable scarring (RR 0.25, 95% CI 0.07 to 0.91, $P = 0.04$) [15] and shorter operative time (Pooled OR 21.7 [22.7 to 0.7]; $P$ 0.001) [16] but without differences regarding mortality related to the procedure (Peto odds ratio (POR) 0.52, 95% CI 0.10 to 2.60) [15], mortality after the procedure (POR 0.30, 95% CI 0.05 to 1.77) [15], life threatening events (RR 0.72, 95% CI 0.41 to 1.25) [15], major bleeding (RR 0.70, 95% CI 0.45 to 1.09, I2 = 47%, $P = 0.12$) [15], tracheal tube obstruction (RR 1.36, 95% CI 0.65 to 2.82, $P = 0.42$) [15], or late complications such as tracheal stenosis, tracheomalacia, tracheocutaneous/esophageal fistula (Risk Difference (RD) 0.01, 95% CI 0.06 to 0.03, $P = 0.51$) [17], thus reserving the ST for patients with an increased risk of presenting a difficult insertion of PT [18].

Among the percutaneous techniques, the assisted ones by FBC or US and the unassisted ones stand out, without significative differences as regards of major complications when comparing the use of assistance versus unassisted techniques (RD 0.00, 95% CI 0.03 to 0.04) [17], but with a decrease in minor complications such as accidental extubation, cuff perforation of the endotracheal tube, and hemorrhage in the case of using FBC [9] and blood vessel puncture in the case of using US [19]; without differences when comparing the use of FBC versus US (pooled RR: 0.48, 95% CI: 0.13–1.71) [20]. Therefore, international guides recommend the use of assisted PT as the surgical technique of choice [7].

The first PT report was done by Shelden in 1955 [21], but this technique wasn't widely accepted until Ciagla described, in 1985, the first dilatational percutaneous tracheostomy [22]. The Ciagla Blue Rhino ST was introduced in 1998 as a modification of the original Cigala procedure described in 1985 [22–23]. Among the diverse techniques of PT, we have opted by Ciagla's because it presents a lower rate of per and post-surgical complications when compared with other techniques (rate ratio 0.62, 95% CI 0.42 to 0.92, $P = 0.02$) [15]. This procedure is performed with assistance of FBC or US, and general anesthesia [24–28]. It also involves a senior consultant, a second medic assigned to the fibro bronchoscopy and anesthesia, a resident and a nurse [28–29], which increments costs and difficult team's coordination to perform the procedure [29–30].

In the clinical practice we observed that, in most of cases, the use of FBC was systematically unnecessary. No doubts related to airway's lesions or intraluminal bleeding in our patients. This information agrees with Jackson, et al. [31] who published a series of 266 patients, in who they didn't find any difference in the complication risk of assisted and unassisted PT.

The development of the Avalos Flowchart of Selection (AFS) has the objective of facilitate the surgeon's decision regarding the tracheostomy technique that must be applied, in function of anatomic and clinical conditions. The first step is based on BMI, neck infection or trauma, and the coagulation status that can increase the general surgical risks. The second step is related to anatomical conditions of the neck that can increase the local surgical risks or the orotracheal reintubation in the case of the procedure's failure.

After the application of AFS in ICU patients and the performance of the PT using the Ciagla technique, no major complications were observed, as cardiac arrest, loss of airways, massive bleeding, pneumothorax, pneumomediastinum, tracheal perforation, or tracheal ring breakage. In regards of the minor complications, we reported a rate of 5.55% (10 patients), eight of them due to bleeding of the surgical wound; they were all resolved with wound exploration and skin suture. Two patients presented with a false tract that required reintubation and percutaneous tracheostomy was achieved at the second attempt. The rate of complications in this series is similar to others PT studies [5,24,31] and even lower [4,28,31]. This can be explained by the fact that in selected patient's potential risks are avoided, being patients with some risk factor derived for the performance of ST or assisted PT, being dealt in this way in a more directed and certain way. The patients' selection with AFS favored the quick performance of PT, without the need for other physicians to assist the procedure and lowering costs.

We believe that the greatest limitation of our study was the lack of a control group, without the application of AFS, for comparison to be done regarding minor and major complications. This study is still a report of our initial results with the application of AFS in ICU patients; more data is being collected to perform longer series. However, our initial results lead to suggest the application of AFS as a tool for senior consultants at the moment of choosing a tracheostomy technique for ICU patients, offering the security of choosing the unassisted PT in well selected patients, with little complications.

## 5. Conclusion

PDT is the most commonly performed procedure in ICU patients receiving mechanical ventilation. It is regularly performed using bronchoscope or US guidance. Based on our results, we believe this procedure may be executed without further assistance in well-selected patients. This selection should be based on anatomy and clinical screening organized by our team in a binary answer flow chart named the Avalos Screening Chart. This preliminary report of our results suggests this flow chart is highly useful and feasible to senior consultant PDT decision making, resulting in both cost savings and improvement in patient care.

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