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Revisão Sistemática

Criteria for tracheostomy decannulation: literature review

Critérios para decanulação da traqueostomia: revisão de literatura

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Keywords

Tracheostomy
Weaning
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Review

ABSTRACT

Purpose: To perform a literature review on the existing international criteria and protocols for tracheostomy decannulation. **Research strategies**: Literature review using the *PubMed* database with the English keywords *"Tracheostomy", "Weaning", "Decannulation", "Removal Tube", "Speech, Language and Hearing Sciences", "Intensive Care Units", "Dysphagia", "Swallowing", "Deglutition" and "Deglutition Disorders* ". **Selection criteria:** Studies published in the last five years (2012 to 2017); studies with human adult population (i.e. ages above 18 years); articles published in English; unrestricted full access articles; and research related to the objectives of the study. **Data analysis**: we analyzed sample characterization; professionals involved in the decannulation process; steps of the decannulation process; total time in days of tracheostomy use; total time in days to complete decannulation process; and failure factors to complete the decannulation process. **Results:** Most of the studies investigated tracheostomy decannulation in a sample of males with neurological impairments. The professionals involved in the decannulation process were doctors, speech therapists, physiotherapists and nurses. The most cited decannulation steps were: swallowing assessment; occlusion training; evaluation of air permeability; ability to manipulate secretion and exchange of cannula; cuff deflation and cough training; use of speech valve. **Conclusion:** Speech therapists are of great help during the decannulation process, since the assessment of swallowing was one of the decisive steps of the investigated studies. The processes of decannulation includes a multidisciplinary approach and should be performed by the cooperation between physicians, physiotherapists and speech therapists.

Descritores

Traqueostomia
Desmame
Deglutição
Fonoaudiologia
Revisão

RESUMO

Objetivo: Realizar um levantamento bibliográfico a respeito da decanulação da traqueostomia para verificar os fatores e protocolos utilizados em estudos internacionais. **Estratégia de pesquisa:** Estudo de revisão de literatura utilizando a base de dados *PubMed* com os descritores em língua inglesa "*Tracheostomy", "Weaning", "Decannulation", "Removal tube", "Speech, Language and Hearing Sciences", "Intensive Care Units", "Dysphagia", "Swallowing", "Deglutition"* e *"Deglutition Disorders"*. **Critérios de seleção:** Estudos publicados nos últimos cinco anos (2012 a 2017), com população acima de 18 anos de idade; pesquisas realizadas somente com seres humanos; artigos publicados em língua inglesa; artigos com acesso completo irrestrito; pesquisas relacionadas aos objetivos do estudo. **Análise dos dados:** foram analisados quanto aos seguintes itens: caracterização da amostra; profissionais envolvidos no processo da decanulação; etapas do processo de decanulação; tempo total em dias de uso da traqueostomia; tempo total em dias para concluir processo de decanulação; fatores de insucesso para conclusão do processo de decanulação. **Resultados:** A maior parte da população estudada foi do gênero masculino e com alterações neurológicas. Dos profissionais envolvidos no processo de decanulação, participaram em ordem decrescente médicos, fonoaudiólogos, fisioterapeutas e enfermeiros. As etapas da decanulação mais citadas foram: avaliação da deglutição; treino de oclusão; avaliação da permeabilidade de passagem do ar; habilidade de manipulação de secreção e troca de cânula; desinsuflação do *cuff* e treino de tosse; uso de válvula de fala. Além disso, obtiveram-se dados a respeito do tempo total de traqueostomia e de decanulação. **Conclusão:** A presença do fonoaudiólogo é extremamente importante no processo de decanulação, visto que a avaliação da deglutição foi a etapa mais citada nos estudos, sendo esse trabalho realizado em conjunto com médicos e fisioterapeutas.

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INTRODUCTION

Invasive mechanical ventilation or assisted ventilation is one of the most common procedures used in intensive care units (ICUs)[1] to treat patients with acute or chronic acute respiratory failure, aiding in gas exchange maintenance, respiratory muscle work, and decreased oxygen use[2]. This assisted ventilation support has reduced the mortality of critically ill patients over the decades, resulting in the conversion of many lethal conditions[3].

However, the prolonged use of invasive mechanical ventilation, specifically the orotracheal intubation (OTI) causes several changes to the individual, such as lesions in the airway mucosa, vocal fold lesions, tracheal dilatation or stenosis, respiratory tract infections, among others[4]. According to the VIII Consensus of the French Society of Intensive Care Medicine[5] and other authors[6-9], patients should undergo tracheostomy if predicted the use of OTI over 21 days[5] and with upper airway obstruction, excess tracheobronchial secretion, and ventilator weaning difficulties[6-9].

Tracheostomy is one of the oldest procedures performed on critically ill patients. The tracheostomy cannula can be put in the patient by surgical or percutaneous dilation. This procedure is to make an opening in the anterior wall of the trachea, allowing the patient to breathe. As observed in OTI, a tracheostomy can cause anatomical changes that will interfere with the physiological process of swallowing. According to the literature, swallowing disorders are observed in 50% to 83% of patients with tracheostomy[10,11]. Changes in the swallowing process due to tracheostomy are not only related to increased risk of laryngotracheal aspiration (saliva or food) but mainly to changes in the pharyngeal phase of swallowing[9,12]. According to the literature, changes in swallowing biomechanics associated with tracheostomy include reduction in laryngeal elevation, resulting in insufficient airway closure, external cuff pressure in the esophagus, causing difficulty in the passage of the food bolus, less subglottic pressure, increased occurrence of stasis in the supraglottic region, reduced cough reflex, decreased airway protection, reduced vocal fold adduction reflex, causing slowness and incoordination in their closure[13].

As observed in patients undergoing OTI, patients with a tracheostomy may have delayed oral feeding introduction[14,15]. The removing process of the tracheostomy cannula is known as decannulation and can be performed in the ICUs and the wards and ambulatories[14]. Several studies reported the importance of the multidisciplinary team's participation in the management of this process, ensuring safer and more effective procedures. The literature highlights the participation of doctors, physiotherapists, speech therapists and nurses among the members who are part of this multidisciplinary team[16-19], with each of these professionals involved in a different step of the decannulation process.

Swallowing and airway permeability assessment, cuff deflation, the adaptation of speech valve and occlusion training of the tracheostomy cannula are described in the literature as part of the decannulation process[11,14,19-21]. However, in general, there is no consensus in the description of these steps in the literature[22].

Objective

This study aimed to analyze the literature and verify the tracheostomy decannulation protocols used in international studies, observing the professionals involved, and describing the steps of this process.

Strategy and research

The procedures described in this study did not go through the process of submission or assessment of the Research Ethics Committee of the institution due to its methodological character as a literature review study.

The precepts of the Cochrane HANDBOOK for Systematic Reviews of Interventions[23] were followed to establish the research method. The articles used in this study were selected through the PubMed database, using the descriptors "Tracheostomy", "Weaning", "Decannulation", "Removal tube", "Speech, Language and Hearing Sciences", "Intensive Care Units", "Dysphagia", "Swallowing", "Deglutition" and "Deglutition Disorders", limited to articles in English, published between January 2012 and December 2017.

Three researchers searched the database independently to minimize possible loss of citations. The texts effectively related to the research proposal were analyzed. The researchers conducted all the research steps independently.

Selection criteria

The articles included described the steps of decannulation of adult patients who had a tracheostomy, or described the professionals involved in the process. Articles in English were excluded, as well as those that did not allow access to the full text and those repeated by superposition of the keywords. The texts excluded referred to literature reviews, letters to the editor, and texts that were not directly related to the theme. When there was disagreement among the researchers, only texts in which the final position was consensual were included.

Data analyses

The selected articles analyzed sample characterization (age, gender and base disturbance of the participants); professionals involved in the decannulation process; steps of the decannulation process; total time in days of tracheostomy use; total time in days to complete decannulation process; and failure factors to complete the decannulation process.

RESULTS

The research had a total of 778 articles published between 2012 and 2017. After removing the duplicate articles, the total number went down to 537 articles. After applying the inclusion

and exclusion criteria, we selected 24 articles for analysis (Figure 1).

We observed the main results found in the studies of this literature review regarding the characterization of the sample, such as mean age, gender, presence of control group and professionals involved (Table 1).

Two studies showed the participation of occupational therapists in the process of decannulation, and two studies showed the participation of psychologists[18,25] among the professionals[17,25]. Only one study reported coordinators or professionals of rehabilitation[17,25,30,33]. From the medical area, there was one specialist in head and neck surgery, trauma surgeons, pulmonologists, anesthesiologists, otolaryngologists, intensive care doctor, neurologist, thoracic surgeon, and physiatrist. Three of the studies used medical records as a way of collecting data, and one study did not mention the members of the team.

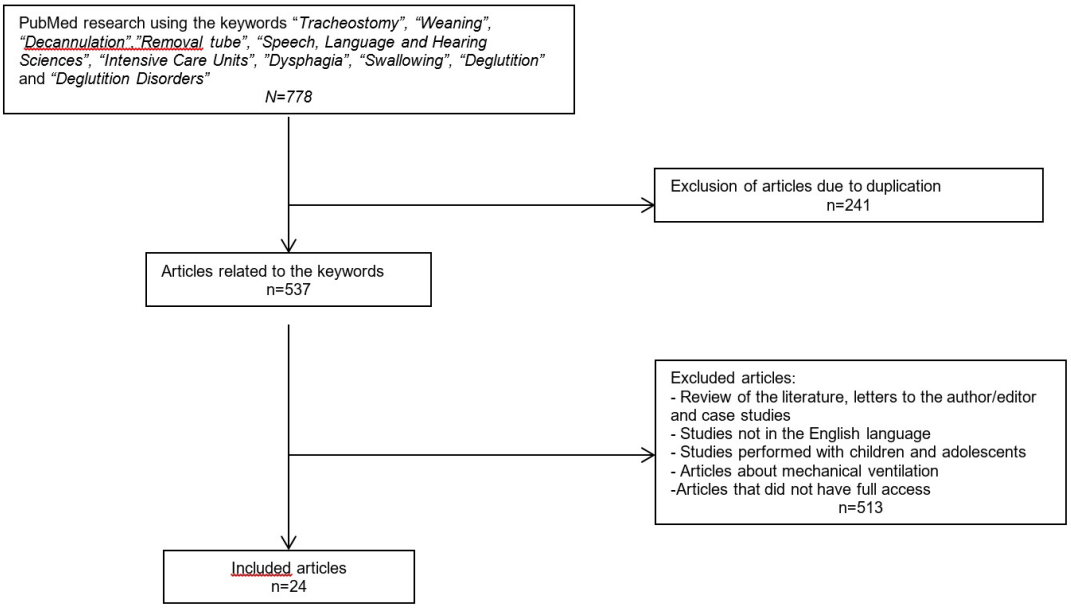

Figure 1. Selection of articles included in the research; n: number of articles

Table 1. Main results in the articles related to sample characterization

Articles	Age	Gender		Professionals			
		Female	Male	Doctor	Physiotherapist	Speech therapist	Nursing
Luo et al.[24]	44.57	4	17				X
Berney et al.[25]	47	15	29	X	X	X	X
Pandian et al.[20]	58.07	18	39	X	X	X	X
Warnecke et al.[26]	56.4	45	55	X		X	
Hernández et al.[27]	54.5	43	108	X	X	X	
Pryor et al.[15]	53	44	82	X		X	X
Cohen et al.[22]	61.6	18	31	X		X	
Mah et al.[19]	55.1	144	249		X	X	X
Zanata et al.[9]	32.1	10	50			X	
Mathur et al.[28]	22.67	12	18	X			
Kim et al.[29]	47.6	7	55	-	-	-	-
Mitton et al.[30]	52	41	65	X	X	X	X
Welton et al.[16]	61	23	21	X	X	X	X
Pasqua et al.[31]	64	21	27	-	-	-	-
Zanata et al.[21]	53	4	16	X		X	
Thomas et al.[17]	71.4	36	86	X	X	X	
Tawfik et al.[32]	48	57	38	-	-	-	-
Nakashima et al.[33]	44.9	22	142	X			
Terra et al.[34]	37.8	33	59	X	X		
Schneider et al.[35]	61.4	22	31	X		X	X
Bianchi et al.[11]	75	24	27	X		X	X
Shrestha et al.[36]	36	20	98	X	X	X	-
Budweiser et al.[37]	70	46	120	-	-	-	-
Gundogdu et al.[18]	29.2	7	28	X	X	X	X
Mean/Percentage	51.5	29.8	62.1	70.8%	41.6%	66.6%	41.6%

Caption: Age (mean age of participants); Gender (exact number per gender)

Baseline disturbances data were also listed in the populations of each article (Table 2). Some studies did not have present data because the authors selected all patients able to the decannulation process at the institution. The data cited in the table also included patients with abdominal and sepsis disease[27] and from the service of medications and physical/rehabilitation medicine[20].

The spinal cord injury[24,29], head trauma[9,21,36], supratentorial and infratentorial injuries[30], vascular trauma[35], and cervical injury[18,33] were among the most frequent neurological changes.

Among the steps of the decannulation process, this literature review found procedures of cuff deflation; occlusion training, replacement of tracheostomy cannula, cough training, mobilization of secretion, assessment of airway permeability and swallowing and use of speech valve in most of the articles (Table 3). Six articles did not describe the protocol used for decannulation[15,17,28,29,32,34].

We also found that 14 articles used objective examinations in the decannulation process, having five studies using nasolaringofibroscopia[11,18,20,22,31], four using broncoscopia[20,27,28,35], two using tomography[18,36] and three studies using swallowing videoendoscopy[15,18,26]. The use of the pulmonar[29] and manometry[31] function tests were less observed.

Eighteen articles reported data on the time of decannulation (process time) and the total time of tracheostomy (placement up to decannulation) (Table 4).

The factors that led to failure in the decannulation process were difficulty in expectorating or increased secretion, presence of tracheal stenosis and pulmonary infection, and these three factors were the most present in the studies (Chart 1).

Table 2. Population-based disorders of each selected study

Articles	Neurology			Head and neck	Trauma	Cardiology	Oncology	Pulmonary disease	Burned	Surgery	AW change	General medicine
	CNS	PNS	Geral									
Luo et al.[24]		X										
Berney et al.[25]	X	X										
Pandian et al.[20]			X	X		X	X			X		
Warnecke et al.[26]			X									
Hernández et al.[27]	X				X	X		X		X		
Pryor et al.[15]		X	X	X		X			X	X		X
Cohen et al.[22]	-	-	-	-	-	-	-	-	-	-	-	-
Mah et al.[19]			X		X	X				X		X
Zanata et al.[9]	X											
Mathur et al.[28]	-	-	-	-	-	-	-	-	-	-	-	-
Kim et al.[29]		X										
Mitton et al.[30]	X											
Welton et al.[16]										X		
Pasqua et al.[31]						X		X		X		
Zanata et al.[21]	X											
Thomas et al.[17]		X										X
Tawfik et al.[32]							X				X	
Nakashima et al.[33]		X										
Terra et al.[34]											X	
Schneider et al.[35]	X											
Bianchi et al.[11]	X	X									X	
Shrestha et al.[36]	X											
Budweiser et al.[37]								X				X
Gundogdu et al.[18]		X										
Percentage	36.3%	31.8%	18.1%	9.0%	9.0%	22.7%	9.0%	13.6%	4.5%	21.2%	13.6%	13.6%

Caption: CNS: central nervous system; PNS: peripheral nervous system; AW: airways

Table 3. Decannulation process steps

Articles	Cuff deflation	Occlusion Training	Air passage permeability	Swallowing Assessment	Mobilization of secretion	Cough Training	Speech valve	TCT cannula exchange
Luo et al.[24]		X		X		X		X
Berney et al.[25]		X	X			X	X	X
Pandian et al.[20]	X	X			X		X	

Caption: TCT: tracheostomy

Table 3. Continued...

Articles	Cuff deflation	Occlusion Training	Air passage permeability	Swallowing Assessment	Mobilization of secretion	Cough Training	Speech valve	TCT cannula exchange
Warnecke et al.[26]				X	X			
Hernández et al.[27]	X	X	X	X	X			X
Pryor et al.[15]	X			X				
Cohen et al.[22]			X	X				
Mah et al.[19]				X			X	X
Zanata et al.[9]	X	X						X
Mathur et al.[28]	-	-	-	-	-	-	-	-
Kim et al.[29]		X		X				
Mitton et al.[30]							X	
Welton et al.[16]	X	X	X				X	X
Pasqua et al.[31]		X	X	X	X	X		X
Zanata et al.[21]	X	X	X	X	X	X		
Thomas et al.[17]	-	-	-	X	-	-	-	-
Tawfik et al.[32]	-	-	-	-	-	-	-	-
Nakashima et al.[33]			X	X	X			
Terra et al.[34]	-	-	-	-	-	-	-	-
Schneider et al.[35]			X	X	X			
Bianchi et al.[11]	X	X		X		X		X
Shrestha et al.[36]				X	X	X		
Budweiser et al.[37]			X		X	X		
Gundogdu et al.[18]	X	X	X	X	X	X		X
Porcentagem	40%	55%	50%	75%	50%	40%	25%	50%

Caption: TCT: tracheostomy

Table 4. Total tracheostomy use time and decannulation process time (in days)

Articles	Total TCT Time	Decannulation time
Luo et al.[24]	40	18.8
Berney et al.[25]	24.65	9.9
Pandian et al.[20]	16	-
Warnecke et al.[26]	21	10.5
Hernández et al.[27]	-	15
Pryor et al.[15]	20	7.0
Cohen et al.[22]	21.3	-
Mah et al.[19]	-	7.0
Zanata et al.[9]	-	59
Mathur et al.[28]	16.6	26.5
Kim et al.[29]	91.61	-
Mitton et al.[30]	28	-
Welton et al.[16]	59	12
Pasqua et al.[31]	-	45.9
Zanata et al.[21]	-	74
Thomas et al.[17]	31.3	17.66
Tawfik et al.[32]	31	-
Nakashima et al.[33]	61.5	16.9
Mean	35.5	24.6

Caption: TCT: tracheostomy

Chart 1. Failure factors to complete the decannulation process

Articles	Failure Factors
Luo et al.[24]	Sputum difficulty/increased secretion; pulmonary infection; prolonged mechanical ventilation; late tracheostomy.
Berney et al.[25]	Pulmonary infection and facial trauma.
Pandian et al.[20]	Sputum difficulty/increased secretion; prolonged mechanical ventilation; longer tracheostomy use.
Warnecke et al.[26]	Silent aspiration of saliva; dysphagia; cough.
Hernández et al.[27]	Sputum difficulty/increased secretion; prolonged mechanical ventilation; dysphagia; elderly population.
Pryor et al.[15]	Burned.
Cohen et al.[22]	Stenosis.
Mah et al.[19]	-
Zanata et al.[9]	-
Mathur et al.[28]	Longer use of tracheostomy and stenosis.
Kim et al.[29]	-
Mitton et al.[30]	Sputum difficulty/increased secretion and dysphagia.
Welton et al.[16]	-
Pasqua et al.[31]	Pulmonary infection and longer tracheostomy use.
Zanata et al.[21]	Sputum difficulty/increased secretion; Silent aspiration of saliva and cough.
Thomas et al.[17]	-
Tawfik et al.[32]	Stenosis.
Nakashima et al.[33]	-
Terra et al.[34]	Stenosis.
Schneider et al.[35]	Pulmonary infection and elderly population.
Bianchi et al.[11]	-
Shrestha et al.[36]	Cough.
Budweiser et al.[37]	Elderly population.
Gundogdu et al.[18]	Stenosis.

-: studies that did not analyze the failure factors of the decannulation process

DISCUSSION

This review of the 24 articles analyzed found several variables of participants – between 20[9] and 393[19] individuals; mean age - wide variation between 23[28] and 71 years old[17]. In most studies, the age ranged from 45 to 60 years old; male gender prevalence; neurological diseases prevalence; central nervous system (CNS) diseases appeared in 36.3% of the studies, peripheral nervous system diseases (PNS) appeared in 31.8%, and other unspecified neurological alterations appeared in 18.1%.

Doctors and speech therapists, physicians, and speech therapists were the most indicated among the professionals involved in the decannulation process, with percentages of 70.8% and 66.6%, respectively. Seventeen of the 24 studies analyzed cited more than one professional participating in this process, being doctors, speech therapists, physiotherapists, and nurses. One study compared groups of patients with tracheostomy pre and post-intervention by a multidisciplinary team, analyzing the time of weaning of mechanical ventilation (MV), exchange of tracheostomy cannula and referral time for speech-language pathology assessment. We conclude that the participation of a multidisciplinary team in the treatment of these patients could improve the quality and efficacy of care[16].

The articles analyzed described some criteria that should be presented by patients to ensure the success of decannulation. Such criteria are no dependence on humidifiers[24] and mechanical ventilation; prior assessment of swallowing (ensuring that there is no risk for aspiration)[9,22,24,26,31]; at least eight points in the Coma Glasgow scale[9,27]; stability of cardiac frequency[22,27] with less than 140 beats/minute; non-dependence on vasoactive drugs; temperature below 38 °C[27]; spontaneous cough reflex[22,27,31]; the ability to manage secretions[15]; tracheostomy for at least seven days; respiratory rate below 20 cycles/minute[22]; oxygen saturation above 90% in air environment[9,22]; alert and collaborative level of consciousness. The study by Pasqua et al.[31] showed that 100% of the patients who had all these criteria had a successful decannulation, while only 10% among the patients who did not have any of these criteria completed the process successfully.

In the procedures performed during the decannulation process, two steps are considered primordial for the initiation of this process, being cuff deflation and assessment of the permeability of the airways[27]. According to the data described in Table 3, eight of 24 studies analyzed cited the process of manipulation of the cuff or balloon as the main item in the decannulation process. The study by Gundogdu et al.[18] described that all participants who underwent cuff deflation training associated with inspiratory muscle training had more success in decannulation. According to the literature, the association between cuff deflation training, swallowing and cough stimulation techniques has efficiently reduced the decannulation time[11].

The analyzed literature described that in the presence of the cuff during the decannulation process, the cuff should deflate for as long as possible, considering the tolerance, the need for ventilation and the amount of secretion of the patient[15,25]. This step of the process should be initiated early to avoid possible loss of the sensitivity of the oropharynx[25]. The results of this

review point out that the stable patients, who remain comfortable with the cuff inflated already in the first attempt, should remain continuously[15]. The literature also points out that the cuff should remain inflated only in cases where tracheal aspiration is necessary four times or more in the period of 8 hours[27]. Thus, the process of cuff deflation was described in 40% of the articles analyzed, since some authors consider this step as the step before the decannulation process.

After the cuff deflation, the literature indicates the need to assess airway permeability; that is, the verification of air passage through the vocal folds to the upper airways. Studies indicated that in this step, the tracheostomy should be occluded (finger, speech valve or syringe plunger)[25] for a period of up to five minutes[27]. During this period, the patient should have the vital signs monitored (heart and respiratory rates, blood pressure and oxygen saturation) since the alteration of these signs suggests airway obstruction.

The description of the tracheostomy occlusion training was not uniform in the studies analyzed. The options found for this training were to remain 48 hours with tracheostomy occluded[9,25,31]; to remain 24 hours with the tracheostomy occluded[16,20,27] and, in case of discomfort, to opt for a more conservative approach, performing the following sequence: 12 hours occlusive, 12 hours non-occlusive and new attempt to remain 24 hours with occlusive tracheostomy[20].

Studies that did not report the training of tracheostomy occlusion as a step of the decannulation process performed the decannulation based on the results of the deglutition assessment[26] and the permeability of the airways[22], or did not describe the process in details[15,19,30]. Regarding the use of the speech valve (25% of the articles) and the exchange of the tracheostomy cannula (50% of the articles) during the decannulation process, five articles described the use of the valve for occlusion training of the traqueosthomy[16,19,20,25,30] and nine articles described the exchange of tracheostomy cannula as a step before the training of occlusion (exchange for a cannula of smaller caliber[16,19,24,27]; exchange for fenestrated cannula or without cuff[25]; exchange for metal cannula[9].

For patients who have changes of vital signs during the occlusion step of the tracheostomy, we suggest and objective examination such as bronchoscopy[27], to confirm airway obstruction. In this review, seven studies used the broncoschopy[20,27,28,31,32,34,35] and three studies used the laringoscopy[20,22,34] to confirm the presence of airway obstruction. One of the studies analyzed here, whose objective was to evaluate individuals able to do decannulation through bronchoscopy found that there was no correlation between the success of decannulation and the findings of this examination (characteristics of tracheostomy, inflammation, infection, granulations, ulcerations, among others)[28].

In this sense, the authors concluded that limiting the decannulation procedure to an airway permeability examination is not the most appropriate method to ensure the success of decannulation. Thus, the objective exams used to verify the presence of changes, such as tracheal stenosis or granulomas (fibroscopy, bronchoscopy, etc.)[31,34] should be part of the decannulation process and not be determinant in this process.

According to Hernández et al.[27], after performing the previous steps, it is suggested the assessment of the patient's ability to protect the lower airways, avoiding a possible bronchoaspiration. This assessment is performed through swallowing assessment. In this review, 75% of the analyzed articles performed some swallowing assessment during the decannulation process. To verify the risk of bronchoaspiration during swallowing, the studies analyzed the use of the following procedures: blue dye test[31], modified blue dye test[26], clinical assessment[9,15,17,18,27,36], objective assessment (Videodeglutogram and swallowing videoendoscopy)[11,15,17,18,26,29,31,35]. In three of the analyzed articles, although the authors cited the importance of swallowing assessment, they did not describe how it was held[19,22,24].

The methodology applied for the clinical assessment of swallowing varied considerably in the studies, with no consensus regarding the best protocol/procedure. The main procedures used were: supply of 50 ml of water with the deflated cuff[27]; assessment based on the Frazier Free water Protocol, with free demand water supply, regardless of whether the cuff is deflated or not[15]; supply of 200 ml of water and thickened water in the consistency of pudding with a deflated cuff, and the thickened water offered in the volumes of 5 ml, 10 ml and free demand[9]; assessment of the patient's ability to swallow secretion, cough efficiency and quantification of aspirated secretion of the tracheostomy[26].

Two exams for the objective assessment of swallowing were performed: Videodeglutogram and swallowing videoendoscopy. As observed for the clinical assessment of swallowing, there was no consensus regarding the items evaluated in the objective exams described in the analyzed studies. Each study described the protocol used in the institution in which the data were collected. For the swallowing videoendoscopy, there were the following items: the presence of massive aspiration or saliva silent; the efficiency of spontaneous swallowing of saliva per minute; the assessment of oropharyngeal sensitivity and the presence of cough reflex; the observation of swallowing events after offering a teaspoon of water and mashed potatoes[26]. The videodeglutogram was performed with the supply of fine and semi-solid liquids[29], in different volumes and quantities.

Another step involved in the decannulation process described in ten of the analyzed articles was the assessment of the patient's ability to manage secretions[27] and expel them through the oropharynx through cough[20]. This assessment step was conducted in studies by physiotherapists[27] and speech therapists[26], and efficiency of the cough[22,26], quantity[26] and quality of secretion and frequency of the need for aspiration of the tracheostomy[27] were observed. According to Hernández et al.[27], one of the criteria that should be considered for a successful decannulation is the need for tracheostomy aspiration, which should not exceed the maximum of two times in the interval of 8 hours.

For patients who cannot pass this step, eight of the studies suggested cough training. Assessment of this step indicated the need to perform cough training in some patients. This training appeared in eight studies, and the cough was manually assisted was one of the techniques used[24].

The sufficient performance of the respiratory musculature and the consequent efficacy of cough, the normal airway

permeability, and the absence of dysphagia facilitated the process of removal of the cannula in most cases[31]. The last step of the decannulation process is the permanence of the occluded tracheostomy. According to Zanata et al.[21], during tube occlusion, the patient should be able to breathe spontaneously and sufficiently through the upper airway, maintaining stable oxygen saturation.

Considering the time of tracheostomy used, there was a variation between 16 and 91 days in the literature, and the decannulation process was performed in seven to 74 days. According to Thomas et al.[17], the underlying disease has a direct impact on decannulation time. According to the literature, the site of brain injury (CNS or SNP) has a direct impact on the meantime of decannulation, which is lower in patients with neurological central diseases[11,18,24]. The study that presented the longest time in the decannulation process (74 days) was performed in patients with ischemic stroke[35].

Finally, the studies point out the following factors as negative for the decannulation process: male individuals[27,28], presence of facial traumas[25], patients with burns[15], bronchopneumonia[25], increased secretion[20], use of mechanical ventilation for a prolonged time[20], silent saliva aspiration[26], absence of saliva swallowing[26], alteration in laryngeal sensitivity[26], inefficient cough[26], age above 60 years old[27], frequent need for aspiration of tracheostomy[20,27,30], presence of tracheal stenosis[22], prolonged time of use of the tracheostomy[20,28], presence of dysphagia[30], low pH and high PaO_2[31].

CONCLUSION

This literature review concludes that:

- The most present professionals in the decannulation process are doctors and speech therapists, with also relevance participation of physiotherapists and nurses;
- The indicative factors of success in the decannulation process are clinical and hemodynamic stability, level of alert consciousness and collaborative patient, no need for mechanical ventilation, no dependence on humidification, good secretions management and absence of bronchoaspiration;
- The most important steps in the decannulation process were cuff deflation; airway permeability, swallowing assessment, secretions management, and tracheostomy occlusion training;
- The assessment of swallowing was the step of the decannulation process most cited in the articles analyzed, evidencing the importance of the professional speech therapist in this process.

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Author contributions

CLS and GM participated in the data collection, analysis, writing, and review of the article; FCS, GCM, and CRFA had the project guidance, writing, and review of the article.