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Dysphagic Patients with Tracheotomies: A Multidisciplinary Approach to Treatment and Decannulation Management

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Abstract. In 2000 a multidisciplinary protocol for weaning dysphagic patients from the tracheotomy tube and a decannulation decision chart created according to principles of the F.O.T.T.® Concept (Face and Oral Tract Therapy) were introduced in the Swiss Neurological Rehabilitation Centre REHAB in Basel. In the present study we introduce these guidelines and present an evaluation of the treatment and decannulation procedure. We retrospectively compared data from patients before and after introduction of the multidisciplinary procedure with regard to mean cannulation times and success of decannulation. Furthermore, we analyzed the rehabilitation progress of the group who underwent multidisciplinary treatment as well as the participation of the speech language therapist. The results show that the treatment introduced to improve swallowing functions and wean patients from the tracheotomy tube led to a fast and safe decannulation of our patients. The mean length of cannulation time was reduced significantly. After decannulation the patients showed clear functional improvements. Interdisciplinary treatment using the approach discussed in this study can be considered efficient and an important basis for further functional progress in the rehabilitation process.

Key words: Deglutition — Deglutition disorders — Tracheotomy — Decannulation management — Multidisciplinary approach — Face and Oral Tract Therapy.

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The treatment of a patient with severe neurogenic dysphagia and a tracheotomy becomes more important in neurologic rehabilitation. However, to our knowledge, only a few studies delineate criteria and decision charts to follow for the safe and fast decannulation of patients with severe dysphagia and describe treatment procedures for weaning dysphagic patients from the tracheotomy tube in detail. Furthermore, there seems to be only little written on and general consensus about these aspects of therapeutic intervention. In the present study, a multidisciplinary swallowing and weaning protocol and a decannulation decision chart that uses the principles of the F.O.T.T.® (Face and Oral Tract Therapy) Concept [1,2] are introduced. One part of the F.O.T.T. concept is a swallowing intervention approach that integrates the modification of tonus, posture, movement, and function by application of treatment principles developed via the empirical work of therapists, principally Berta Bobath. It is based on current knowledge about neurophysiology and learning theory. After a short summary of the theoretical background and the details of our approach, we present data from a preliminary study that evaluated the efficiency of the treatment. We retrospectively analyzed two groups of tracheotomized patients with severe dysphagia three years before and three years after introduction of the new protocol in our hospital. In addition, data concerning the functional rehabilitation progress of the group who underwent the multidisciplinary treatment and the duration of swallowing and weaning intervention are presented. The objective of this study was to motivate further discussion and scientific exchange about treatment procedures and decannulation decision charts for tracheotomized dysphagic patients.

The main indications for tracheotomy and application of a tracheotomy tube are respiratory dysfunctions or severe dysphagia with high incidence of saliva aspiration [3]. While patients with tracheotomies because of respiratory problems can often be supplied with uncuffed, fenestrated tubes and speaking valves, this is usually no option for dysphagic patients. In this group, unfenestrated tubes with inflated cuffs are applied to prevent aspirated material from entering the deeper respiratory tract and causing severe pulmonal complications.

Although cuffed tracheotomy tubes have a life-preserving function, there are several studies showing their negative effects on swallowing and communication. The question whether the tracheotomy tube itself is a factor for increased aspiration has been discussed controversially in the research literature. It was argued, for example, that the inflated cuff might have an anchoring effect on the trachea by decreasing the elevation and anterior rotation of the larynx [4–6], or that the lack of respiratory airflow through the upper airway causes a gradual decrease in abductor vocal fold activity [7]. In contrast, other studies found no direct effect of the inflated cuff on the aspiration risk for dysphagic patients [8]. Some authors suggested the addition of a one-way valve to the deflated tracheotomy tube [9–11] or digital occlusion of the tube to reduce the incidence of aspiration [12,13]. Again, other studies could not confirm that these interventions had a significant effect on the incidence of aspiration in tracheotomized individuals [14,15]. Undoubtedly, the occlusion of the deflated tube has positive effects. The expiratory airflow can find its physiologic way through the upper airway and improvement may be achieved in the reinstatement of laryngeal adductor and abductor reflexes [16], regulation and better clearing of upper airway secretions [17–19], olfactory sensation [17], and improved ability for efficient coughing and verbal communication [15,20]. Considering that long-term tracheotomies and especially inflated tracheotomy tubes can lead to severe complications such as stenoses and tracheomalacias [21–23], it is obvious that the main focus of the multidisciplinary team should be a fast and secure weaning from the tracheotomy tube and subsequent decannulation as soon as possible.

In the research literature descriptions about weaning procedures, decision charts, and decannulation protocols focus mainly on patients with tracheotomies due to respiratory indications [24,25]. Only a few studies report details about these procedures for dysphagic patients with tracheotomy tubes. In an early study, Greenbaum [26] suggested that a patient is ready for decannulation when he/she is weaned from mechanical ventilation, protective reflexes are intact, coughing is effective, and 24 h of cuff deflation is tolerated even during mealtimes. Decannulation criteria for neurologic and neurosurgical patients were defined by Ladyshewsky and Gousseau [27] as follows: a fenestrated tracheotomy tube is *in situ*, intact gag reflex and strong spontaneous cough, the ability to swallow saliva as assessed by a speech pathologist, oxygen saturation above 90%, and arterial blood gases within normal limits within 24 h. Ross et al. [28] described criteria for the decannulation of patients with spinal cord injuries, including an assessment of patency of the upper airway, cough effectiveness, and the ability to protect the airway from saliva. The authors showed that with a multidisciplinary and closely monitored decannulation protocol, decannulations of four aspirating patients with long-term tracheotomies were successful after risks of premature decannulation were carefully compared against those of prolonged tracheotomy. Lipp and Schlaegel [29] introduced a weaning and decannulation protocol adapted from the F.O.T.T. concept, used in the Burgau Neurological Treatment Centre, Germany. In the weaning phase, the tracheal tube is deflated in increasing intervals. In a second step, the patient is supplied with a cuffless fenestrated tube that is capped in therapy sessions for stimulation of physiologic respiration through the upper airway and swallowing and coughing functions. After successful completion of the weaning phase, patients are decannulated temporarily, and after rhinolaryngoscopic examination, permanent decannulation follows.

Tracheotomy: Management in the REHAB Basel

The REHAB Basel, Switzerland, is a private rehabilitation center specializing in the treatment of paraplegic and severely brain-damaged patients. In 2000, binding written guidelines for weaning from a tracheotomy tube, a decannulation decision chart, and a protocol for decannulation were established. The bases for these guidelines were principles suggested by the F.O.T.T. Concept (Face and Oral Tract Therapy) [2] based on the Bobath Therapy Concept [30]. Tracheotomized dysphagic patients in our hospital usually have a dilatational tracheotomy and a tracheotomy tube with an inflated cuff because of severe deglutition disorders. Speech-language pathologists have the main responsibility for the treatment of these patients and dysphagia intervention begins on the day of admission. A main component of the swallowing

Table 1. Protocol for cuff deflation and stimulation of upper airway respiration, swallowing, coughing, voicing, and communication in the REHAB Basel

Nurse and speech pathologist:
1. Positioning of the patient (sitting up or lying on the side)
2. Cleaning of the oral tract
3. Pulse oximetry during the cuff-deflation interval
4. If necessary, suctioning of the mouth, nasopharyngeal tract, and within the tracheal tube
5. Introduction of the suctioning catheter into the tube without suction so that the end of the catheter remains just below the end of the tube (nurse)
6. Cuff deflation during an expiration phase of the patient (speech pathologist)
7. Suctioning of secretions that are in danger of running from the cuff into the trachea after cuff-deflation. Avoidance of irritation for the patient (nurse)
8. Occlusion of the tube either digitally or with a tube cap or one-way valve, first only in expiration phases then in inspiration phases. Duration: a few breaths up to 20 min or more (speech pathologist)
9. Stimulation of swallowing, voicing, coughing, and throat clearing to improve management of secretions. Application of olfactory and gustatory stimulations (speech pathologist)
10. Stimulation and support of verbal communication between patient, therapist, and the patient's family (speech pathologist/nurse)
11. Documentation of the cuff-deflation interval (speech pathologist/nurse)

treatment with tracheotomized patients is the process of cuff deflation and stimulation of swallowing and coughing functions while the cuff is deflated (Table 1). By applying swallowing and coughing stimulation techniques to the dysphagic individual during a cuff-deflation interval, an anchoring effect of the inflated cuff on the larynx can be avoided and the expiratory airflow through the upper airway can be used to improve the ability to cough and swallow [15–20]. During intervention the speech therapist supports physiologic respiration via the upper airway, stimulates the respiratory muscles and thorax movements if necessary, and trains the patient the techniques of safe swallowing and effective coughing [2]. Multimodal olfactory and gustatory stimulation is often used during the deflation intervals as well. If the patient tolerates the deflation and intervention procedures, the cuff-deflation intervals are extended day by day until a minimum of 20 min of cuff deflation, capping (digitally or with a one-way valve), and swallowing and coughing intervention are possible. By combining cuff-deflation phases and swallowing therapy, it is possible to wean the patient from the tracheotomy tube and intervene to reinstate swallowing functions and protective reflexes simultaneously. We observed that most patients benefit very much from the sensation of the expiratory airflow through the larynx and upper airways during cuff deflation. Most individuals begin with swallowing and throat-clearing immediately after cuff deflation takes place. If improvements are seen during the continuous weaning and swallowing therapy, the multidisciplinary team (nurse, speech therapist, and physician) discusses the indications for decannulation. The specific criteria for readiness for decannulation used by the speech pathologist, nurse, and physician responsible for the tracheotomized individual are shown in Table 2. If necessary the patient's swallowing ability is evaluated by fiberoptic endoscopic evaluation of swallowing (FEES) [31].

If the patient meets the criteria, decannulation is conducted on the following day, early in the morning, without intermediate steps like downsizing or using fenestrated tubes. After decannulation, the patient is placed on continuous pulse oximetry and checked in short intervals for a minimum of 12 h. If necessary, the speech pathologist and physiotherapist support the patient's saliva management by frequent stimulation of the swallowing and breathing activity and positioning the patient so that the pooled saliva can drool.

The multidisciplinary weaning and treatment protocol described above offered us the opportunity to define the duties and responsibilities of every team member working with a tracheotomized individual and to use synergy effects of the activities of the therapeutic and nursing team members. Before the introduction of this approach, cuff-deflation intervals and swallowing interventions were coordinated rather unsystematically; the new weaning protocol makes use of the synergy effects of these procedures as described above and assigns clear responsibilities to every team member. Thus, the procedures and their effects became much more transparent to every team member and, thus, better efficiency in intervention time and costs were observed. After using the new protocol for three years, we aimed to evaluate this efficiency by a systematic analysis.

Table 2. Multidisciplinary decision chart for evaluating readiness for decannulation used in the REHAB Basel

Speech Pathologist:
1. Patient can be positioned upright, on the side, or in prone position so that saliva can be swallowed or let drool
2. Cleaning of oral tract and teeth is possible
3. During cuff deflation intervals, only minimal secretions from above the cuff have to be suctioned
4. During cuff-deflation and tube-occlusion intervals, the patient can breathe spontaneously and sufficiently through the upper airway for a minimum of 20 min with sufficient and stable oxygen saturation (minimum 95% ± 5%)
5. Patient can swallow his secretions spontaneously or with light stimulation
6. Efficient spontaneous coughing with subsequent swallowing
7. Improved vigilance
8. Exclusion of reflux and frequent vomiting
9. If necessary, fiberoptic endoscopic evaluation of swallowing (FEES)
Nurse (in addition to speech pathologist's criteria):
1. Decreasing need for tracheal suctioning
2. Secretions are liquid and whitish
3. Patient tolerates a mask for respiratory assistance if necessary
4. Positioning to support respiration and secretion management is possible
5. No anesthesia/operations planned for the following week
Physician (in addition to speech pathologist's and nurse's criteria):
1. No acute pulmonary complications, no atelectasis
2. If necessary, evaluation of patency of the upper airway
3. Evaluation of further specific medical contraindications

Evaluation of the Multidisciplinary Tracheotomy Management

In a retrospective study, we evaluated the efficiency of the multidisciplinary protocol with regard to saving time, complication rate, and functional improvement of the tracheotomized individuals. We defined the following research questions:

1. Has the introduction of the multidisciplinary approach led to a reduction in the mean duration of cannulation?
2. Have decannulations been successful?
3. How has the development of functional rehabilitation of the individuals treated with the multidisciplinary approach progressed?
4. If a decreased duration of cannulation time is shown, can this effect be attributed to the multidisciplinary approach or rather to mechanisms of general functional improvement in the rehabilitation process?
5. How much time does it take to wean a patient from the tracheotomy tube in relation to the total duration of speech therapy?

Materials and Methods

Participants

To evaluate the effects of our new treatment protocol, we chose to analyze data from tracheotomized patients admitted to the REHAB Basel in 2003. At this time we had been using our protocol for three years and it was considered to be established and well-known by all team members. Because we wanted to compare our findings with data from a patient group who had not undergone this systematic treatment, we chose to analyze data from patients tracheotomized in 1997, when our systematic multidisciplinary approach had not yet been established. Thus, patient populations three years before and three years after introduction of the multidisciplinary approach were included. Inclusion criteria were tracheotomy due to severe dysphagia and high incidence of saliva aspiration, a cuffed tracheotomy tube in place, and dysphagia as assessed by a speech therapist. The dysphagia assessment included an evaluation of basic oral sensory and motor functions, type and appropriateness of the tracheotomy tube, spontaneous and assisted swallowing, protective reflexes and an aspiration rating related to the amount of secretions suctioned from above the cuff.

Group 1 comprised all 35 tracheotomized patients admitted to the REHAB Basel in 2003, seven of whom were in a persistent vegetative state and one was in a minimally conscious state. In 1997, 13 tracheotomized patients were admitted to the REHAB Basel. One patient was excluded from the study because he was admitted to our hospital two years after tracheotomy and confounding influences from other kinds of intervention could not be excluded. Group 2 therefore comprised 12 patients with 4 patients in a persistent vegetative state. None of the patients in our study received oral nutrition until decannulation and all patients were fed via a percutaneous gastrostomy tube or a jejunostomy tube.

Measures

To evaluate the functional rehabilitation progress of our patients, we used the FIM assessment (Functional Independence Measure) [32]. The FIM is a 7-level assessment tool containing 18 items designed to assess the amount of assistance a person needs to perform basic life activities related to self-care, sphincter control, transfers, locomotion, communication, and social cognition. By adding the points for each item, a score that can range from 18 (lowest) to 126 (highest) shows the level of functional independence of the individual. According to Streppel et al. [33,34], a difference of 13

Table 3. Comparison of the data samples of two groups of tracheotomized patients in the REHAB Basel

Parameter	Group 1 (2003) ($n = 35$)	Group 2 (1997) ($n = 12$)	Comparison
Medical classification			Fischer's exact (two-tailed)
traumatic	$n = 17$	$n = 8$	$p > 0.05$
vascular	$n = 18$	$n = 4$	$p > 0.05$
Age (mean/SD)	47.29 (17.53)	35.53 (14.81)	$T = -2.08$, df $= 45$ $p < 0.05$*
FIM[a] scores(mean/SD/median)			
(1) admission	20.54 (5.43; 18)	18.17 (0.58; 18)	$U = 146.0$, $p > 0.05$
(2) decannulation	21.64 (5.64; 19)	22.0 (12.94; 18)	$U = 116.5$, $p > 0.05$
(3) discharge	59.91 (42.84; 42)	42.08 (33.42; 25)	$U = 153.5$, $p > 0.05$

SD = standard deviation.
[a]FIM scale = Functional Independence Measure; range = 18 (lowest) – 126 (highest).

FIM points between two measurements indicates functional progress. Because the FIM evaluation parameters require marked improvements to assign a higher score to a patient, severely impaired individuals often show floor effects in FIM assessment scores. This means that the FIM assessment does not appropriately indicate if an individual in a persistent vegetative state or a minimally conscious state shows improvements in basic abilities. To account for these floor effects, we also used the EFA (Early Functional Abilities) [35,36], an assessment tool for patients in a persistent vegetative state or a minimally conscious state. The EFA scale contains 20 items on five levels and assesses early basic abilities related to vegetative functions, face and oral activities, sensory-motor activities, and sensory-cognitive abilities. FIM and EFA scores were calculated every week by the therapists, nurses, and physicians responsible for the patient.

Procedures

On the basis of medical charts and speech pathology documentation, we retrospectively analyzed data of the two groups of tracheotomized patients. Parameters extracted from the database were biographical data; date of admission and discharge; etiology and onset of the brain lesion; date of tracheotomy and decannulation; FIM and EFA scores at admission, in the week before decannulation, and at discharge; complications such as aspiration pneumonias up to one week after decannulation; and the duration of the speech therapist's intervention. To identify pneumonic complications related to decannulation, we provided the following operational definition: We assumed that dysphagic aspiration pneumonia was related to the decannulation when we observed typical pneumonic symptoms that were confirmed by specific bacteriologic findings and a radiologic assessment within one week after decannulation, and when we could exclude other causes for these symptoms. We assumed a successful weaning and decannulation process when after decannulation we found no aspiration-related pneumonia and when there was no indication for recannulation because of insufficient secretion management or respiratory failure.

As an objective method to distinguish the effects of general functional improvement from the effects of therapeutic intervention (question 4), we predefined the following criterion: If we find a significant correlation between the amount of general functional improvement (as shown by an increase in FIM and EFA scores) and the duration of cannulation, a rapid weaning and decannulation process can be attributed to the effects of general functional recovery. If we find no significant correlation between the increase in FIM and EFA scores and the duration of cannulation, we can assume a positive influence of the multidisciplinary intervention protocol on the weaning and decannulation process.

Results

Comparability of the Two Groups

A comparison of biographical and medical data of the two groups is given in Table 3. Both groups show no significant difference in the prevalence of medical classification and functional independence status (FIM scores) at the time of admission, decannulation, and discharge. Comparing the means of the subjects' ages, we found a marginal significant difference (*$p = 0.043$).

Cannulation Time and Rate of Decannulation

Table 4 shows the results of our analysis with respect to duration of cannulation and rate of successful decannulations (questions 1 and 2). In Group 1 (2003) we could wean from the tube and decannulate 33 of the 35 tracheotomized patients (94.3%) without complications. Two patients had to be recannulated (6%) within two weeks of decannulation because of failure to manage secretions. In Group 1 (2003) the mean length of time the tracheotomy tube remained in place was 28.3 days from admission to decannulation and 48.24 days from tracheotomy to decannulation. In Group 2 (1997), successful weaning from the tube and decannulation was possible for 10 of the 12 tracheotomized individuals (83.3%) without complications and without any recannulations. In this group the mean duration of cannulation was 94.7 days from tracheotomy to decannulation and the mean duration from admission to decannulation was 75.4 days. Comparing the duration of cannulation in both groups, we found a highly significant reduction in the mean length of cannulation time (Mann-Whitney **$p = 0.004$, $U = 65.0$) in the period between admission and decannulation and a significant reduction in the period between tracheotomy and decannulation (Mann-Whitney *$p = 0.016$, $U = 81.0$).

Table 4. Comparison of cannulation time data in both analyzed groups of tracheotomized patients in the REHAB Basel

Parameter	Group 1 (2003) ($n = 35$)	Group 2 (1997) ($n = 12$)
Decannulations	33	10
Cannulation time (days) tracheotomy to decannulation (mean/SD/median)	48.2 (51.58; 31)	94.7 (60.01; 90)
Cannulation time (days) admission to decannulation (mean/SD/median)	28.3 (43.7; 11)	75.4 (59.87; 72.5)
Complications/pneumonias (1 week after decannulation)	None	None
Recannulations	2	None

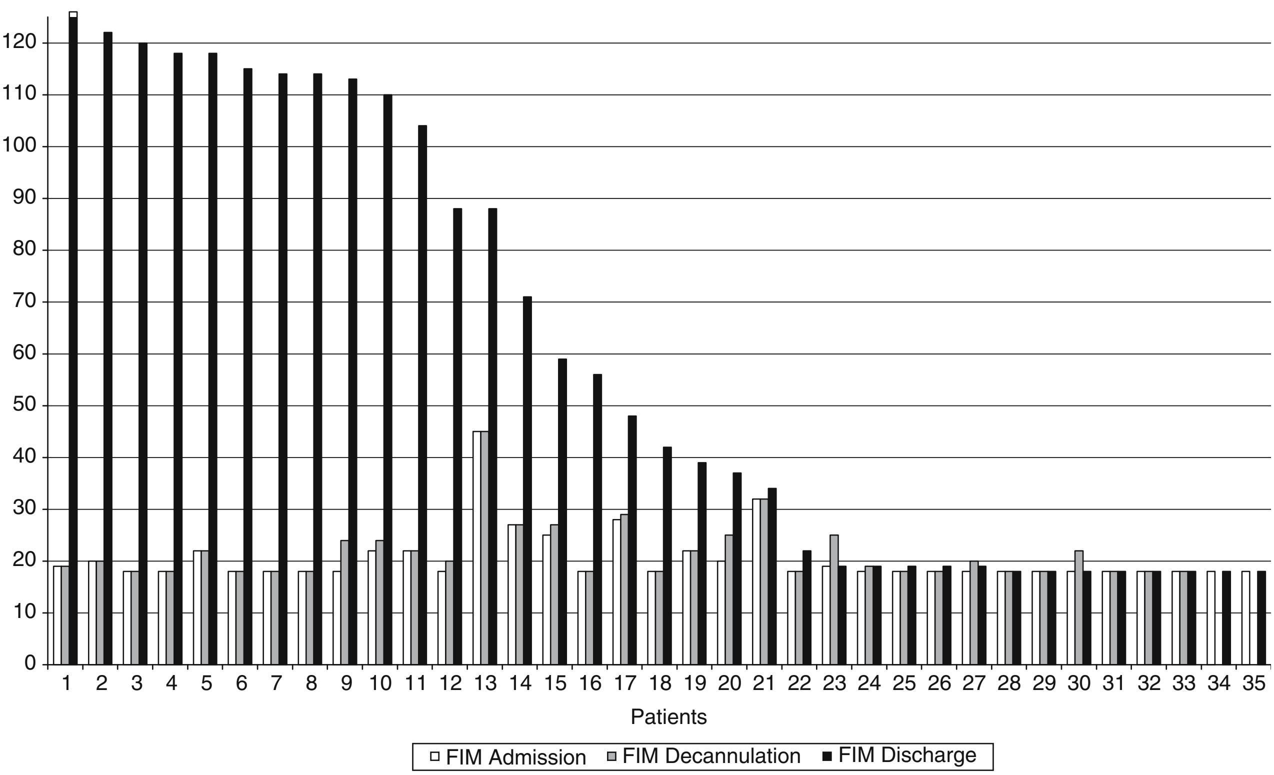

Fig. 1. Development of FIM (Functional Independence Measure) scores in tracheotomized dysphagic patients of Group 1 (2003) in the REHAB Basel. Data sorted by FIM scores at the day of discharge. Range = 18 (lowest) – 126 (highest).

Development in the Rehabilitation Process of Group 1 (2003)

Results concerning the general functional development of Group 1 (question 3) are given in Figure 1. We found that the 35 subjects of Group 1 (2003) improved their FIM scores from admission to discharge by an average of 40.23 [SD = 44.03, median (Md) = 20] points. An analysis of the scores of the 33 decannulated individuals shows that none of the patients could improve their FIM scores up to a minimum of 13 points until decannulation. This would have indicated a clear functional improvement according to Streppel et al. [33]. The mean increase of FIM scores in the whole group of decannulated patients was only 0.93 points (SD = 1.78, Md = 0) from admission to decannulation. In contrast to these results, we found a clear increase in FIM scores after decannulation. In the period between decannulation and discharge, 19 of the 33 individuals improved their FIM scores by more than 13 points and the mean score of the decannulated group ($n = 33$) increased by 41.79 points (SD = 44.43, Md = 24). Four patients showed an increase in their scores after decannulation but failed to meet the 13-point-difference criterion of Streppel et al. [33]. In general, a relevant improvement of functional abilities was evident only after decannulation. In two of our patients we observed a slight increase in FIM scores until decannulation and then a decrease in FIM scores. These were

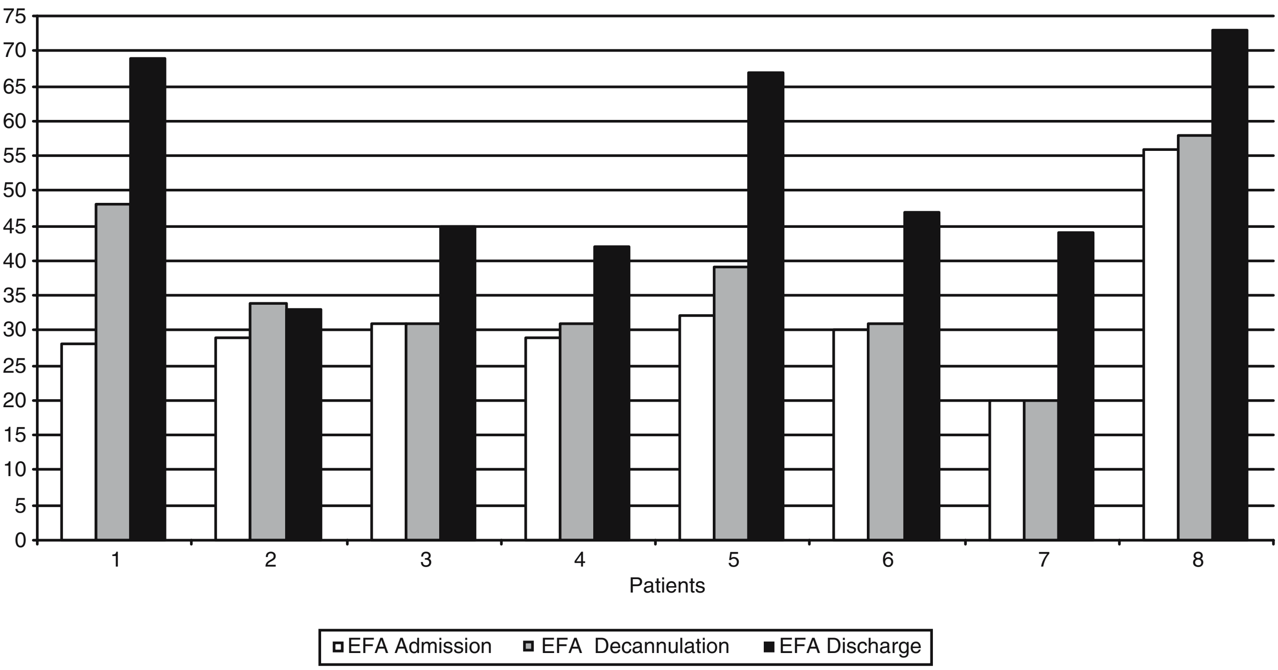

Fig. 2. Development of EFA (Early Functional Abilities) scores in severely impaired tracheotomized patients (persistent vegetative state or minimally conscious state) of Group 1 (2003) in the REHAB Basel. Range = 20 (lowest) – 100 (highest).

the two patients who had to be recannulated and their scores decreased shortly after recannulation. Our data also reveal that for 8 of the 33 decannulated patients the FIM scores did not change at all. All these patients were in a persistent vegetative state or a minimally conscious state and thus showed floor effects in the FIM assessment. A secondary analysis of EFA scores of this subgroup (Fig. 2) in the period from admission to discharge showed a mean increase of 20.63 points (SD = 12.17, Md = 17). From admission to decannulation, the mean increase was only 4.63 points (SD = 6.67, Md = 2), and, again, only after decannulation was there a clear mean increase of 16 points (SD = 8.88, Md = 15.5). Thus, these data confirm that a clear functional improvement becomes evident after decannulation of the tracheotomized patients.

Decreased Weaning Phases: Result of Treatment or General Functional Recovery?

After finding a significant reduction of the weaning phase and cannulation times, we wanted to verify if this effect could be attributed to the weaning and decannulation protocol (question 4). Analyzing correlations between the duration of cannulation and the functional development of the neurologic state, we found no significant correlation between the increase in FIM scores in the period between admission and decannulation and the cannulation times in the patients of Group 1 (Spearman rank $p = 0.428$, $r_s = -0.146$).

Likewise, there was no significant correlation between the increase in EFA scores in this period and the duration of cannulation in the eight severely impaired patients (Spearman rank $p = 0.227$, $r_s = -0.482$). Therefore, we assume that the rapid decannulation of our patients is not related to any spontaneous recovery of the neurologic state and that there is a positive influence of the treatment protocol.

Duration of the Weaning Phase in Proportion to Total Duration of Speech and Language Therapy

Evaluating the efficiency of the protocols, the factor of the duration of therapeutical intervention in the weaning phase was considered important (question 5). To exemplify this, we analyzed the duration of speech therapy in the tracheotomized individuals of Group 1. In the swallowing intervention and weaning phase from the day of admission up to the day of decannulation, the speech-language therapists spent an average of 23.04 h (SD = 32.06, Md = 13) treating the patients of Group 1. During the entire stay in our rehabilitation center, these patients received an average of 137.7 h (SD = 88.25, Md = 123) of speech and language therapy. Thus, using the multidisciplinary approach, the period of weaning from the tracheotomy tube took only 16.73% of the total time spent on speech-language therapy.

Discussion

There is a growing need for information about treatment of tracheotomized dysphagic individuals and treatment methods have to be evaluated objectively. Only a few publications have given descriptions of weaning from a tracheotomy tube and decannulation criteria and protocols for this patient group. In our study, we aimed to introduce a method and protocol that we use in our rehabilitation center and describe some preliminary data we collected to evaluate this approach. These data show that fast and safe weaning from the tracheotomy tube and decannulation of tracheotomized dysphagic patients is possible with a multidisciplinary approach that combines cuff-deflation intervals and swallowing therapy systematically. The average cannulation time for the patients treated with this protocol decreased significantly compared with formerly treated patients. The mean cannulation time with the new approach was 28 days, which is in line with the findings of Leung et al. [37], who found an average cannulation time of 33 days for their aspirating patients. In both groups of patients in our study, two patients could not be decannulated. The difficulty in assessing the readiness for decannulation is evident in the fact that another two patients in Group 1 (2003) had to be recannulated. Both were long-time tracheotomized patients who clearly had difficulty in their management of secretions, even after weaning and swallowing therapy. These difficulties could obviously not be influenced sufficiently by therapeutical intervention before and after decannulation. Regarding the rehabilitation progress of Group 1 (2003), our data revealed that clear functional improvements, as shown by an increase in FIM and EFA scores, were not evident before decannulation. After decannulation, however, the functional improvements showed a rapid and positive development in most patients. The comparatively short cannulation times we found in Group 1 can presumably not be attributed to processes of general functional recovery, because we found no significant correlations between cannulation times of the individuals and their FIM and EFA scores. Therefore, a relationship between the short cannulation periods and the multidisciplinary intervention approach as described can be assumed. Another positive result that shows the efficiency of the treatment is that the weaning and decannulation phase took only about 17% of the entire time of speech and language treatment.

Although we found a marginally significant difference in the average age of the subjects, we consider them to be comparable. The rehabilitation status of the two groups at the time of admission, decannulation, and discharge did not differ significantly. The fact that Group 2 (1997) was found to be significantly younger than Group 1 can be considered an advantage for this group. More problematic is the difference in sample size between the two groups. Because we compared retrospective data with clearly defined inclusion criteria for subjects, we had little influence on sample sizes. Our choice of samples with a six-year time span between patient groups may have contributed to this disadvantageous effect. In the course of the last decade, we observed a general increase in admission of tracheotomized patients to our rehabilitation unit. An explanation for this might be that because of progress in intensive care medicine, more severely injured patients survive and are admitted to early rehabilitation and that there is more awareness of the need for tracheotomization of severely dysphagic patients. This has led to an increased need for scientific exchange in this field and has motivated our study. A followup study to verify our results should include prospective data of tracheotomized dysphagic patient groups of a defined period and contain systematic instrumental pre- and post-decannulation swallowing evaluations to be able to quantify direct effects of our approach on dysphagia.

Tracheotomy and the application of a cuffed tracheotomy tube is a life-supporting measure for aspirating individuals with severe dysphagia. In the early phase after brain lesions, it ensures secretion management and protection against aspiration pneumonias. On the other hand, the inflated cuff hinders the tracheotomized patient from swallowing and coughing efficiently, and the lack of expiratory airflow and subsequent deprivation of the pharyngolaryngeal and oral tract is likely to have an impact on the aspiration risk. Decannulation alone certainly does not solve the problem and it does not resolve dysphagia. In the light of conflicting findings about the effect of cuffed tracheotomy tubes on the incidence and severity of aspiration, it remains unclear whether decannulation itself has a facilitating effect on the swallowing process. However, our clinical observations, confirmed by data we presented here, show that an intensive weaning phase combining cuff-deflation intervals with swallowing and coughing stimulation techniques can lead to fast and safe decannulation of dysphagic tracheotomized patients. Furthermore, our data show that decannulation can be considered the basis for further functional improvement, on which further therapeutic goals such as communication and oral nutrition can be achieved.

Conclusion

Weaning from the tracheotomy tube and decannulation as fast and safely as possible should be the main focus of the medical and therapeutical staff in neurologic rehabilitation to build the basis for functional rehabilitation and independence. This study shows that this is possible with an adequate amount of therapeutic intervention time when a multidisciplinary approach is followed consequently. Further research and exchange is needed to modify the multidisciplinary approach and evaluate it with larger and more homogeneous populations of tracheotomized dysphagic patients.

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