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Dysphagia

Cervical Spinal Cord Injury and Deglutition Disorders

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Abstract. The association of cervical spinal cord injury and swallowing disorders is clinically well recognized. This study was performed to determine the clinical significance and the outcome of deglutition disorders observed in the initial treatment of cervical spinal cord injury in our tertiary care spinal cord injury unit. All patients with cervical spinal cord injury admitted to our facility for initial care between January 1997 and December 2000 were included in our study. Prevalence of dysphagia and frequency of pneumonia were determined. An assessment of deglutition at discharge was performed. Dysphagia was diagnosed in 26 of the 73 patients with cervical spinal cord injury. Tracheostomy and duration of orotracheal intubation are associated with dysphagia. The disorder necessitated dietary restrictions in 18 patients. Six of these patients had to be discharged with a percutaneous enterogastric feeding tube; seven had persistent problems not resulting in dietary restrictions. The incidence of late pneumonia was significantly increased with two associated deaths. Dysphagia is a serious complication associated with prolonged requirement for ventilatory support. Patients have to be monitored closely because the incidence of pneumonia is increased. While the situation improves for most patients, a significant number of patients need a percutaneous enterogastric feeding tube as a permanent solution.

Key words: Deglutition disorders — Orotracheal intubation — Spinal cord injuries/complications/rehabilitation — Tracheostomy/rehabilitation — Deglutition.

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It is clinically well recognized that patients with a cervical lesion of the spinal cord frequently have swallowing problems. This problem has been linked to cervical spine surgery [1–6], tracheostomy [7–9], and associated traumatic brain injury [10,11]. However, there are few publications dealing specifically with the spinal cord injury (SCI) associated swallowing problems. Kirshblum et al. [12] reviewed their patients and identified age, cervical surgery, and tracheostomy as predictors of dysphagia in this special group of patients.

Dysphagia further diminishes the quality of life. It may lead to inadequate caloric intake with subsequent malnourishment. It is associated with aspiration of food and saliva into the airway. Since the ability to cough is reduced after cervical SCI [13], patients are more susceptible to [14–16] chronic aspiration and pulmonary problems. Usually dietary restrictions are instituted with emphasis on the texture of fluids and food.

It is the aim of this prospective study to describe the outcome of deglutition disorders observed in the initial treatment of cervical SCI and to determine the influence of dysphagia on the incidence of pneumonia.

Material and Methods

Seventy-three consecutive patients with a cervical SCI admitted to our facility for initial care between January 1997 and December 2000 were included in this study regardless of the etiology, age, or accompanying medical problems. The patient population consisted of 51 males and 22 females. The mean age at the onset of SCI was 42.9 years (0.57–86.8; ±23.17). There was a subgroup of 9 spinal cord injured children under age 10 with a mean age of 2.8 years (0.57–7.82 years).

The etiologies of the SCI are summarized in Table 1. The distribution of the level of the lesion is displayed in Figure 1. A complete lesion (ASIA A; no sensation in the last sacral segment, no anal contraction) was seen in 41 patients, while an incomplete lesion was seen in 32 patients.

Table 1. Origin of spinal cord injury

Etiology	*n*
Trauma	56
Spondylitis	5
Tumor	3
Other	9

The following variables were recorded for all patients: date of onset of neurological symptoms, associated head and chest injuries, and preexisting medical conditions (i.e., neurologic and psychiatric disorders, medical problems, and ankylosing spondylitis). The method of initial treatment was categorized into nonoperative, anterior approach, posterior approach, combined approach, and multiple surgeries to the cervical spine. Also, the use of a Halo-vest was noted. Temporal variables included the date of admission, the date of discharge, the number of days of intensive care and of mechanical ventilation, as well as the dates of tracheostomy and tracheostomy closure.

Pneumonia was diagnosed when radiological findings on plain chest X-rays correlated with an elevated white blood cell count, serum C-reactive protein, and clinical findings. Pneumonia was grouped into three categories. Early pneumonia was applied when the pneumonia became evident within the first 2 weeks after the onset of neurologic symptoms. All other cases of pneumonia were classified as late pneumonia. The category "multiple late pneumonias" was used if at least two instances of late pneumonia were recorded.

The screening for dysphagia was performed by applying the questionnaire and tests suggested by Logemann et al. [17]. The patients with suspected dysphagia were followed by a speech therapist and further examined with methylene blue dye tests (MBT) when the patient had a tracheostoma and videofluoroscopic swallowing studies (VFSS). According to the findings, the disorder was categorized for severity (severe, moderate, modest), phase of impaired swallowing (oral, pharyngeal, and esophageal), and resulting dietary restrictions.

Deglutition at discharge was categorized as "resolved," "persistent, sufficient oral intake" for patients having a fully compensated swallowing problem, or "persistent, insufficient oral intake" for the necessity to substitute the oral intake (tube feeding).

Of further interest was the role of the duration of orotracheal intubation in the development of dysphagia taking tracheostomy into account. For this purpose patients were grouped according to the presence or absence of tracheostomy. Then subgroups were formed for patients with and without dysphagia. For each subgroup the mean duration of orotracheal intubation was calculated.

The study protocol required the completion of the data sheet for each patient upon discharge. The median interval between the onset of neurologic symptoms or the accident and admission into our facility was 18 days with an interquartile range (IQR) of 26 days. The patients spent 200 (median, IQR 99) days on our ward. Five patients died 5–290 days after admission on the ward.

Results

Prevalence of Dysphagia

Dysphagia was clinically suspected in 32 cases. One patient who complained of painful swallowing due to acute tonsillitis was excluded. The clinical findings are listed in Table 2. In 6 cases further investigation did not confirm the presence of dysphagia. Three patients had severe impairment of deglutition, 8 had moderate impairment, and 15 had minimal impairment. One patient had swallowing problems in the esophageal phase of deglutition due to loose hardware (Fig. 2). The problem resolved after surgical removal of the screw. There was a combination of oral and pharyngeal impairment in 8 cases, and 17 had pharyngeal phase impairment alone. No patient had an isolated oral phase problem. Figure 3A–C demonstrates a pharyngeal phase problem (VFSS).

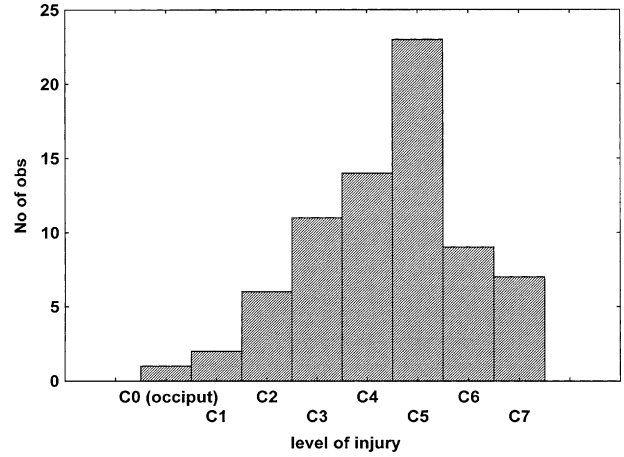

Fig. 1. Level of lesion ($n = 73$).

Age

There was no association between dysphagia and age. The mean age of the group of patients without dysphagia was 43.5 years (range = 1.4–86.8 years) and for patients with dysphagia it was 41.5 years (range = 0.6–74.2 years). An association of dysphagia with age was not demonstrated either in the subgroup of patients with traumatic SCI or in the subgroup of patients older than 10 years.

Neurologic Level of Injury

There is a correlation of dysphagia and the level of injury such that patients with higher levels of cervical injury are more likely to have a swallowing disorder (Pearson $\chi^2 = 16.2$, $df = 7$, $p < 0.05$). Patients with a complete (ASIA A) lesion have deglutition disorders more frequently (21 out of 41 cases) than those with incomplete lesions (5 of 32 cases). This finding is statistically significant (Pearson $\chi^2 = 9.9$, $df = 1$, $p < 0.01$).

Table 2. Initial symptoms of dysphagia

Clinical presentation of dysphagia	*n*	Deglutition disorder confirmed	Recurrent nerve paralysis
Swallowing problem noted by patient	14	12	2
Swallowing problem noted by staff	14	13	2
Impaired voice	13	9	2
Aspiration	11	11	3

Totals add up to more than the actual number of patients because multiple inspections were possible.

Fig. 2. Loose screws causing esophageal problems. Clearly visible, several screws of the spinal instrumentation are loose and protruding toward the esophagus. In this case there was not yet a laceration of the esophagus.

Traumatic Brain Injury

A total of 10 patients had an associated traumatic brain injury. According to the admission policy of our institution, none of these patients required special care, e.g., speech therapy. This policy limits the admission to cases with mild traumatic brain injury. In 4 cases dysphagia was diagnosed. The incidence of dysphagia in this subgroup was not different from patients with no history of traumatic brain injury ($\chi^2 = 0.097$, $p > 0.75$).

Intensive Care, Mechanical Ventilation, and Tracheostomy

The median intensive care unit stay was 24 days (IQR 40). Forty-four patients required mechanical ventilation for more than 24 hours, 33 patients for more than 10 days, and 4 patients were never weaned from the respirator. The median duration of respirator dependency was 24 days (IQR 31.5). Tracheostomy was performed for 33 patients. Eleven tracheostomies had been performed prior to admission to our facility and 22 tracheostomies were performed at our institution. The median interval between the initiation of mechanical ventilation and tracheostomy was 8 days (IQR 14). Tracheostomy was performed if mechanical ventilation longer than 10 days was anticipated or two extubation efforts had failed [18–23]. Tracheostomy was strongly associated with the incidence of dysphagia (Pearson $\chi^2 = 14.56$, $p = 0.00014$).

Weaning was possible 22 days (median, IQR 27) after tracheostomy in 29 cases. Patients with dysphagia required a significantly longer duration of respirator support (100.1 vs. 24.1 days mean duration; $p < 0.01$). There were also significant differences in the duration of oral or nasal intubation (5.7 vs. 14.4 days mean; $p = 0.015$). The period of orotracheal intubation prior to tracheostomy was 10.0 days in patients without dysphagia versus 16.9 days in patients with dysphagia. Patients not being tracheostomized required a mean duration of 3.9 days of orotracheal intubation for those not developing swallowing problems versus 8.3 for those with dysphagia. Both findings are not statistically significant ($p > 0.05$).

Tracheostomy closure was performed 88 days (median, IQR 81) after tracheostomy, and 67 days (median, IQR 86) after the end of mechanical ventilation in 25 cases. Three patients with tracheostomy died, four remained respirator dependent, and one patient suffered from recurrent pulmonary aspiration necessitating prolonged endotracheal suctioning. The

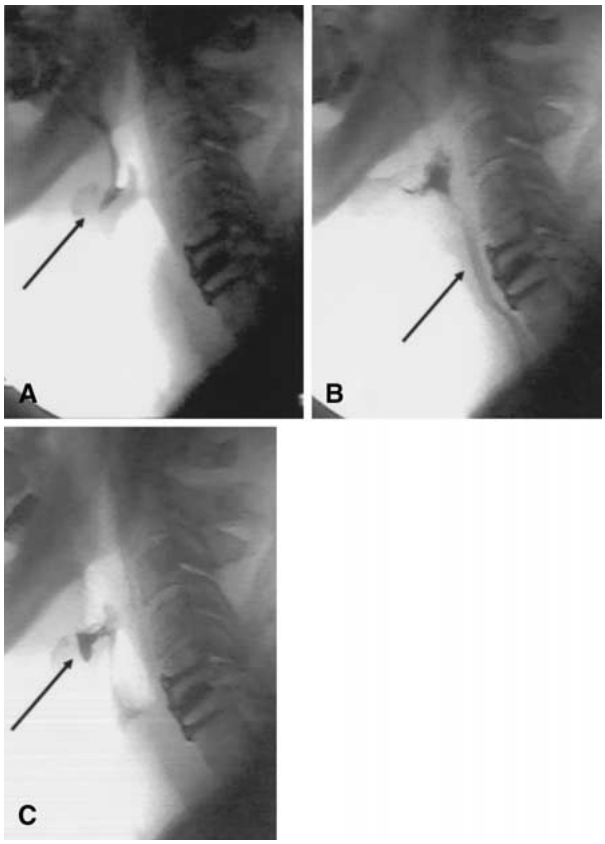

Fig. 3. Pharyngeal phase deglutition disorder with incomplete emptying of the valleculae. These images are taken from a videofluoroscopic examination of a patient where endotracheal suctioning produced food particles after eating repeatedly. **A** Fluid with contrast agent flows past the tongue into the valleculae. **B** Later phase of swallowing while the valleculae are supposed to empty and the fluid is passed down through the esophagus. The examination does not show actual aspiration of the contrast agent. Remaining substance in the valleculae after the completion of swallowing is clearly seen.

mean time between the end of mechanically assisted respiration and tracheostomy closure was significantly longer for patients with dysphagia (106.4 days vs. 188.5 days; $p < 0.05$).

Surgery to the Cervical Spine

Surgery to the cervical spine was performed with an anterior approach ($n = 39$), combined anterior–posterior approach ($n = 10$), and with a posterior approach ($n = 6$). Eighteen cases were treated without spine surgery. We did not find a significant correlation of anterior surgical trauma and dysphagia. Excluding oral phase dysphagia, anterior spinal surgery again did not result in a significant contribution to dysphagia (Table 3; Pearson $\chi^2 = 0.67$, $p = 0.42$). A similar result was found after limiting the patient population to traumatic SCI. However, there was no patient with dysphagia who had neither tracheostomy nor anterior surgery of the cervical spine. A forward stepwise logit regression model excluded age as predictor, but it indicated that the combination of tracheostomy and anterior cervical surgery might further increase the risk for dysphagia.

Rigid Fixation of the Cervical Spine

Only 6 patients needed halo fixation which made swallowing difficult because of the fixed head position. It was not associated with a deglutition disorder. No problems were seen after removal of the device and no late pneumonia occurred in this group. Four patients suffered from preexisting ankylosing spondylitis with a rigid cervical spine. Three of these patients needed tracheostomy. All three patients presented with severe dysphagia, all aspirated, one patient died due to recurrent pneumonia, and one required a permanent percutaneous enterogastric tube.

Pneumonia

Thirty-one patients never developed symptoms of pneumonia. Twenty-four patients had only one episode of pneumonia, 22 were classified as early pneumonia and 2 as late pneumonia. In 6 cases there was early pneumonia and one episode of late pneumonia; 11 patients experienced early pneumonia and multiple episodes of late pneumonia. The relation to dysphagia showed a comparable incidence of early pneumonia for patients with or without dysphagia (27% vs. 34%). The incidence of late or multiple late pneumonia was significantly higher (58% vs. 9%) for patients with dysphagia (Pearson $\chi^2 = 24.6$, $df = 4$, $p < 0.01$).

Dietary Restrictions

Dysphagia necessitated dietary restrictions in regard to the texture of fluids or solid food for 18 of 26 patients with confirmed swallowing pathology. Table 4 lists the necessary restrictions in regard to the involved phase of swallowing. All patients with oral phase problems required dietary modifications at a significantly higher rate than those with a swallowing problem restricted to the pharyngeal phase (10 of 17; Fisher's exact test: $p = 0.044$). For 10 patients, a percutaneous gastric tube was needed to ensure adequate feeding. It could be removed in 4 cases after 74.7 days (mean) with a range of 22–160 days. Three of the remaining 6 patients were children, 2 of them with a C1 level ASIA A lesion requiring permanent ventilator support. The 3 adults had ASIA A SCI with levels ranging from C2 to C4.

Table 3. Surgery to the anterior cervical spine and pharyngeal phase dysphagia

	Pharyngeal phase dysphagia		
Anterior spine surgery	No	Yes	Totals
No	17	7	24
Yes	31	18	49
Totals	48	25	73

The inability to regain sufficient deglutition was associated with ankylosing spondylitis (1 case), psychosis (1 case), and noncompliance. In one case there was no improvement on swallowing despite the absence of complicating factors.

Results at Discharge

Five of our patients died. One of them died 6 days after admission secondary to septic complications of spondylitis. No clinical signs of dysphagia had been noted. The other 4 patients had clinically evident dysphagia. In 2 cases death was related to cardiac failure or a pulmonary embolism, and 2 patients died due to recurrent pneumonia.

At the time of discharge, for 9 of the 22 surviving patients with confirmed deglutition disorder, the problem had resolved. Among them was the only patient with an isolated esophageal phase swallowing problem, which was resolved after removal of the screw. None of these patients had a problem in the oral phase of swallowing.

The outcome for 7 patients was categorized as "persistent problem, sufficient oral intake." Five of these patients had a pharyngeal phase swallowing problem and 2 had a combined oral and pharyngeal phase swallowing problem. None of these 7 patients required dietary restrictions, however, all were hypervigilant while swallowing. Also, all of these patients were found to have sufficient coughing ability on clinical examination.

Six patients had persistent dysphagia associated with insufficient oral feeding capabilities. They were discharged with a percutaneous gastric feeding tube in place (see detailed description of these cases above). Table 5 summarizes the results.

Discussion

Predisposing Factors

Dysphagia is a common problem associated with cervical spinal cord injury. Dysphagia was suspected in 44% (32 of 73 cases) of the study patients. In 36% (26 of 73 cases), appropriate clinical and instrumented diagnostic measures done by an experienced speech therapist confirmed a deglutition disorder.

When starting our study in January 1997, there had been virtually no relevant publications dealing specifically with deglutition disorders in the population of spinal cord injured patients. However, there had been reports that linked dysphagia to a number of predictors for dysphagia such as age [24], anterior surgery to the spine [1–6,25–29], tracheostomy [9,21,30,31], and prolonged oral or nasal intubation [7,9,23,32]. Also, there had been reports about mechanical obstacles impairing deglutition, e.g., osteophytes, hematoma [33–47]. No reports were available concerning the impact of the level of SCI or outcome or frequency of complications.

Since 1997, Kirshblum et al. [48] published the results of a review of 187 patients identifying age, anterior spinal surgery, and tracheostomy as possible predictors of dysphagia following SCI. However, they did not comment on the outcome or the complications attributed to dysphagia. Our results concerning the factors contributing to dysphagia agree with the findings of Kirshblum et al. insofar as tracheostomy seems to be the most important single predicting factor. We could not reproduce the effect of age seen in their series, even after limiting the review to traumatic cases and excluding children younger than 10 years of age. However, the increased incidence of dysphagia in the population of elderly patients is well described [49], and we do not want to refute age as a potential risk factor because this effect might be masked by the large age range of our patients.

We certainly agree with the literature [1–6,25–29] that surgery in the proximity of the anatomical structures involved in swallowing increases the risk of dysphagia, but, according to our data, surgery was not a particularly important source of swallowing problems for our patients. The combination of tracheostomy and a rigid fixation because of ankylosing spondylitis of the cervical spine caused serious problems. All three patients with this condition aspirated. Corresponding again with the findings of Kirshblum et al. [48], we found that patients with high and complete lesions are more likely to suffer from a swallowing problem. This may be due to the longer duration of respirator dependency of these patients.

Care has to be taken not to confound the statistical association of swallowing disorders and tracheotomy with evidence that tracheotomy by itself causes dysphagia. The critical clinical situation of the patient may well both necessitate tracheotomy and

Table 4. Initial dietary restrictions (food and fluid texture) necessitated by deglutition disorder

	Fluids				Solid food			
Type (n = 26)	Normal	Thick	Spoonful	No fluids	Normal	Soft	Mashed	No oral feeding
Oral and pharyngeal (8)	1	2	1	3	0	4	2	2
Pharyngeal (17)	12	1	4	0	7	7	3	0
Esophageal (1)	1	0	0	0	1	0	0	0

Table 5. Outcome at discharge (26 patients with dysphagia)

Type of deglutition disorder	Dysphagia resolved solved	Persistent dysphagia, sufficient oral intake	Persistent dysphagia, insufficient oral intake	Patient died	Totals
Pharyngeal phase	8	5	1	3	17
Pharyngeal and oral phase	0	2	5	1	8
Esophageal phase	1	0	0	0	1
Totals	9	7	6	4	26

cause dysphagia. There is published evidence that tracheotomy itself does not induce dysphagia (Leder and Ross [50]), and the authors certainly do not want to imply that necessary tracheotomies should be delayed. Since the nervous structures involved in the motor aspect of swallowing exit the brainstem above C2, it is challenging to explain a defect in motility. However, there may also be a deficit in sensibility. This would explain some of the mechanisms of the oral phase deglutition problems. These problems were usually seen at the end of the oral phase as a lack of reflex activation.

We cannot comment on the association of dysphagia and traumatic brain injury because we admit only SCI patients with minor additional traumatic brain injury into our hospital.

As expected and in accordance with previous reports [7,9,23,32], we found a relationship between the duration of orotracheal intubation and the development of dysphagia.

Outcome

Beyond discomfort for the patient, dysphagia is clearly associated with an increased incidence of late pneumonia, even if the therapeutic team is alert, proper precautions are taken, and dietary restrictions are applied. Furthermore, dysphagia leads to prolonged indwelling of the tracheostomy tube which reinforces or supports dysphagia. In the future, we will try more aggressively to close the tracheostomy earlier. As our results show, there is a rather favorable prognosis in the majority of cases. All patients improved clinically and, despite severe problems initially, 16 of 22 surviving patients could be discharged with sufficient oral caloric intake without textural dietary restrictions. This progress was appreciated as a gain in life quality for the patients involved. However, six patients had to be discharged with a permanent enterogastric feeding tube and there were two deaths associated with recurrent aspiration.

Conclusion

Dysphagia is a serious problem in the population of patients with cervical spinal cord injury. It affects about one-third of all patients with a problem in either the oral or the pharyngeal phase of swallowing or a combination of both. The notion that dysphagia is caused directly by a deficit of motor control due to the spinal cord injury is not supported by our data. There is good reason to assume that it is associated with prolonged need for respiratory support and possibly with anterior spinal surgery. In particular, if only the pharyngeal phase of swallowing is impaired and the patient can cooperate, the prognosis for functional recovery is good. The situation has to be treated seriously because the risk for late pneumonia, with significant potential to cause death, is increased. It remains to be elucidated by further studies in which way the management of respirator-dependent tetraplegic patients can be modified (e.g., different surgical techniques of tracheostomy, concept of weaning,

timing of tracheotomy closure) to reduce the rate and complications of swallowing disorders.

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