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ORIGINAL ARTICLE

Long-Lasting Dysphagia Developing After Thoracotomy for Pulmonary Resection: a Case Series

Ikuno Ito[1] · **Kohei Hamada**[1] · **Hiroyuki Sato**[1] · **Naoko Shindo**[1]

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Abstract The purpose of this study was to retrospectively evaluate the severity and the characteristics of dysphagia using videofluoroscopic swallowing studies (VFSS) in long-lasting dysphagia patients developing after thoracotomy performed for pulmonary resection. Eleven patients (10 men and 1 woman, average age 67 ± 6.6 years; the average operation time in the patients was 507 min) were selected from among patients who developed dysphagia after undergoing thoracotomy for pulmonary resection between January 2009 and December 2012. The videofluoroscopic dysphagia scale (VDS) at 1 month postoperatively was used as a representative of parameters examined by the VFSS. The score on the functional oral intake scale (FOIS) was determined to evaluate the swallowing capacity at 1 and 3 months postoperatively. Most of the patients showed improvement of FOIS score at 3 months postoperatively. The patients showed mainly pharyngeal dysfunction. In spite of preserving the swallowing reflex, abnormalities of the residue in the vallecula and pyriform sinus and penetration were relatively frequent. Perioperative factors (age, %VC, $FEV_{1.0\ \%}$, operation time, length of ICU stay) and FOIS were investigated to determine their relationships with the VDS score. While it showed no relationship with the age, lung function, operation time, and length of ICU stay, the VDS score was found to be significantly associated with the FOIS score at 3 months postoperatively. Evaluation by VFSS after lung surgery is useful to predict the prognosis of swallowing difficulty.

✉ Ikuno Ito
itoikuno@yahoo.co.jp

[1] Department of Rehabilitation, National Hospital Organization Tokyo National Hospital, 3-1-1 Takeoka, Kiyose, 204-8585 Tokyo, Japan

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Introduction

Dysphagia is well known to occur as a complication of intrathoracic surgical procedures [1–8]. There are numerous reports of the investigation of postoperative dysphagia after cardiac operations [1–6]. Barker reported that dysphagia occurred in 51 % of patients who underwent cardiac surgery with prolonged endotracheal intubation [1]. Ferraris reported that older patients with diabetes, preoperative heart failure, and renal insufficiency are at a risk for the development of dysphagia after cardiac surgery [2].

In contrast, there are fewer reports of investigation of postoperative dysphagia developing after thoracotomy for pulmonary resection. According to some studies, the incidence of aspiration after thoracotomy for pulmonary resection is nearly 20 % [7, 8]. It was suggested that "older age" and "previous or current head and neck malignancy" were high-risk factors for postoperative dysphagia development. However, in these aforementioned studies, dysphagia evaluations were performed on postoperative day 1, and the long-term prognosis with respect to the swallowing functions was not addressed. Han reported long-lasting dysphagia patients who had undergone an operation unrelated to pharyngeal and laryngeal structures, which include lung cancer surgery [9].

There are the important clinical questions of whether patients who show aspiration on VFSS could be started on oral intake, require special diet modifications, or require tube support permanently. Furthermore, previous studies have only investigated the existence of aspiration, whereas the swallowing function cannot be precisely estimated by the presence of aspiration alone, as various abnormalities are

Table 1 Functional oral intake scale

Tube dependent (levels 1–3)	
1	No oral intake
2	Tube dependent with minimal/inconsistent oral intake
3	Tube supplements with consistent oral intake
Total oral intake (levels 4–7)	
4	Total oral intake of a single consistency
5	Total oral intake of multiple consistencies requiring special preparation
6	Total oral intake with no special preparation but must avoid specific foods or liquid items
7	Total oral intake with restrictions

involved. Therefore, we previously attempted to investigate the swallowing capacity using the functional oral intake scale (FOIS) [10] (Table 1). In addition, we also attempted a comprehensive evaluation of VFSS findings and tried to quantify those VFSS results using the videofluoroscopic dysphagia scale (VDS) [11], which was developed by Han for quantifying the swallowing function based on the VFSS findings. Here, we investigated the relationship of the results of the VFSS evaluation and perioperative factors, with the FOIS score.

Patients and Methods

This study was conducted with the approval of the National Tokyo Hospital Institutional Review Board.

We selected the patients who required dysphagia foods or tube feeding because of swallowing dysfunction at 1 month after thoracotomy and had undergone VFSS between January 2009 and December 2012. We excluded the patients who were not sufficiently stable condition for performing the VFSS study. We also excluded patients who had a history of aspiration pneumonia or symptom of dysphagia before surgery.

The VFSS was performed by experienced physiatrists, dentists, and speech therapists. Informed consent was obtained from all patients prior to the performance of the VFSS. During the VFSS, the participants were instructed to sit in an upright position and images were obtained in the lateral projection. Participants were asked to drink a barium-enriched material. We used three consistencies: nectar-like thick liquid, honey-like thick liquid, and thin liquid. For the swallowing study, 5 ml bolus was used.

The VFSS results at 1 month postoperatively were used to evaluate the dysphagia severity. The VFSS recordings were analyzed at normal speed, in slow motion, and frame-by-frame as many times as needed for confident judgment by a

Table 2 Clinical characteristics at study entry patients who showed dysphagia after surgery

No.	Age	Sex	Disease	Surgical procedure	Operative approach	Side	Location	LND	Operation time (min)	VFP	Tracheotomy	ICU stay (days)	VDS score	FOIS score (initial)	FOIS score (final)
1	71	M	LC	Lobectomy	PLT	R	Lower	+	319	−	+	22	46.5	1	2
2	63	M	LC	Pneumonectomy	PLT Sternotomy	L	Total	+	738	+	−	2	8.5	2	7
3	59	M	LC	Lobectomy	PLT	R	Upper	+	392	−	+	11	49.5	1	3
4	81	M	LC	Pneumonectomy	Sternotomy	R	Total	+	400	−	−	6	39.5	1	1
5	65	M	LC	Segmental resection	Sternotomy	L	S3	+	805	+	−	5	6	1	6
6	69	M	LC	Lobectomy	ALT	R	Upper	+	300	−	−	2	10	2	6
7	79	M	LC	Segmental resection	PLT	L	S6	+	239	−	−	2	19	1	5
8	61	M	LA	Pneumonectomy	PLT	L	Total	−	771	+	−	4	7	1	5
9	59	M	LA	Lobectomy	Sternotomy	L	Lower	−	669	+	−	14	2	1	6
10	59	M	IT	Segmental resection	Sternotomy	R	Upper	+	642	−	−	14	2	2	7
11	66	F	NTM	Lobectomy	PLT	L	Lower	−	300	+	−	7	4	2	6

LC lung cancer, *LA* lung aspergillosis, *NTM* nontuberculous mycobacteria, *IT* infiltrative thymoma, *LND* lymph node dissection, *VFP* vocal fold paralysis, *VDS* videofluoroscopic dysphagia scale, *FOIS* functional oral intake score, *PLT* posterolateral thoracotomy, *ALT* anterolateral thoracotomy

Table 3 Videofluoroscopic dysphagia scale (VDS) and abnormal findings in VFSS

Parameter	Coded value		Score	No. of patients (%)	Average score
Lip closure	Intact	0	4	11 (100 %)	0
	Inadequate	2		0	
	None	4		0	
Bolus formation	Intact	0	6	10 (90.9 %)	0.27
	Inadequate	3		1 (9.1 %)	
	None	6		0	
Mastication	Intact	0	8	11	0
	Inadequate	4		0	
	None	8		0	
Apraxia	None	0	4.5	11 (100 %)	0
	Mild	1.5		0	
	Moderate	3		0	
	Severe	4.5		0	
Tongue-to-palate contact	Intact	0	10	11 (100 %)	0
	Inadequate	5		0	
	None	10		0	
Premature bolus loss	None	0	4.5	11 (100 %)	0
	<10 %	1.5		0	
	10–50 %	3		0	
	>50 %	4.5		0	
Oral transit time	<1.5 s	0	3	7 (63.6 %)	1.09
	>1.5 s	3		4 (36.3 %)	
Triggering of pharyngeal swallow	Normal	0	4.5	10 (90.9 %)	0.40
	Delayed	4.5		1 (9.1 %)	
Vallecular residue	None	0	6	1 (9.1 %)	3.27
	<10 %	2		4 (36.3 %)	
	10–50 %	4		4 (36.3 %)	
	>50 %	6		2 (18.1 %)	
Laryngeal elevation	Normal	0	9	7 (63.6 %)	3.27
	Impaired	9		4(36.3 %)	
Pryiform sinus residue	None	0	13.5	7(63.6 %)	3.86
	<10 %	4.5		1 (9.1 %)	
	10–50 %	9		0	
	>50 %	13.5		3 (27.3 %)	
Coating of pharyngeal wall	No	0	9	11 (100 %)	0
	Yes	9		0	
Pharyngeal transit time	<1.0 s	0	6	9 (81.8 %)	1.09
	>1.0 s	6		2 (18.1 %)	
Aspiration	None	0	12	5 (45.4 %)	4.36
	Supraglottic penetration	6		4 (36.3 %)	
	Subglottic aspiration	12		2 (18.1 %)	
Total			100		17.6

physiatrist with sufficient experience in the analysis of VFSS. We determined the scores for each bolus of three consistencies and used the worst score for the analysis. The VDS is reported as a sensitive and specific method for quantifying the severity of dysphagia in stroke patients [11, 12], and it was also applied to investigate the severity of dysphagia developing after surgical procedures [9]. The VDS shows a moderate rate of inter-rater reliability for evaluating the swallowing function [13].

The scale is composed of the following 14 items: lip closure, bolus formation, mastication, apraxia, tongue-to-palate contact, premature bolus loss, oral transit time, triggering of pharyngeal swallowing, vallecular residue, laryngeal elevation, pyriform sinus residue, coating of the pharyngeal wall, pharyngeal transit time, and aspiration. The lower VDS scores mean better swallowing.

Data on the preoperative factors (age, percent vital capacity (%VC), forced expiratory volume ($FEV_{1.0\ \%}$), intraoperative factors (operation time), and postoperative factors (length of ICU stay) were collected retrospectively.

A speech therapist evaluated the FOIS score. FOIS score at 1 month after surgery was defined as an initial evaluation, and those score at 3 months after surgery was defined as a final evaluation. The FOIS is based strictly on the patient's ability to consume foods and liquids of various consistencies orally and reveals specifics about the food texture and liquid consistencies that the patient can tolerate. FOIS is used to estimate the functional eating ability and consists of seven levels, where levels 1–3 are related to varying degrees of non-oral feeding and levels 4–7 are related to varying degrees of oral feeding without non-oral supplementation [10].

To determine the relationship between the dysphagia severity and perioperative factors, the Spearman's rank correlation coefficients were determined. SPSS ver12 was used in this study, and $p < 0.05$ was considered to indicate statistical significance.

Results

We selected the patients who had suffered from persistent dysphagia beyond 1 month after surgery and had undergone VFSS between January 2009 and December 2012. A total of 688 patients underwent thoracotomy during this period. Of these, 11 patients (1.6 %) were included in this study (10 men and 1 woman, average age = 66.7 ± 6.6 years). All the 11 patients had no history of dysphagia before surgery. Of the eleven, seven patients had lung cancer, three had infectious disease, and one had infiltrative thymoma. The average %VC of the patients was 72.3 ± 21.5, and the average $FEV_{1.0\ \%}$ was 79.5 ± 10. The average operation time in the patients was 507 min, and the average length of stay in the ICU was 7 days. Pneumonectomy was conducted in 3 patients, lobectomy in 5 patients, and segmental resection in 3 patients. Operative approach was posterolateral thoracotomy in 5 patients, sternotomy in 4 patients, anterolateral thoracotomy in 1 patient, and combination of posterolateral thoracotomy and sternotomy in 1 patient. Mediastinal lymph node dissection was performed in 8 patients. Of the 11, 5 patients were diagnosed as having unilateral vocal fold motion impairment induced by the surgical procedures. The documentation of the vocal cord paralysis mandated a visual inspection of the patient's vocal cords by an otolaryngologist in our institution to confirm the diagnosis. Two patients had required placement of a tracheostomy postoperatively for respiratory failure. The detailed data are presented in Table 2.

The VFSS was performed 1 month after the surgery. The mean of VDS score was 17.6 ± 18. The abnormalities in the oral and pharyngeal phases are summarized in Table 3. In the oral phase, bolus formation was abnormal in 1 patient (9.1 %), and the oral transit time was delayed in 4 patients (36.3 %). In the pharyngeal phase, excessive vallecular residue showed very high occurrence (90.1 %), and incomplete laryngeal elevation and excessive priform sinus residue showed relatively high occurrence (36.3 %). In contrast, the triggering of pharyngeal swallow was delayed in 1 patient (9.1 %) and the pharyngeal transit time was delayed in 2 patients (18.1 %). Aspiration was documented in 2 patients (18.1 %), and 4 patients (36.3 %) showed penetration.

The average initial FOIS score was 1.36. Most of the patients showed improvement of the FOIS score at 3 months after operation, and the mean final FOIS score was 4.9 ± 2.2.

No correlation was observed between the VDS score and the age, lung function, operation time, or length of ICU stay; the Spearman's rank correlation coefficients between the VDS and age, %VC, $FEV_{1.0\ \%}$, operation time, length of ICU stay, and initial FOIS were 0.38 ($p = 0.24$), 0.31 ($p = 0.35$), 0.16 ($p = 0.62$), −0.50 ($p = 0.11$), 0.53 ($p = 0.08$), and −0.38 ($p = 0.23$), respectively. On the other hand, there was a significant relationship between the VDS and final FOIS score (Table 4). Spearman's rank correlation coefficients between the VDS score and final FOIS score was −0.90 ($p < 0.05$) (Fig. 1). Three patients (case 1, case 3, case 4,) required tube feeding at 3 months postoperatively, even though they had received rehabilitation at the hospital stay by a speech therapist. Percutaneous endoscopic gastrostomy (PEG) was established in two of these cases, while the third was on nasal feeding.

Table 4 Spearman's *r* correlations between perioperative factors and VDS score

Factors	*r*	*p*
Age	0.38	0.24
%VC	0.31	0.35
$FEV_{1.0\ \%}$	0.16	0.62
Operation time (min)	−0.50	0.11
Length of ICU stay (days)	0.53	0.08
FOIS (initial)	−0.38	0.23
FOIS (final)	−0.90	<0.05

VDS videofluoroscopic swallowing scale, *FOIS* functional oral intake scale

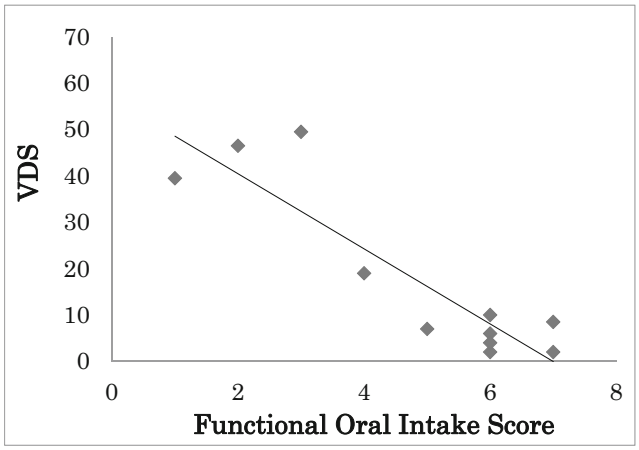

Fig. 1 Scatter plots of the videofluoroscopic dysphagia scale (VDS) score and FOIS score at 3 months postoperatively. There was a significant correlation between the VDS score and FOIS score ($r = -0.90$, $p < 0.05$)

Discussion

The aim of this study was to retrospectively investigate the severity and the characteristics of dysphagia by videofluoroscopic swallowing studies (VFSS) in patients who showed dysphagia which had persisted beyond 1 month after thoracotomy.

Keeling reported evidence of aspiration on VFSS in 17.8 % of patients after thoracotomy for pulmonary resection [7]. However, in the aforementioned study, the long-term prognosis with respect to the swallowing functions was not addressed. In addition, a comprehensive evaluation of VFSS findings has not been attempted. Therefore, in this study, we tried to evaluate the characteristics and the severity of dysphagia and follow up their swallowing capacity over time.

This sample of patients was characterized by relatively longer surgery time. The surgical procedures, operation time, and operative approaches were various. Five patients were diagnosed as having unilateral vocal fold motion impairment induced by the surgical procedures and two patients had required placement of a tracheostomy postoperatively for respiratory failure. We speculate that with longer intubation time, the vocal fold paralysis and the tracheostomy might affect the swallowing function.

Of the 11, 8 patients were able to eat meal without non-oral supplementation, although 3 patients required tube feeding at 3 months postoperatively. The improvement of the FOIS score was various.

In the present study, abnormal findings of VFSS in patients were shown primarily in the pharyngeal phase. In spite of preserving the normal swallowing reflex, abnormalities of the residue in the vallecula and pyriform sinus and penetration and aspiration were relatively frequent. These results suggest that the major cause of dysphagia could be a reduced pharyngeal movement and a lack of mechanical protection. In the view of treatment planning, the results of the present study suggest that the treatment of patients needs to be focused on pharyngeal muscle strengthening.

No correlation was observed between the VDS score and perioperative factors statistically, although the results of the VFSS showed a significant relationship to the FOIS score at 3 months postoperatively. Our findings suggested that VFSS study is a useful tool for prediction of the swallowing outcome in patients developing postoperative dysphagia after thoracotomy.

Our study had some limitations. First, the sample size was too small for reliable statistical analysis, since persistent dysphagia requiring permanent tube feeding or a dysphagic diet is not a frequent complication after thoracotomy performed for pulmonary resections [7, 8]. A matched comparison on those with similar profile of surgery/disease without dysphagia will be needed in the future. In addition, it would be desirable to compare with a higher number control group. Secondly, we did not investigate all the factors which affect the swallowing function, such as a previous history of stroke, chronic obstructive lung disease, and the smoking history. The retrospective study design for data extraction did not allow for the capture of all the desired variables.

Despite the limits on the scope, our findings have important clinical implications. In our study, the results of quantitative VFSS evaluation were correlated with the ability for oral intake in patients who had developed dysphagia which lasted long after thoracotomy. The results suggested that VFSS is a useful tool for predicting the prognosis of postoperative dysphagia. In addition, the comprehensive evaluation of VFSS would be a useful reference for rehabilitative treatment planning. It is suggested that practitioners should undertake VFSS when development of dysphagia is suspected after surgery and take into consideration the results of the VFSS for postoperative care and nutritional support.

Compliance with Ethical Standards This study was conducted with the approval of the National Tokyo Hospital Institutional Review Board.

Conflict of Interest We have no grant or financial support.

References

1. Barker J, Martino R, Reichardt B, Ej H, Edwasrds RA (2009) Incidence and impact of dysphagia in patients receiving prolonged endotracheal intubation after cardiac surgery. Can J Surg 52:119–124
2. Ferraris VA, Ferraris SP, Moritz DM, Welch S (2001) Oropharyngeal dysphagia after cardiac operations. Ann Thorac Surg 71:1792–1795
3. Rousou JA, Tighe DA, Garb JL, Krasner H, Engelman RM, Flack JE, Deaton DW (2000) Risk of dysphagia after transesophageal

echocardiography during cardiac operations. Ann Thorac Surg 69: 486–489
4. Hogue CW Jr, Lappas GD, Creswell LL, Ferguson TB Jr, Sample M, Pugh D, Balfe D, Cox JL, Lappas DG (1995) Swallowing dysfunction after cardiac operations. Associated adverse outcomes and risk factors including intraoperative transesophageal enchocardiography. J Thorac Cardiovasc Surg 110:517–522
5. Hariington OB, Jk D, Starned CL, White P, Fleming L, Kritchevesky SB, Pickering R (1998) Silent aspiration after coronary artery bypass grafting. Ann Thorac Surg 65:1599–1603
6. PatrilBL SM, Schueller G, Voracek M, Schima W, Schober E, Mueller MR, Leung AN, Denk DM, Pokieser P (2003) Videofluoroscopy of swallowing abnormalities in 22 symptomatic patients after cardiovascular surgery. AJR Am J Roentgenol 180: 987–992
7. Keeling WB, Lewis V, Blazick E, Maxey TS, Garrett JR, Sommers KE (2007) Routine evaluation for aspiration after thoracotomy for pulmonary resection. Ann Thorac Surg 83:193–196
8. Keeling WB, Hernandez JM, Lewis V, Czapla M, Zhu W, Garrettt JR, Sommers KE (2010) Increased age is an independent risk factor for radiographic aspiration and laryngeal penetration after thoracotomy for pulmonary resection. J Thorac Cardiovasc Surg 140:537–577
9. Han TR, Kim HR, Kim SJ (2009) Dysphagia development after surgery unrelated to laryngeal and pharyngeal structures. Dysphagia 24:167–171
10. Crary MA, Carnaby GD, Groher ME (2005) Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. Arch Phys Med Rehabil 86:1516–1520
11. Han TR, Paik NJ, Park JW (2001) Quantifying swallowing function after stroke: a functional dysphagia scale based on videofluoroscopic studies. Arch Phys Med Rehabil 82:677–682
12. Han TR, Paik NJ, Park JW, Kwon BS (2008) The prediction of persistent dysphagia beyond six months after stroke. Dysphagia 23:59–64
13. Kim DH, Choi KH, Kim HM, Koo JH, Kim BR, Kim TW, Ryu JS, Im S, Choi IS, Pyun SB, Park JW, Kang JY, Yang HS (2012) Interrater reliability of videofluoroscopic dysphagia scale. Ann Rehabil Med 36:791–796