Showa Univ J Med Sci **27**(2), 111～116, June 2015

Original

Endoscopic Findings of Post-wedge Bronchoplastic Lobectomy

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Abstract: It is speculated that the advantage of wedge bronchoplastic lobectomy lies in the reduction in the incidence of major anastomotic complications. On the other hand, wedge bronchoscopic lobectomy can result in kinking at the anastomosis site. This study was performed to evaluate the operative outcomes and the postoperative endoscopic findings for wedge resection of the bronchus. From 2004 to 2012, nine patients underwent wedge bronchoplastic lobectomy for lung carcinoma. We evaluated the angles of the wedge and the distance of the preserved parts to the cut line of the bronchus (the so-called bronchial bridge). There were six right upper lobectomies, two middle and lower lobectomies, and one left lower lobectomy. Regarding bronchoscopic findings, five patients who underwent right upper lobectomy showed bulging into the bronchial lumen. There were no anastomotic strictures. Intraoperatively it was noted in these five patients that the bronchial bridge tended to be relatively long and / or the angle of the wedge resection tended to be relatively wide. To prevent bulging into the bronchial lumen after right upper wedge bronchoplastic lobectomy, bronchial wedge excisions should be shaped in order to reduce the length of the bronchial bridge.

Key words: bronchoscopic findings, post-wedge bronchoplastic lobectomy, lung cancer

Introduction

Sleeve lobectomy is a standard procedure that can be performed in any segment or lobe in either lung. On the other hand, the advantages of wedge lobectomy include a relatively easy suturing technique, a potential to preserve the bronchial blood supply and a reduction in the incidence of major anastomotic complications. However, this procedure has the disadvantage of creating kinking at the level of the reconstruction. This study was performed to evaluate the operative findings of wedge resection of the bronchus and the postoperative endoscopic findings of the site of anastomosis in order to investigate factors involved in bronchial kinking.

Material and methods

Patients

The subjects included nine patients who underwent wedge lobectomy between 2004 and 2012.

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Table 1. Patient Characteristics

Case [a]	Location	Pathology	c-Stage	Induction therapy	Surgical Procedure	p-Stage
1. 64 / M	RUL	SCC	T2aN2M0	Chemotherapy	RUWL	T2aN2M0
2. 58 / M	RUL	SCC	T2aN2M0	Chemotherapy	RUWL	T2aN2M0
3. 75 / M	RUL	SCC	T2aN1M0	None	RUWL	T2aN2M0
4. 68 / M	RUL	SCC	T2bN1M0	None	RUWL	T2bN1M0
5. 65 / M	RUL	SCC	T3N1M0	Chemotherapy	RUWL	T3N1M0
6. 55 / M	RUL	SCC	T2aN1M0	Chemo-Rt [b]	RUWL	T1N0M0
7. 64 / M	RLL	SCC	T3N1M0	None [c]	RMLWL	T3N1M0
8. 51 / M	RLL	SCC	T3N1M0	None [c]	RMLWL	T3N2M0
9. 46 / M	LLL	SCC	T3N2M0	Chemo-Rt [d]	LLWL	T3N2M0

[a] Age (y) / gender ; [b] Two courses of cisplatin / docetaxel + 45 Gy (concurrent); [c] Surgical margin positive at frozen section ; [d] Four courses of cisplatin / docetaxel + 72 Gy (salvage surgery).

M, male ; RUL, right upper lobe ; RLL, right lower lobe ; LLL, left lower lobe ; SCC, squamous cell carcinoma ; Rt, radiation ; RUWL, right upper wedge lobectomy ; RMLWL, right middle and lower wedge lobectomy ; LLWL, left lower wedge lobectomy.

All nine patients were male, with squamous cell carcinoma. Five of the nine patients received some form of induction therapy. There were six cases of right upper wedge lobectomy, two of middle and lower wedge lobectomy, and one case of left lower wedge lobectomy (Table 1). During this period, five patients underwent sleeve lobectomy. Wedge lobectomy was selected for patients who had undergone induction chemo-radiotherapy or chemotherapy, or patients with severe diabetes mellitus.

Operative findings

We estimated the angle of the cutting line with bronchial wedge resection and the shape of the bronchial defect before suturing for plasty. Regarding the wedge angle of the bronchial cutting line, we classified the cases as involving a narrow wedge angle or wide wedge angle. We defined a narrow wedge angle as being less than 45 degrees.

We classified the shape of the bronchial defect after wedge resection as either "eyeglasses" type or "ski goggles" type. The eyeglasses type is characterized by a short preserving bronchial connection due to a deeper incision (we called this portion the bronchial bridge). The ski goggles type exhibited a relatively long bronchial bridge (Fig. 1a, b).

The suture of the bronchial defect was accomplished, in a single layer, with interrupted absorbable suture No.4 such as Maxon™. In all patients, the bronchial stump was covered with intercostal muscle flap.

Endoscopic findings

Bronchoscopy was routinely performed on postoperative day 8. Follow-up bronchoscopy was performed in four patients. Regarding the endoscopic findings of kinking, we evaluated the

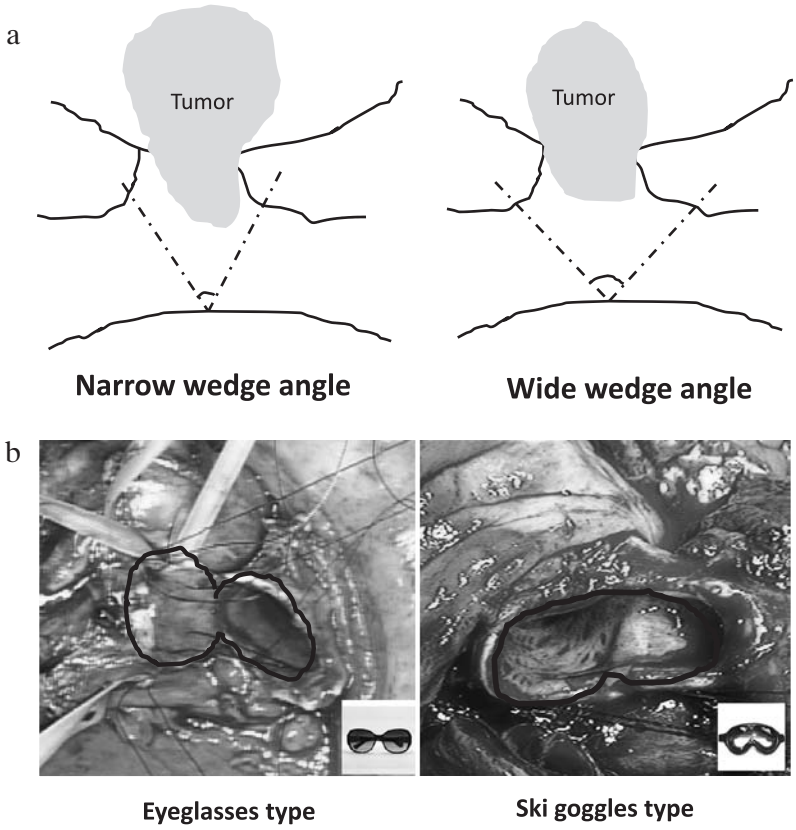

Fig. 1.
a. Angle of the cutting line with bronchial wedge resection.
b. Intraoperative findings after wedge resection of the bronchus (before suturing for plasty).

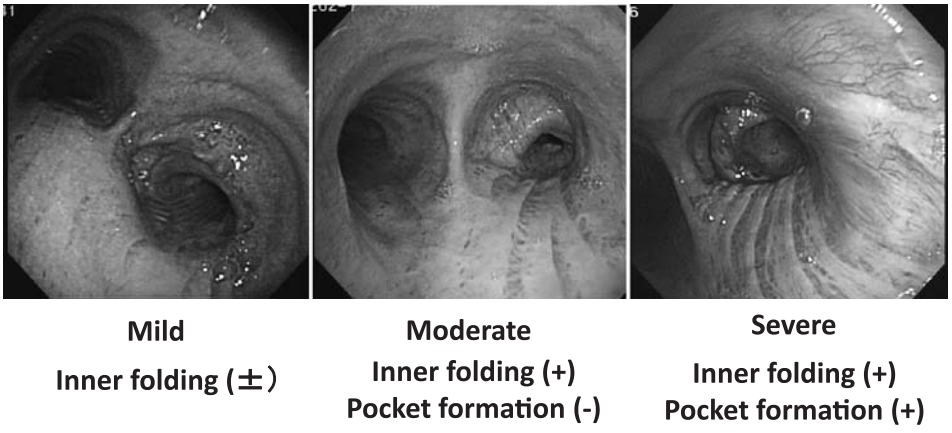

Fig. 2. Endoscopic findings. The degree of kinking at the bronchoplastic site.

degree of inner folding and the presence of pocket formation. The findings of kinking at the bronchoplastic site were categorized as mild, moderate, or severe. Mild kinking involved no or only slight inner folding. Moderate kinking involved readily apparent inner folding without pocket formation. Severe kinking involved readily apparent inner folding with pocket formation (Fig. 2).

Table 2. Results

	Case [a]	Operation	Wedge angle	Bronchial defect shape	Degree of kinking	Complication	Prognosis
1.	64 / M	RUWL	Wide	Ski goggles	Severe	(−)	36 mo ; dead
2.	58 / M	RUWL	Narrow	Ski goggles	Moderate	(−)	16 mo ; dead
3.	75 / M	RUWL	Wide	Ski goggles	Severe	(−)	18 mo ; dead
4.	68 / M	RUWL	Wide	Eyeglasses	Moderate	(−)	13 mo ; dead
5.	65 / M	RUWL	Narrow	Eyeglasses	Mild	(−)	70 mo, alive
6.	55 / M	RUWL	Wide	Eyeglasses	Mild	(−)	30 mo ; alive
7.	64 / M	RMLWL	Wide	Ski goggles	Mild	(−)	58 mo ; dead
8.	51 / M	RMLWL	Wide	Ski goggles	Moderate	(−)	Unknown
9.	46 / M	LLWL	Wide	Eyeglasses	Moderate	(−)	23 mo ; dead

[a] Age (y) / gender.

M, male ; RUWL, right upper wedge lobectomy ; RMLWL, right middle and lower wedge lobectomy ; LLWL, left lower wedge lobectomy.

Results

With respect to the degree of the wedge angle, two cases involved narrow angles and seven cases involved wide angles. Regarding the shape of the defect of the bronchus, five cases involved the ski goggles type and four cases involved the eyeglasses type. There were two cases of severe kinking, both of which involved right upper wedge lobectomy and the ski goggles type shape.

In the right upper wedge lobectomy procedure, cases involving the ski goggles type shape tended to kink more severely than those involving the eyeglasses type. Two cases of the ski goggles type defect after right middle and lower wedge lobectomy did not display severe kinking. The postoperative courses of all patients were uneventful (Table 2). The follow-up endoscopic findings in four patients revealed no progression of kinking at the bronchoplastic site.

Discussion

Sleeve lobectomy has the advantage of an ability to achieve adequate surgical margins and has a variety of indications for many bronchial tumors. However, anastomotic complications can cause fatal complications. The operative mortality rate for sleeve lobectomy has been reported to be 1.8-11.4%[1].

According to the review of Tedder et al of 1915 bronchoplastic procedures, late complications included an approximately 5% rate of bronchial stricture, a 3.5% rate of bronchopleural fistulaes (BPF), and a 2.6% rate of bronchovascular fistulaes[2].

The advantages of wedge lobectomy include a relatively easy suturing technique, the potential to preserve the bronchial blood supply and a reduction in the incidence of major anastomotic complications. Park *et al* reported that the incidence of bronchial stenosis and the rate of BPF were 2.6% and 1.5%, respectively in 191 patients who underwent wedge bronchoplastic

lobectomy[3]. Kruger *et al* reported a significantly lower rate of anastomotic complications and pneumonias after wedge lobectomy than after sleeve bronchoplasty[4]. In another comparative study of sleeve lobectomy and wedge lobectomy, wedge lobectomy has been reported as a useful bronchoplastic procedure in terms of safety, prognosis, and postoperative respiratory function[5-7]. Although the number of patients in our study is small, there were no deaths, nor any cases of bronchial stenosis or BPF.

The disadvantage of bronchial wedge resection is kinking at the level of reconstruction. Khargi *et al* have reported that anastomotic complications, such as bronchial stenosis, frequently developed after wedge lobectomy[8]. In the postoperative endoscopic findings in this study, the pattern of bronchial deformity of almost all cases after wedge lobectomy revealed an inner folding at the site of the bronchial preserving portion. On the other hand, postoperative bronchoscopy in five cases with sleeve lobectomy during the same period revealed no findings of any bronchial deformity.

The cutting design of the bronchus is the most important factor to prevent stenosis at the level of reconstruction. It has been demonstrated that a smaller wedge angle and deeper incision can reduce the incidence of kinking at the level of reconstruction. Although we classified the cases as involving a narrow wedge angle or wide wedge angle in this study, this classification was relatively rough due to the limitations of two-dimensional images. Therefore, we also classified the shape of the bronchial defect as either the eyeglasses type or ski goggles type. Tsubota *et al*[6] described that a deep wedge indicates that a part of the membranous portion in continuity is not resected. Massard *et al* reported that bronchial wedge excisions were shaped in order to reduce the bronchial bridge to a length of less than 5 mm, to prevent bulging into the bronchial lumen[9]. Our study also revealed that cases with a long bronchial bridge (ski goggles type) tended to kink more severely than cases with a short bronchial bridge (eyeglasses type) in right upper wedge lobectomy.

On the other hand, two cases of the ski goggles type treated with right middle and lower wedge lobectomy did not display severe kinking. Anatomically, the right main bronchus and truncus intermedius are in a straight line, so wedge resection causes bronchial kinking. However, in right middle and lower wedge lobectomy, because the right main bronchus and upper lobe bronchus are not in a straight line, wedge resection keeps the anastomosis straight.

Sleeve lobectomy is a standard procedure that can be performed in any segment or lobe in either lung, and bronchial kinking seldom occurs at the anastomosis site. However, wedge lobectomy may be a preferable procedure in patients with a high risk of anastomotic dehiscence.

A good indication for wedge lobectomy is for high risk patients for bronchoplastic surgery, such as patients who have undergone high dose radiation therapy, or patients with severe diabetes mellitus, or long-term steroid use.

The limitation of this study is the small number of surgical cases and there is no comparative study between wedge lobectomy and sleeve lobectomy.

In conclusion the choice of sleeve versus wedge lobectomy is determined according to the nature of the tumor and the patient's condition. When wedge lobectomy is selected, in order to prevent kinking of the bronchoplastic site after right upper wedge lobectomy, the area of bronchial wedge excision should be shaped to reduce the length of the bronchial bridge.

Conflict of interest disclosure

There is no conflict of interest to disclose.

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[Received March 17, 2015 : Accepted April 27, 2015]