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Surgical treatment of superficial esophageal cancer

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Abstract *Objective:* The worldwide incidence of superficial esophageal cancer (SEC) is increasing. The aim of this study is to review the systematic surgical outcomes of esophagectomy for SEC. *Data sources:* Only manuscripts written in English and written between 1980 and 2003 were selected from MEDLINE. The keywords consisting of superficial esophageal cancer, early esophageal cancer, and early stage or superficial stage or stage I in esophageal cancer were searched. *Study selection:* There were no exclusion criteria for published information relevant to the topics. The most representative articles were selected when there were several articles from the same institution. Case reports were excluded. *Data extractions:* Thirty-two manuscripts were finally collected from MEDLINE and eight articles were also added from reference lists of the pertinent literatures. In evaluating the statistical analysis of the complications of the reported literature, collective method was used. *Data synthesis:* The collected information was organized. *Conclusions:* The conclusions drawn from those articles showed that the overall prevalence of SEC accounted around 10% and increased to 25% in the 2000s. The overall incidence of lymph node metastasis of SEC was about 25% and its incidences in mucosal and submucosal cancer were 5 and 35%, respectively. The percentage of the cases of squamous cell carcinoma (SCC) vs adenocarcinoma (AC) widely varied depending on the geographic locations reported; most SCC cases were from the Asian countries and most AC cases were from the European countries. Clinical significance of multimodal treatment for SEC has dramatically developed in the recent era and could provide various potential therapeutic options for SEC. These concepts make it possible to individualize surgical management of SEC as part of various multimodal treatments. The operative approaches for SEC varied from minimally invasive thoracoscopic esophagectomy, limited transabdominal distal esophagectomy, conventional transthoracic esophagectomy, transhiatal esophagectomy without thoracotomy, en bloc esophagectomy, and to extended esophagectomy with a complete three-field lymph node dissection. A 5-year overall survival rate of SEC after esophagectomy was good (46 to 83%) to excellent (71 and 100%) for mucosal SEC, but far from satisfactory (33 and 78%) for submucosal SEC. Early diagnosis, development of multimodal treatment, standardization of the surgical procedure including routine lymph node dissection, and improved perioperative management of patients have led to a better survival for patients with SEC.

Keywords Superficial esophageal cancer · Early esophageal cancer · Lymph node metastasis · Esophagectomy · Prognosis

Introduction

The worldwide incidence of esophageal cancer is increasing, particularly for adenocarcinoma (AC) of the lower esophagus and gastroesophageal junction [1, 2]. At diagnosis, most of esophageal carcinomas are in the advanced stage, thus surgery is inappropriate in 40–60% of patients mainly due to the unresectable disease status, presence of distant metastases, or high operative risk [3]. The long-term survival rate of patients who have undergone esophagectomy remains still low. A collected review of patients treated between 1953 and 1978 showed that a 5-year survival rate after surgery was only 4% [4] and another review of patients treated between 1980 and 1988 showed only a marginal improvement of a 5-year survival rate (4 to 10%) [5]. Neoadjuvant and/or postoperative adjuvant treatments are widely used to improve the surgical outcomes. Recent two metaanalysis comparing neoadjuvant treatment and surgery to surgery alone for resectable esophageal cancer showed that preoperative chemotherapy [6] or preoperative chemoradiotherapy [7] significantly increased survival at 3 years compared with surgery alone. However, there was an estimated 6.4% improvement in 2-year survival and only 10–20% of patients survived at 5 years.

Recently, clinical significance of multimodal treatment for SEC has dramatically developed and could provide various potential therapeutic options for SEC. These concepts make it possible to individualize surgical management of SEC as part of various multimodal treatments. Among the various treatment modalities, surgery remains the mainstay for the treatment of patients with potentially curable disease. The long-term survival is however disappointing when the disease extends through the esophageal wall or when it is diagnosed with widespread lymph node involvement [3, 8, 9]. The operative approaches for the superficial esophageal cancer (SEC), thus, vary from minimally invasive thoracoscopic esophagectomy (MIE) [10], conventional transthoracic esophagectomy (TTE) [11, 12], limited esophagectomy without thoracotomy [13–15], en bloc esophagectomy [16–18], and to extended esophagectomy with three-field lymph node dissection [19, 20].

It is desirable to detect esophageal cancer at an early stage because the prognosis of patients with esophageal cancer is clearly related with the disease progression. Recent advances in diagnostic modalities make it possible to frequently diagnose esophageal cancer at an early stage. The easy availability of flexible gastroendoscopy and adoption of screening programs have contributed to the early detection of esophageal cancer [21]. This review examines the current results of esophagectomy for SEC.

Materials and methods

SEC is defined as intraepithelial (Tis), mucosal (T1a), and submucosal (T1b) esophageal carcinoma irrespective of the lymph node status. Only manuscripts written in English were selected from MEDLINE between January 1980 and December 2003. The terms of surgical treatment of superficial esophageal cancer (number of citations identified: 38), early esophageal cancer (EEC: 53), and early stage (28) or superficial stage (14) or stage I (10) in esophageal cancer were identified. Articles regarding surgical treatment were included and those regarding endoscopic treatment were excluded. Articles regarding all stages of esophageal carcinoma were also excluded. Representative manuscripts were selected when there were several manuscripts from the same institution and manuscripts of a case report category were excluded. After check and evaluation, 13 manuscripts were excluded. Thirty-two manuscripts were finally collected from MEDLINE and eight articles were also added from reference lists of the personal pertinent literature. In evaluating the statistical analysis of the data from the reported literature, collective method [16, 20] was used.

Results

Definition of SEC

In the esophagus, neoplastic lesions are called “superficial” when the appearance suggests either a small or noninvasive neoplastic lesion. “SEC” corresponds to the T1 stage of the Tumor-Node-Metastasis/American Joint Committee on Cancer (TNM/AJCC) classification [22, 23] in which invasion is limited to the mucosa or submucosa. Superficial tumors are nonobstructive, usually asymptomatic, and often detected by incidental finding or by screening.

The term “EEC” suggests a localized tumor with potential for complete cure after resection and a low risk of metastasis with an excellent prognosis. In gastric cancer classification [24, 25], early gastric cancer is defined as intraepithelial, mucosal, or submucosal cancer irrespective of the presence or absence of lymph node metastasis. In esophageal cancers, some authors favorably use the same definition for the EEC as it is described for the early gastric cancer [26]. Others defined it as intraepithelial and mucosal cancer without lymph node metastasis [27] or as Dukes’ A cancers in which invasion is limited to the muscularis propria without any lymph node metastasis [28].

In Japan, superficial gastric cancers were classified as subtypes of “type 0” [23, 24]. The term type 0 was chosen to distinguish the classification of superficial lesions from the Borrmann classification proposed in 1926 for advanced gastric tumor, which included types 1 to 4 [29]. This classification of superficial gastric cancer was promptly applied to esophageal tumors [30]. According to the

T category of the TNM/AJCC classification [22, 23], intraepithelial tumor with no invasion into the lamina propria mucosa (lpm) is called as carcinoma in situ (Tis) and not included in tumor registries. Intramucosal carcinoma with invasion of the lpm is called "T1a" and carcinoma with invasion of the submucosa is called "T1b."

In this review, to avoid and take account readers' confusion regarding the terminology, intraepithelial carcinoma is called Tis, intramucosal carcinoma with invasion of the lpm is called T1a (mucosal carcinoma includes both Tis and T1a cancer), and submucosal cancer is defined as T1b. SEC is thus defined as Tis, T1a, and T1b esophageal carcinoma irrespective of the lymph node status (Fig. 1).

Subclassification of SEC according to the depth of tumor invasion

In the esophageal mucosa, the mucosal layers can be separated into three distinct layers comprising of the epithelium (m1), the superficial layer of the lpm (m2), and the deep layer of the lpm (m3). Likewise, the submucosal layer is arbitrarily divided into three successive sectors of equivalent thickness (sm1, sm2, and sm3) (Fig. 2). This precise subclassification of SEC to six layers was proposed by Japanese Society of Esophageal Diseases [30] and was supported by the worldwide workshop of endoscopic classification of superficial neoplastic lesions [31] because the risk of nodal metastases increases from nil to high with the depth of invasion in the successive layers as shown in Fig. 2. However, full thickness submucosa is not available in endoscopic mucosal resection (EMR) specimens and the exact depth of invasion could not be assessed. The only precise method is a quantitative micrometric measure in microns (µm) of the depth of invasion, measuring the distance between the deepest point of cancer invasion and the lower edge of the muscularis mucosa. When submucosal cancer invasion of the squamous cell epithelium is less than 200 µm, the risk of nodal metastases is small and endoscopic treatments can be considered adequate [21, 31]. For AC of Barrett's esophagus, the cut-off value for invasion is less than 500 µm [21, 32].

Preoperative patients' selection by various diagnostic modalities becomes especially important. However, all the present diagnostic modalities, including esophagogram, fiberscopy, computed tomography [33], endoscopic ultrasonography (EUS) [33, 34], magnetic resonance imaging [35], positron emission tomography [36], and thoracoscopic and/or laparoscopic examination [37, 38], have some limitations. The accuracy of EUS in determining the tumor depth that is confined to the submucosal layer (Tis, T1a vs T1b) is questionable [34]. Even in experienced hands, the accuracy of EUS in SEC is insufficient: 67–84% accuracy of differentiation between mucosal and submu-

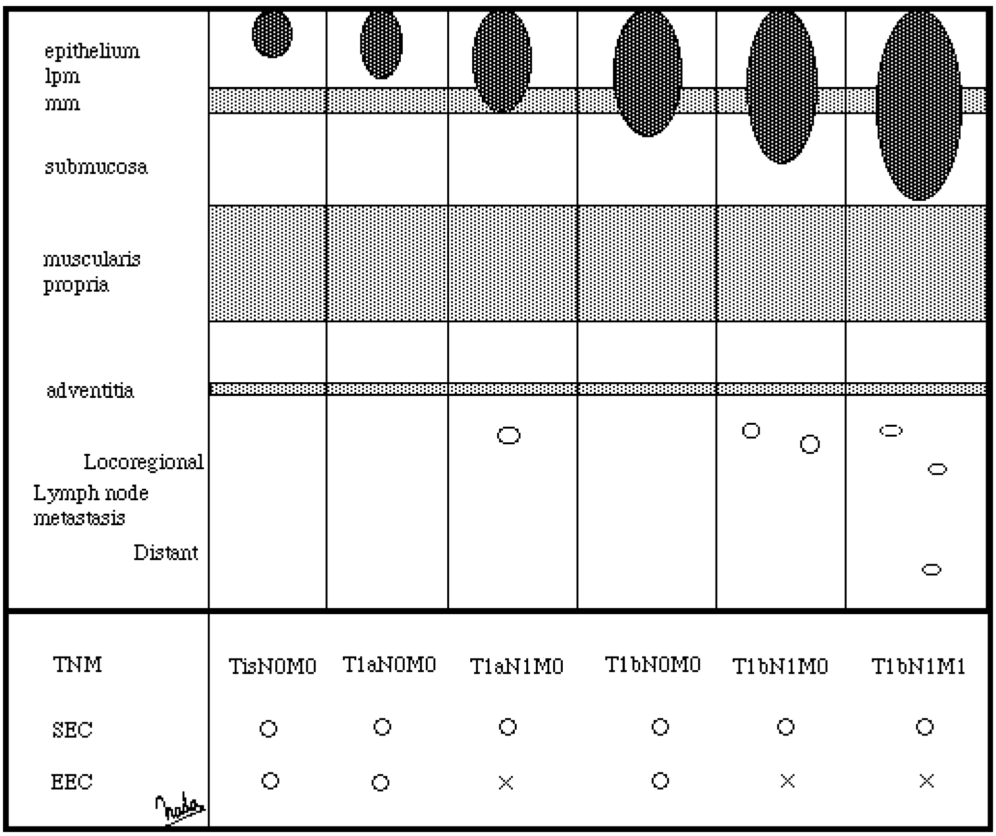

Fig. 1 Definition of SEC. Intraepithelial carcinoma is called Tis, intramucosal carcinoma with invasion of the lamina propria mucosa (*lpm*) is called T1a (mucosal carcinoma includes both Tis and T1a cancer), and submucosal cancer is defined as T1b. Superficial esophageal carcinoma (*SEC*) is defined as Tis, T1a, and T1b esophageal carcinoma irrespective of the lymph node status and early esophageal carcinoma (*EEC*) is defined as superficial carcinoma without lymph node metastasis

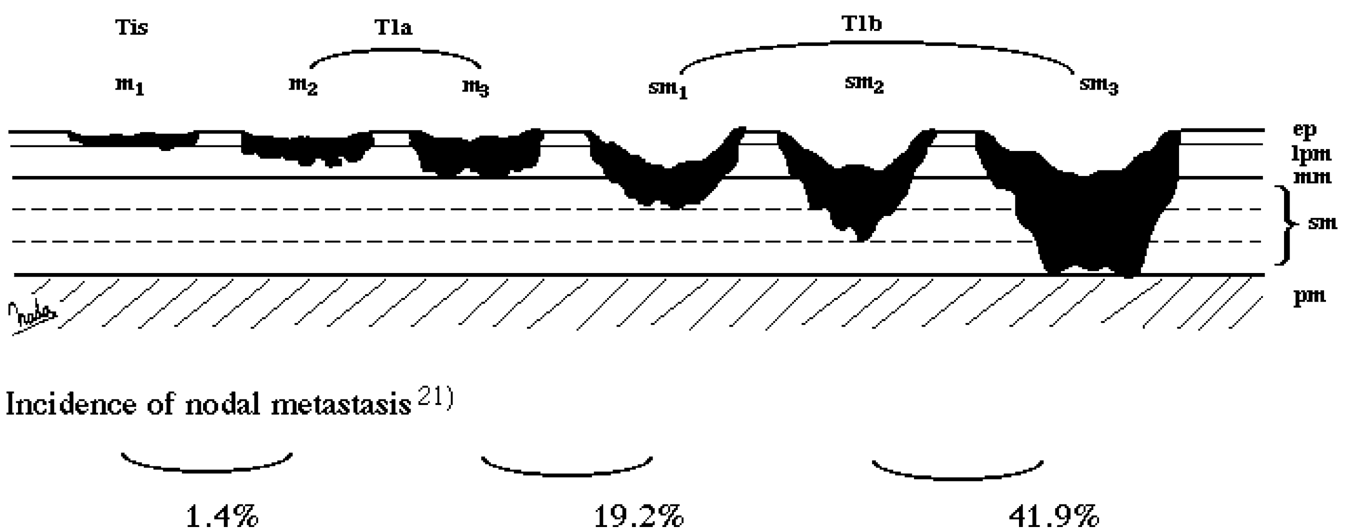

Fig. 2 Subclassification of SEC. *m* Mucosal carcinoma, *m1* carcinoma confined to the epithelium (*Tis*), *m2* carcinoma confined to the superficial layer of the lamina propria mucosa (*lpm*), *m3* carcinoma confined to the deep layer of the lpm, but not beyond the muscularis mucosa (*mm*) (T1a includes both m2 and m3), *sm* submucosal carcinoma (T1b), *sm1* carcinoma confined to superficial layer of the submucosa, *sm2* carcinoma confined to middle layer of the submucosa, *sm3* carcinoma confined to deep layer of the submucosa, and *pm* muscularis propria

cosal infiltration and up to 77% accuracy of lymph node metastasis [34, 39].

Clinicopathological characteristics

1) Prevalence of SEC
The prevalence of SEC in esophageal carcinomas reported ranged from 0.76 to 34%, depending on the different time period and different institutions (Table 1). Before the early 1990s, it accounted around 10%, but it has increased from 15 to 25% in the 2000s. The ratio of Tis, T1a/T1b cases increased from 15% in the 1980s to nearly 50% in the 2000s, reflecting an increased detection of T1a cancer.

2) Incidence of lymph node metastasis
The incidence of lymph node metastasis ranged from 0 to 39% (Table 1). An overall incidence of lymph node metastasis of SEC was about 25% and its incidence in mucosal and submucosal SEC was 5 and 35%, respectively. The incidence of lymph node metastasis did not change by the times mainly as a result of the biological behavior of cancer cells.

3) Pattern and location of lymph node metastasis
The number of metastatic lymph nodes ranged from 1 to 14 (Table 2). The majority of patients had less than three lymph nodes involved.
Regarding the location of lymph node metastasis, cervical nodal involvement was present between 9.3 and 25% [40–45]. T1b squamous cell carcinoma (SCC) of the thoracic esophagus could metastasize to the cervical, mediastinal, and abdominal basins (three-field), whereas lower thoracic AC and/or Barrett's AC could metastasize only to the mediastinal and abdominal nodes (two-field). The majority of patients with SEC have lymph node involvement confined to the regional nodes (N1M0). Distant (cervical and celiac axis, N1M1lym) lymph node metastasis was present between 16.7 and 33.3% [43, 44, 46–48], whereas skip metastasis to the distant nodes (N0M1lym) was rare (Table 2). In T1b SECs, lymph node metastasis was restricted to one field in most cases, ranging from 60 to 83.3% [40–44, 49]; two-field involvement was occasional (16.7–40%) [40, 41, 43, 44, 49] and three-field metastasis was rare. T1b SEC rarely involved all three fields of lymph nodes, whereas mucosal SEC did not involve all three fields. Upper mediastinal lymph node around the bilateral recurrent laryngeal nerves (No. 106rec by Japanese nodal classification [30]) was to be the most frequently involved site followed by perigastric lymph nodes (No. 1, 2, and 3) (Table 2).

4) Multicentric lesions
Multicentric tumor lesions were found in 3.3–57.1% of superficial SCC [41, 44, 46, 50–54] and in 13.3–60.6% of superficial AC [43, 44, 53] (Table 1). Multicentric tumor detection is partly associated with the extent of esophageal resection. Therefore, dye-staining using Lugol [55] of squamous cell epithelium or methylene blue [56, 57] and crystal violet [58] of Barrett's epithelium is mandatory to detect the presence of multiple lesions.

Table 1 Clinicopathological characteristics of SEC

Source	Country	Year	Prevalence (%)	Number of patients			Histological type (%)	Lymph node metastasis (%)			Multicentric lesions (%)
				Total	Tis, T1a/ T1b (%)	Tis, T1a/ T1b (%)	SCC/AC/ others	Tis, T1a	T1b	Total	
Endo et al. [93][a]	Japan	1986	–	113	18/95	16/84	–	11.1	44.2	38.9	9.7
Endo et al. [49][a]	Japan	2000	34	236	112/124	47/53	–	3	41	23	–
Froelicher and Miller [94]	Switzerland	1986	0.76	51[b,c]	33/18	65/35	–	–	–	–	23.5
Schmidt et al. [50]	USA	1986	13	7	1/6	14/86	100/0/0	0	33.3	28.6	57.1
Peracchia et al. [51]	Italy	1989	8.7	61[c]	10/51	16/84	100/0/0	–	–	–	3.3
Bogomoletz et al. [52]	France	1989	22.3	76	23/53	30/70	100/0/0	4.3	30.2	22.4	17.1
Sugimachi et al. [72]	Japan	1989	11.4	42	7/35	17/83	100/0/0	0	17.1	14.3	–
Iizuka et al. [73]	Japan	1989	–	367[b]	49/318	13/87	–	–	–	–	–
Kato et al. [83][a]	Japan	1990	9.1	92	24/68	26/74	76/4/20	4.2	35.3	27.2	–
Kato et al. [40][a]	Japan	1993	–	43	10/33	23/77	84/0/16	10	57.6	46.5	–
Sugimachi et al. [27]	Japan	1991	11.4	243[b]	46/197	19/81	88/?/12	6.5	32.5	27.6	–
Yoshinaka et al. [46]	Japan	1991	14.9	59	21/38	36/64	95/?/5	0	47.4	30.5	13.6
Haruna et al. [84]	Japan	1991	7.7	27	8/19	30/70	100/0/0	0	21.2	14.8	–
Endo et al. [74]	Japan	1991	–	1,496[b]	500/996	33/67	95/1/4	4.2	35.2	24.9	–
Nageya [95]	Japan	1992	–	2,517[b]	726/1,791	29/71	95/–/–	5.2	36.5	27.5	–
Goseki et al. [96]	Japan	1992	–	52	22/30	42/58	100/0/0	4.5	50	30.8	–
Nishimaki et al. [41][a]	Japan	1993	15.2	89	31/58	35/65	91/0/9	0	41.4	27	28.1
Nishimaki et al. [42][a]	Japan	1999	–	51[d]	4/47[e]	–	92/0/8	25	60	57	–
Ide et al. [97]	Japan	1994	29.3	118	33/85	28/72	100/0/0	3	30.6	22.9	–
Holscher et al. [53][a]	Germany	1995	17.1	77	18/59	23/77	61/39/0	0	23.7	18.2	14.3 (SCC=14.8, AC=13.3)
Stein et al. [43][a]	Germany	2000	25.5	94	38/56	40/60	0/100/0	0	17.9	10.6	60.6
Tachibana et al. [44]	Japan	1997	18.2	30	15/15	50/50	100/0/0	0	53.3	26.7	26.7
Kodama and Kakegawa [98]	Japan	1998	–	2,418[b]	922/1,164[e]	44/56	93/2/5	5.7	38.9	27.8	–
Natsugoe et al. [47]	Japan	1998	23.9	30[f]	30/–	–	100/0/0	10	–	–	–
Matsubara et al. [45]	Japan	1999	31.8	110	32/78	29/71	100/0/0	15.6	48.7	39	–
Shimizu et al. [99]	Japan	1999	14.4	74[g]	74/–	–	100/0/0	–	–	4.1	–
Ruol et al. [75]	Italy	2000	–	26	13/13	50/50	0/100/0	–	–	15.4	–
Sandick et al. [48]	The Netherlands	2000	18.5	32	12/20	38/62	0/100/0	0	30	18.8	28.1
Rice et al. [79]	USA	2001	21.1	122	91/30	75/25	0/100/0	2.2	19.4	6.6	–
Yuasa et al. [54]	Japan	2001	16.9	54	5/49	9/91	93/0/7	–	–	33.3	16.7
Fujita et al. [76]	Japan	2001	23.4	150	72/78	48/52	–	2.9	30.8	16.7	–
Benjamin et al. [100]	Australia	2003	–	16	9/7	56/44	0/100/0	0	0	0	–

– Not determined, *SCC* squamous cell carcinoma, and *AC* adenocarcinoma
[a]Data from the same institution were reported
[b]Data collections
[c]No cases
[d]cT1b cases
[e]Data selected
[f]Tis, T1a cases (T1b excluded)
[g]T1a cases (Tis, T1b excluded)

Table 2 Pattern of lymph node metastasis of SEC

Source[a]	Country	Number of lymph node metastasis (LNM)				Location of LNM (1)							Location of LNM (2)			Field of LNM			Frequent sites of LNM[b]			Skip LNM[c]
		Number	1 LNM	2–3 LNM	>4 LNM	Primary lesion	Cervical	Mediastinum				Abdominal	N1MO	N1M1ly	NOMM1ly	One-field	Two-field	Three-field	Most	≥10%	≥ 5%	
								Upper	Middle	Middle and lower	Lower											
Bogomoletz et al. [52]	France	1–5, mean 2.2	–			–							–			–			–			–
Sugimachi et al. [27]	Japan	T1a, mean 1.3	66.7 (2)	33.3 (1)	0	T1a	No	No	No		Yes	Yes	–			–			–			–
		T1b, mean 1.8				T1b	Yes	Yes	Yes		Yes	Yes	–			3FLNM from T1b			–			–
Yoshinaka et al. [46]	Japan	–	–			–							72.2 (13)	22.2 (4)	5.6 (1)	–			–			–
Kato et al. [40]	Japan	–	–				11.6 (5)		30.2 (13)			27.9 (12)				60 (12)	30 (6)	10 (2)	106rec, 1	1, 2, 106rec	7, 110, 3	–
Nishimaki et al. [41][a]	Japan	1–10	65.2 (15)	29.2 (7)	8.3 (2)	Upper: C+A, middle: C+M+A, lower: M+A	16.7 (4)		58.3 (14)			41.7 (10)	–			83.3 (20)	16.7 (4)	0	106 rec	None	1, 106rec, 110	–
Nishimaki et al. [42][a]	Japan	1–10, median 1	55.2 (16)	37.9 (11)	6.9 (2)	T1b	21.6 (11)	23.5 (12)			9.8 (5)	19.6 (20)	–			72.4 (21)	–	–	106rec	106rec, perigastric, 101	104	41.3 (12)
Tachibana et al. [44]	Japan	–	–				25 (2)	37.5 (3)		12.5 (1)		50 (4)	75 (6)	25 (2)	0	75 (6)	25 (2)	0	Perigastric	Perigastric, 106rec	110	–
Natsugoe et al. [47][d]	Japan	1–3, mean 1.7	66.7 (2)	33.3 (1)	0		Yes	Yes	No		Yes	No	66.7 (2)	33.3 (1)	0	100 (3)[d]	0[d]	0[d]	106rec	None	106rec	–
Matsubara et al. [45]	Japan	–					9.3 (4)	55.8 (24)		20.9 (9)		41.9 (18)	–			–			106rec > perigastric			–
Endo et al. [49]	Japan	–	46.2 (24)	34.6 (18)	19.2 (10)	Lower: M+A	25 (13)		69.2 (36)			38.5 (23)	–			69.3 (36)	23.1 (12)	7.7 (4)	106rec	106rec, 1, 2, 7, 104, 110	108, 101	–
Sandick et al. [48]	The Netherlands	1–4	50 (3)	33.3 (2)	16.7 (1)	Adenocarcinoma	No	No	Yes		Yes	Yes	83.5 (5)	16.7 (1)	0	–			–			–
Stein et al. [43]	Germany	1–14	40 (4)	40 (4)	20 (2)	Barret	10 (1)	0	10 (1)		40 (4)	80 (8)	80 (8)	20 (2)	0	60 (6)	40 (4)	0	Perigastric	Perigastric	110	–

Data are given as percentage (number) of patients
– Not determined, *LNM* lymph node metastasis, *C* cervical LNM, *M* mediastinal LNM, *A* abdominal LNM, and *3FLNM* three-field lymph node metastasis
[a] Data from the same institution were reported
[b] Number represents location of LNM by Japanese classification [30]
[c] Cervical or abdominal LNM without mediastinal LNM
[d] Tis, T1a cases (T1b excluded)

Surgical treatment

Depending on the tumor type and treatment philosophy of the attending surgeons, surgical techniques with curative intent for SEC vary widely from thoracoscopic esophagectomy to three-phase TTE with three-field lymph node dissection (3FLND) and to en bloc esophagectomy.

Recently, ablative techniques involving electrosurgery, laser- and argon-directed light waves, and photodynamic therapy were advocated [59, 60]. The risk and benefit of these procedures have not yet been evaluated, thus, the mucosal ablation remains investigational and should be performed under clinical trials.

A limited resection of the distal esophagus and proximal stomach, regional lymphadenectomy through a transabdominal approach for early Barrett's AC (Merendino procedure) was reported [43]. There were no deaths or recurrences after this limited resection (n=49).

Law and Wong [10] reviewed various types of minimally invasive esophagectomy for esophageal cancer. Minimally invasive techniques were certainly feasible and could be done safely in centers with experienced operators. Postoperative morbidity and mortality rates were not reduced substantially and operating time was longer. There were also concerns regarding the adequacy of tumor clearance.

Excellent experiences with transhiatal esophagectomy without thoracotomy (THE) was reported [14]. Five-year survival rate of stage I was 59%. Moreover, Siewert et al. [61] and Holscher et al. [53] showed that radical subtotal esophagectomy can be performed by extended THE that includes a systematic lymphadenectomy in the lower thoracic and upper abdominal compartments.

Ivor Lewis procedure can be performed with low mortality (2.1–4%), low leakage rate (3.5–4%), and acceptable morbidity (29–40%), but with a disappointing 3-year survival rate (29.6%) [62, 63]. The median survival time of patients with stage I carcinoma was 3.0 years [62].

For tumors located in the upper and middle thoracic esophagus, a three-phase transthoracic subtotal esophagectomy with two-field lymphadenectomy (2FLND) is the procedure of choice. Lymphadenectomy along the paratracheal nodes is not routinely performed. This 2FLND can be performed with a moderately low mortality (5–7.4%) and a 5-year survival rate between 20.8 and 37.4% could be attained [61, 64, 65].

Extended esophagectomy with 3FLND are done through right thoracotomy, laparotomy, and bilateral cervical collar incision. Tachibana et al. [20] reported a review of the surgical results of 3FLND. The incidence of lymph node metastasis around the recurrent laryngeal nerve was high (26.7–48.6%) and that around the deep cervix was between 16.7 and 35%. The 5-year survival rate of stage I was excellent (91.7–100%).

The basic principle of en bloc esophagectomy is to resect the tumor-bearing esophagus within an envelope of adjoining tissues. A review of the surgical results of en bloc esophagectomy was reported [16]. Five-year survival rate of stage I was between 73 and 94% [16, 18, 66, 67].

Vagal-sparing esophagectomy [68, 69] can be advocated for patients with high-grade dysplasia or mucosal AC of the Barrett's esophagus.

Surgical outcomes

1) Hospital mortality
   Postoperative hospital mortality rate (death during the hospital stay) after esophagectomy for SEC was reported between 0 and 10% (Table 3). Septic complication associated with leakage and pneumonia was the main cause of death (Table 4).
2) Morbidity
   The overall morbidity rate was 40.3% (278/690) varying from 26.1 to 80.4% (Table 4). Septic complication was the most common cause (15.9%) and most of them were associated with anastomotic leakage. Pulmonary complication was the next common cause, 11.2%; about half of those were atelectasis and pneumonia, including aspiration pneumonia. Among the miscellaneous complications, over half of them developed recurrent laryngeal nerve paralysis (11.0%). Pulmonary complications frequently occurred in patients with vocal cord paralysis, leading to significantly more reintubations and prolonged ventilation time and stay in the intensive care unit [70]. Vocal cord paralysis produced debilitation in performance status and swallowing [71].
3) Five-year overall survival and prognostic factors
   An excellent overall 5-year survival rate varying from 33 to 100% after esophagectomy for SEC was reported [40–42, 45, 46, 49, 51, 53, 72–79] (Table 3). A five-year overall survival rate for mucosal SEC was excellent (71.4–100%), but was far from satisfactory for submucosal SEC (33–78.8%).

   Well-known prognostic factors of survival were the T category (Tis, T1a vs T1b) and N category (N0 vs N1). Method of surgical resection [51, 79, 80], intramural metastasis [81], vessel invasion [81], histological grading [82], histological type of AC [53], age [79], extent of lymph node dissection [76], presence or absence of postoperative complications [76], and presence or absence of double cancer [76] were another possible prognosticators (Table 3). Moreover, multivariate analysis of prognostic factors showed that independent prognosticators were the N category [79, 81, 82], histological grading [82], histological type of AC [53], intramural metastasis, vessel invasion [76, 81], age, surgical procedure of TTE [79], three-field lymph node dissection, complications, and double cancer [76].

Table 3 Surgical results of SEC

Source	Country	Year	Number of samples	Histological type (%)	Postoperative mortality (%)	5-year survival rate (%)			Prognostic factors		
				SCC/AC/ others		Tis, T1a	T1b	Total	Tis, T1a vs T1b	N0 vs N1	Others
Endo et al. [93][a]	Japan	1986	113[b]	–	–	100	70	–	–	–	
Endo et al. [49][a]	Japan	2000	236	–	–	87–82	88–52	67	Yes	–	
Peracchia et al. [51][a]	Italy	1989	61[b]	100/0/0	3.3	100	33	46	Yes	–	THE>TTE
Ruol et al. [75][a]	Italy	2000	26	0/100/0	4.8	–	–	80	–	Yes	
Sugimachi et al. [72][a]	Japan	1989	42	100/0/0	2.4[c]	–	–	56.7	Yes	Yes	
Sugimachi et al. [77][a]	Japan	1993	75	96/0/4	0	100	49	57	Yes	Yes	
Watanabe et al. [81][a]	Japan	2000	78[d]	–	0	100–95.2	74.3	–	Yes	Yes	IM, vessel invasion
Iizuka et al. [73]	Japan	1989	367[e]	–	–	–	47.6[f]	49.9[f]	–	–	
Kato et al. [83][a]	Japan	1990	92	76/4/20	5.4	83.5	54.9	–	Yes	Yes	
Kato et al. [40][a]	Japan	1993	43	84/0/16	2.3	–	–	73.2	–	–	
Tajima et al. [82][a]	Japan	2000	240	100/0/0	–	100	78.4	–	–	Yes	Histologic grade
Sugimachi et al. [27]	Japan	1991	243[e]	88/?/12	1.2[c]	88.4	54.5	–	Yes	–	
Yoshinaka et al. [46]	Japan	1991	59	95/?/5	5.1	100[f]	–	73[f]	–	Yes	
Endo et al. [74]	Japan	1991	1,496[e]	95/1/4	–	91.9	66.9	75.7	Yes	Yes	
Nabeya et al. [95]	Japan	1992	2,517[e]	95/–/–	–	87.6[g,h]	63.6[h]	–	Yes	Yes	
Menke-Pluymers [78]	The Netherlands	1992	13[b]	0/100/0	–	–	–	63	–	–	
Nishimaki et al. [41][a]	Japan	1993	89	91/0/9	2.2	71.4	48.2	55.4	Yes	–	
Nishimaki et al. [42][a]	Japan	1999	51	43/0/8	0	–	–	68	–	Yes	C LN=non-CLN
Holscher et al. [53][a]	Germany	1995	77	61/39/0	7.8	AC: 100 SCC: 63.5	78.8 54.6	82.5 59.2	Yes	No	AC>SCC
Stein et al. [43][a]	Germany	2000	94	0/100/0	3.2	–	–	–	No	Yes	Limited resection
Bonavina et al. [80]	Italy	1995	253[b,e]	–	9.1	72.8	44.3	–	Yes	–	TTE>THE
Tachibana et al. [44]	Japan	1997	30	100/0/0	10	86.7	65	–	Yes	–	
Natsugoe et al. [47]	Japan	1998	30[i]	100/0/0	3.3	75	–	–	–	–	

Table 3 (continued)

Source	Country	Year	Number of samples	Histological type (%) SCC/AC/others	Postoperative mortality (%)	5-year survival rate (%)			Prognostic factors		
						Tis, T1a	T1b	Total	Tis, T1a vs T1b	N0 vs N1	Others
Matsubara et al. [45]	Japan	1999	110	100/0/0	1	–	–	75	–	Yes	
Sandick et al. [48]	The Netherlands	2000	32	0/100/0	0	100[j]	82[j]	88[j]	No	–	
Rice et al. [79]	USA	2001	122	0/100/0	2.5	–	–	77	Yes	Yes	THE>TTE, younger>older
Fujita et al. [76]	Japan	2001	150	–	6	71/61[k]	74/31[k]	61	–	–	3FLND>2FLND, complications, double cancer

– Not determined, *SCC* squamous cell carcinoma, *AC* adenocarcinoma, *TTE* transthoracic esophagectomy, *THE* transhiatal esophagectomy, *CLN* cervical lymph node metastasis, *IM* intramural metastasis, *3FLND* three-field lymph node dissection, and *2FLND* two-field lymph node dissection
[a]Data from the same institution were reported
[b]pN0 cases
[c]Thirty-day mortality
[d]T1b cases
[e]Data collections
[f]Postoperative mortality excluded
[g]T1a cases survival
[h]disease-specific survival
[i]Tis, T1a cases
[j]Three-year disease-specific survival
[k]Survival of the two different treatments

4) Recurrence pattern
The incidence of recurrence after esophagectomy for SEC varied from 0% (T1a cases only) to 25.3%, averaging 14% (179/1278) (Table 5). Recurrence sites equally affected locoregional (*n*=50) and distant regions (*n*=45), but in only a few instances were both regions affected (*n*=8) (Table 5).

Double cancer concomitant with SEC

Double cancers were found before the diagnosis of SEC, synchronously (within 1 year after SEC diagnosis) and metachronously (found beyond 1 year after diagnosis of SEC). The average incidence of double cancer was 22.1% (718/3,254), varying from 5.5 to 45.9% (Table 6). The most affected concomitant organs of double cancer were gastric cancer (*n*=317), followed by head and neck cancer (*n*=262) and colorectal cancer (*n*=113). Previous, synchronous, and metachronous double cancers were found in 33.5, 44.6, and 21.9%, respectively.

Adjuvant treatment

Neoadjuvant cases were excluded in this review because neoadjuvant treatment makes the diagnosis of depth of tumor invasion difficult. The incidence of patients who received adjuvant treatment was between 9.5 and 54.9% [40–42, 50, 75, 76, 83, 84] with a high incidence of adjuvant treatment for T1b SEC. Nodal involvement or positive proximal surgical margin was a indication. However, a definite indication of adjuvant chemotherapy is controversial at this moment.

Discussion

Patient characteristics of SEC

The current data of this manuscript suggested that SEC, particularly mucosal cancer, can be frequently found probably due to the recent development of diagnostic modalities [21]. In general, the prevalence of SEC reported from Japan (7.7–34%) was higher than that (0.76–22.3%) from the Western countries. Submucosal SCC of the thoracic esophagus could metastasize to the cervical, mediastinal, and abdominal basins (three-field), whereas lower thoracic AC and/or Barrett's AC could metastasize

Table 4 Mortality and morbidity of esophagectomy for SEC

Complication	Kato et al. [83] 1990 (*n*=92)[a]	Sugimachi et al. [77] 1993 (*n*=75)[a]	Holscher et al. [53] 1995 (*n*=77)[a]	Bonavina et al. [80] 1995 (*n*=253)[a]	Nishimaki et al. [42] 1999 (*n*=51)[a]	Matsubara et al. [45] 1999 (*n*=110)[a]	Sandick et al. [48] 2000 (*n*=32)[a]	Rice et al. [79] 2001 (*n*=122)[a]	Total
Fatal (%)	5.4 (5)	0	7.8 (6)	9.1 (23)	0	0.9 (1)	0	2.5 (3)	4.7 (38/812)[b]
Pneumonia	2.2 (2)		1.3 (1)	ND		ND		ND	3
Leaks	2.2 (2)		2.6 (2)						4
Cardiac failure	1.1 (1)								1
Tracheal lesion			1.3 (1)						1
GI bleeding			1.3 (1)						1
CVA			1.3 (1)						1
Nonfatal (%)	58.7 (54)	34.7 (26)	45.4 (35)	26.1 (66)	80.4 (41)	39.1 (43)	40.6 (13)	ND	40.3 (278/690)[b]
Bleeding	3.3 (3)	1.3 (1)	7.8 (6)	0	0	0	0	0	1.2 (10/812)
Pulmonary	8.7 (8)	9.3 (7)	5.2 (4)	10.7 (27)	33.3 (17)	5.5 (6)	25 (8)	13.1 (14)	11.2 (91/812)[b]
Pneumonia	5.4 (5)	6.7 (5)	ND		ND	ND	21.8 (7)	8.2 (10)	27
Atelectasis				5.1 (13)					13
Pyothorax	1.1 (1)	1.3 (1)							2
Chylothorax	2.2 (2)	1.3 (1)		0.8 (2)			3.1 (1)		6
Pleural effusion				2.4 (6)					6
ARDS				1.6 (4)					4
Pulmonary embolism				0.8 (2)					2
Aspiration								4.9 (6)	6
Cardiac	0	0	0	0	0	0	9.4 (3)	0	0.4 (3/812)[b]
CHF							9.4 (3)		3
Septic	27.2 (25)	21.3 (16)	33.8 (26)	7.9 (20)	19.6 (10)	10.9 (12)	12.5 (4)	13.1 (16)	15.9 (129/812)[b]
Sepsis									4
All	1.1 (1)				3.9 (2)				3
Abdomen	1.1 (1)								1
Leaks									125
Anastomotic	25 (23)	21.3 (16)	28.6 (22)	7.9 (20)	15.6 (8)	10.9 (12)	12.5 (4)	13.1 (16)	121
All			5.2 (4)						4
Miscellaneous	38 (35)	20 (15)	6.5 (5)	7.5 (19)	70.6 (36)	16.4 (18)	18.8 (6)	21.3 (26)	19.7 (160/812)[b]
RLNP	10.9 (10)	4 (3)	6.5 (5)	2.4 (6)	66.7 (34)	16.4 (18)	15.6 (5)	6.6 (8)	89
Wound infection	5.4 (5)			3.2 (8)				14.8 (18)	31
Cardiac disease	3.3 (3)								3
Liver disease	4.3 (4)	2.7 (2)							6
Renal disease	1.1 (1)	1.3 (1)							2
Intestinal obstruction	2.2 (2)	1.3 (1)		0.8 (2)					5
Anastomotic stricture	10.9 (10)	10.7 (8)							18
CVA				0.4 (1)					1

Table 4 (continued)

Complication	Kato et al. [83] 1990 (*n*=92)[a]	Sugimachi et al. [77] 1993 (*n*=75)[a]	Holscher et al. [53] 1995 (*n*=77)[a]	Bonavina et al. [80] 1995 (*n*=253)[a]	Nishimaki et al. [42] 1999 (*n*=51)[a]	Matsubara et al. [45] 1999 (*n*=110)[a]	Sandick et al. [48] 2000 (*n*=32)[a]	Rice et al. [79] 2001 (*n*=122)[a]	Total
GI bleeding				0.4 (1)					1
Lower-limb ischemia				0.4 (1)					1
Organ failure					3.9 (2)				2
Diaphragm herniation							3.1 (1)		1

Values in parentheses are the number of patients

ND Not determined, *CVA* cerebrovascular attack, *CHF* congestive hear failure, *ARDS* acute respiratory distress syndrome, *RLNP* recurrent laryngeal nerve paralysis, and *GI* gastrointestinal

[a]Data are given as percentage (number) of patients who experienced the specific complication

[b]Data are given as percentage (number affected/total number) of patients who experienced the specific complication

only to the lower/middle mediastinal and abdominal nodes (two-field). This difference may be, in part, a consequence of the extent of lymph node dissection performed for these two different diseases in Japan and Western countries. Most papers quoted were from Japan in which three-field dissection is performed [19, 20, 40, 42, 44, 45, 76] while only two-field dissection is performed for AC of the distal esophagus in the West [16, 53, 61–63]. However, there exists a lack of definite data explaining the different mode of recurrence of SEC with SCC and AC. Upper mediastinal lymph node around the bilateral recurrent laryngeal nerves was the most frequently involved site, this was the main reason why several Japanese surgeons suggested three-field lymph node dissection even for SEC [19, 20, 40, 42, 44, 45, 76]. Multicentric tumor lesions were frequently found but its incidence varied widely in both superficial SCC and AC. These differences of multicentric lesions between the different institutions could be an epidemiologic phenomenon, but were more likely to be detailed work-up of the resected specimen. Moreover, this high incidence was probably due to coexisting dysplasia or carcinoma in situ in SCC and additional foci of high-grade dysplasia or Tis in Barrett's AC. Moreover, multicentric tumor detection was partly associated with the extent of esophageal resection by different surgical procedures. Therefore, preoperative dye-staining using Lugol [55] of squamous cell epithelium or methylene blue [56, 57] and crystal violet [58] of Barrett's epithelium is mandatory to detect multiple lesions.

Surgical treatment

Several authors reported good to excellent surgical results using different surgical procedures that they preferred. It might be difficult to draw a uniform consensus of the surgical technique for SEC at the moment from those various surgical techniques and different results. For superficial SCC mostly located at the middle thoracic esophagus, TTE might be chosen; on the contrary, for superficial AC mostly originating from the distal esophagus, both THE and TTE might be justified. The extent of lymph node dissection for both superficial SCC and AC remains controversial: two-field vs three-field lymph node dissection. Before a final conclusion, further information regarding the extent of lymphadenectomy need to be collected.

Surgical outcomes

Postoperative hospital mortality rate was 5% and morbidity rate was 40%. These data suggested that any type of esophagectomy for SEC could be safely performed. A 5-year overall survival rate of SEC after esophagectomy was good to excellent for mucosal SEC but far from satisfactory for submucosal SEC. The rate of lymph node metastasis of submucosal SEC was high (35%) and the location of nodal involvement was widespread. On the contrary, an overall incidence of recurrence accounted only 14%. These data might suggest that a certain number of patients with SEC die of unrelated causes to esophageal cancer during the long-term follow-up period. Tachibana et al. [85] reported certainly that age-related deaths such as cerebrocardiopulmonary diseases were more frequent in patients with early-stage esophageal diseases.

Double cancer concomitant with SEC

The average incidence of double cancer concomitant with SEC varied from 5.5 to 45.9%. These differences probably

Table 5 Recurrence after esophagectomy for SEC

Source	Number of samples	Incidence of recurrence (%)	DOD	Recurrent sites												
				LR	C	C and M	M	A	Anast	LR+ distant	Distant	Lung	Liver	Liver and bone	Bone	Others
Froelicher et al. [94]	51[b]	21.6 (11)	(5)	–						–	–					
Schmidt et al. [50]	7	14.3 (1)	(1)	0						0	1				1	
Peracchia et al. [51]	61[b]	14.8 (9)	–	4						0	5					
Bogomoletz et al. [52]	76	9.2 (7)	(3)	4						0	3					
Kato et al. [83][a]	92	15.2 (14)	(9)[c]	9	5				4	0	6		4		2	
Kato et al. [40][a]	43	7 (3)	–	0						0	3			2		1
Yoshinaka et al. [46]	59	10.2 (6)	(6)	2						0	4	4				
Haruna et al. [84]	27	3.7 (1)	(1)	–						–	–					
Nishimaki et al. [41][a]	89	16.9 (15)	(15)	–						–	–					
Nishimaki et al. [42][a]	51[d]	17.6 (9)	–	6						3						
Sugimachi et al. [77][a]	75	25.3 (19)	–	7	2	1	4			4	8	4	3		2	2
Watanabe et al. [81][a]	78[e]	19.2 (15)	(15)	9	1		3	1	4	0	6	4	2		1	
Holscher et al. [53]	77	15.6 (12)	(12)	–						–	–					
Tachibana et al. [44]	30	3.3 (1)	(1)	1			1			0	0					
Natsugoe et al. [47]	30[f]	0														
Matsubara et al. [45]	110	13.6 (15)	–	7		3		4		1	7	4	3			
Endo et al. [49]	236	12.7 (30)	(30)	–						–	–					
Sandick et al. [48]	32	9.4 (3)	(3)	1			1		1	0	2				1	1
Yuasa et al. [54]	54	14.8 (8)	(8)	–						–	–					
Total	1,278	14.0 (179)		50	8	4	9	5	9	8	45	16	12	2	7	4

Values in parentheses are the number of patients
– Not determined, *DOD* died of disease, *LR* locoregional, *C* cervical, *M* mediastinal, *A* abdominal, and *Anast* anastomosis
[a]Data from the same institution were reported
[b]No cases
[c]Three survived after additional surgical resection and two after radiotherapy
[d]cT1b cases
[e]T1b cases
[f]Tis/T1a cases (T1b excluded)

depend on the different surveillance of the institutions and different follow-up periods. The most affected concomitant organs of double cancer were gastric cancer. The reason why the stomach was the mostly affected organ might be explained by the fact that most of the studies originated from Japan where gastric cancer is the most frequent cancer.

Table 6 Double cancer concomitant with SEC

	Bogomoletz et al. [52]	Holshcer et al. [53]	Tachibana et al. [44]	Kodama and Kakegawa [98]	Natsugoe et al. [47]	Endo et al. [49]	Kokawa et al. [101]	Yuasa et al. [54]	Benjamin et al. [100]	Total
Incidence (%)	18.4 (14/76)	21.3 (10/77)	10 (3/30)	21.1 (499/2,366)[a]	20 (6/30)	5.5 (13/236)	45.9 (169/368)	5.6 (3/54)	5.9 (1/17)	22.1 (718/3,254)
	All are bronchial or orolaryngopharyngeal carcinoma	SCC: 20.8 (10/47), AC: 0 (0/30)			Including 2 cases of triple cancer	Cases of double cancer death	169 met patients, 233 double lesions			
		Pre: 40 (4)			Pre: 50 (3)		Pre: 40.2 (68)			Pre: 33.5 (75)
		Syn: 40 (4)	Syn: 33.3 (1)	Syn: 13.4	Syn: 33.3 (2)		Syn: 55 (93)			Syn: 44.6 (100)
		Met: 20 (2)	Met: 66.7 (2)		Met: 33.3 (2)		Met: 25.4 (43)			Met: 21.9 (49)
				Nonsyn: 9.3						
Organs (*n*)						Not determined				
Head and neck	Yes	2		150	4		105	1		262
Stomach		2	1	245			69			317
Colorectum			1	88			23	1		113
Lung	Yes	1		19	1		13			34
Hepatobiliary				23	2		6	1		32
Pancreas		1	1	2			1			5
Breast				6			3			9
Gynecological		2		4						4
Urological		1		12			8			21
Hematological				6			2		1	9
Skin		1		1			3			5

Values in parentheses are the number of patients
SCC Squamous cell carcinoma, *AC* adenocarcinoma, *Pre* (previous) found over 1 year before diagnosis of SEC, *Syn* (synchronous) found within 1 year of diagnosis of SEC, and *Met* (metachronous) found over 1 year after diagnosis of SEC
[a]Data collections

Adjuvant treatment

A certain number of patients with submucosal SEC received adjuvant treatment. Nodal involvement or positive proximal surgical margin was an indication. These data suggested that many surgeons treated submucosal SEC with lymph node metastasis as a clinically advanced disease and as a candidate for adjuvant chemotherapy. However, the clear indication of adjuvant chemotherapy is controversial at this moment.

Is extensive lymph node dissection necessary for SEC?

A nationwide multicenter study [19] in Japan compared results of 3FLND with 2FLND. The 5-year survival rate of patients who underwent 3FLND was 34.3%, whereas that of 2FLND was 26.7% ($P<0.001$). The results probably show that survival advantage of 3FLND is attributable to different patients' selection between 3FLND and 2FLND centers and to advancement of perioperative management and superior surgical outcomes of the experienced institutions where 3FLND is performed. Moreover, Nishihira et al. [86] compared 3FLND with 2FLND in a prospective randomized study. Because they followed strict criteria, only 27.6% satisfied the inclusion criteria. The 5-year survival rate was 64.8% after 3FLND and 48.0% after 2FLND ($P=0.192$). The authors intended to conclude that 3FLND might prolong survival. There existed a criticism that these two trials were not specific for SEC but included all patients.

Taken together, no definite survival advantage of 3FLND compared with 2FLND is proven from these results. Rice [87] discouraged 3FLND for SEC. It is obvious, however, that patients with thoracic esophageal cancer have a high incidence of upper mediastinal and cervical lymph node metastasis, varying from 16.7 to 43.4% [20]. Extensive lymph node metastasis from T1b SEC was found in the cervical, mediastinal, and abdominal lymph nodes (Table 2). Therefore, to accomplish a complete removal of tumor-laden tissues, extended esophagectomy with 3FLND may prove effective. However, to date, there are no large series of prospective randomized study to prove the survival advantage of 3FLND. Having these backgrounds, 3FLND could be reserved for only T1b (sm2 and sm3) SEC. However, recent data of lymphatic mapping for esophageal cancer indicates that the first site of micrometastasis is totally unpredictable from the location and depth of primary tumor. In particular, clinical significance of transhiatal esophagectomy has changed due to the recent introduction of chemoradiation therapy for SEC. Therefore, less invasive surgery such as minimally invasive thoracoscopic surgery, 2FLND, or THE can be performed not only for T1a but also for T1b SEC.

SCC vs AC

It remains to be determined whether SCC and AC of SEC are biologically different and whether treatment approaches should differ for SCC and AC. Is there any difference in prognosis of SCC and AC? AC of the distal esophagus continues to increase in prevalence and incidence in the Western world and are now equal to SCC [3, 9]. The majority of esophageal AC arises near the gastroesophageal junction from areas with intestinal metaplasia (Barrett esophagus), whereas SCCs are clearly related to alcohol and cigarette abuse.

Holscher et al. [53] reported that AC was a biologically less invasive cancer type and thus they performed THE for superficial AC of the distal esophagus and TTE for biologically aggressive superficial SCC. Having these different treatment approaches for SCC and AC, histological type of AC became a better independent prognostic factor for survival. Before having a final conclusion regarding the impact of histological type on patients' prognosis, further information needs to be gathered.

Therapeutic guidelines

Clinical significance of multimodal treatment for SEC has dramatically developed in the recent era. Development of endoscopic treatment [59, 60, 88, 89] and chemoradiation [90] therapy could provide attending doctors various potential therapeutic options for SEC. Recently, the sentinel node concept to identify the lymphatic drainage route from primary lesions was extensively investigated in various types of relatively early-stage solid tumors, including gastrointestinal cancer [91, 92]. In SEC, sentinel nodes should be the most important site to detect microlymph node metastasis and it seems to be reasonable to individualize the extent of lymph node dissection for SEC based on the distribution and status of sentinel nodes. These concepts make it possible to individualize surgical management of SEC as part of various multimodal treatments.

Based on the above-mentioned results, therapeutic surgical guidelines for SEC as part of multimodal treatment may be considered as follows with some controversies:

1) MIE or THE could be a good option for multiple m1 or m2 cancers.
2) Single m3 and sm1 cancer: When preoperative nodal metastasis is suspected, TTE with lymphadenectomy is indicated. However, when patients' general condition is poor and preoperative diagnostic examination shows no nodal involvement, EMR or THE may be a treatment of choice.
3) sm2 and sm3 cancer: TTE is a mainstay of the treatment. However, when preoperative diagnostic

modalities show no metastasis, MIE or THE may be a treatment of choice.

4) THE may be a choice of treatment for AC of the distal esophagus (Barrett's AC).
5) Adjuvant treatment is advocated when multiple lymph node metastases are present or proximal surgical margin is positive for cancer. When vessel invasion is suspected in the resected specimen after EMR, definitive treatment may be selected.

Conclusions

The overall prevalence of SEC accounted around 10%, but it has increased to 25% in the 2000s. The incidence of lymph node metastasis of SEC was about 25% and its incidence of mucosal and submucosal cancer was 5 and 35%, respectively. Submucosal SCC of the thoracic esophagus could metastasize to the three-field, whereas AC of the distal esophagus could metastasize only to the two-field areas.

Recently, clinical significance of multimodal treatment for SEC has dramatically developed and could provide various potential therapeutic options for SEC. These concepts make it possible to individualize surgical management of SEC as part of various multimodal treatments. The operative approach for SEC varies from MIE, limited transabdominal distal esophagectomy, conventional TTE, THE, and to extended esophagectomy with three-field lymph node dissection for curative purposes. Postoperative hospital mortality rate was reported to be 4% and morbidity rate to be 40%. Recurrence affected 14% of patients after esophagectomy. A 5-year overall survival rate of SEC after esophagectomy was good (46 to 83%) to excellent (71 and 100%) for mucosal SEC, but far from satisfactory (33 and 78%) for submucosal SEC.

Early diagnosis, development of multimodal treatment, standardization of surgery, including routine lymph node dissection, and postoperative management of patients have all led to better survival rates for SECs.

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