

# BMJ Open Significance of the dissection of common hepatic arterial lymph nodes in patients with oesophageal carcinoma: a multicentre retrospective study

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## ABSTRACT

**Objectives** To explore the significance of intraoperative common hepatic arterial lymph node dissection in patients with oesophageal squamous carcinoma (ESCC) without coeliac trunk lymph node metastasis indicated by abdominal enhanced CT.

**Methods** Patients aged 18–75 years who underwent oesophagectomy in three medical centres from June 2012 to June 2015, for whom R0 resection was completed and lymph node metastasis in the abdominal trunk was not identified before the operation were retrospectively analysed. The effects of the application value of common hepatic arterial lymph node dissection on survival were evaluated in patients with ESCC without coeliac trunk lymph node metastasis indicated by preoperative CT. According to the eighth version of American Joint Committee on Cancer (AJCC)/Union for International Cancer Control (UICC) staging, we selected patients with a Pathological Tumor Node Metastasis (pTNM) stage ranging from IA to IVA for analysis.

**Results** Among the 816 qualified patients, 577 did not have coeliac trunk lymph node metastasis based on preoperative abdominal enhanced CT, and common hepatic arterial lymph node dissection was performed during the operation (observation group). Two hundred and thirty-nine preoperative CT examinations indicated no coeliac trunk lymph node metastasis, and common hepatic arterial lymph node dissection was not performed during the operation (control group). A multifactor Cox proportional hazards model showed no risk factors for overall survival (OS) (adjusted HR (HRadj)=0.91; p=0.404) or disease-free survival (DFS) (HRadj=0.86; p=0.179), regardless of whether common hepatic arterial lymph node dissection was performed. For patients with positive left gastric arterial lymph node metastasis, a multifactor Cox proportional hazards model indicated that common hepatic arterial lymph node dissection was a risk factor for OS (HRadj=0.63; p=0.035) and DFS (HRadj=0.58; p=0.026).

**Conclusions** For patients with ESCC without coeliac trunk metastasis indicated by abdominal enhanced CT, common hepatic arterial lymph node dissection conferred no survival benefits. However, for patients with left gastric arterial lymph node metastasis, common hepatic arterial lymph node dissection was beneficial.

## Strengths and limitations of this study

- This is a multicentre, large sample, retrospective study.
- The highlight of this study is use of noninvasive preoperative examination to guide the operation of specific invasive procedures.
- However, due to the limitations inherent to retrospective studies, no detailed surgical criteria, such as coeliac trunk skeletonisation of the vasculature, were developed. Operation standards for completing the surgery were not unified, which was a limitation in this research study.

## BACKGROUND

The global distribution of oesophageal squamous carcinoma (ESCC) varies greatly and is more commonly observed in Asian populations.<sup>1–3</sup> Due to a low early-stage diagnosis rate and because lymph node metastasis can occur in a very early stage of the disease,<sup>4–7</sup> the prognosis of ESCC is abysmal. A related study of ESCC in Japan and China was at the forefront globally. However, the overall survival (OS) rate of patients with ESCC who underwent three-field dissection was not satisfactory in previous studies, and the differences in 1-year, 3-year and 5-year survival rates in each study varied substantially at 87%, 49.8% and 29.3%–52.0%, respectively.<sup>8,9</sup> Moreover, due to the high complication rate during the perioperative period of three-field dissection, surgery-related death risks increase.<sup>8,10</sup> Therefore, controversy exists regarding the use of three-field dissection internationally. As a country with a high ESCC incidence rate, two-field dissection is currently the main operation performed in China.

With advances in adjuvant therapies, studies examining whether excess lymph node dissection provides definitive survival benefits to patients are worthwhile. Coeliac

trunk peripheral lymph node dissection is an essential component of complete abdominal field lymph node dissection in patients with ESCC.<sup>11</sup> In a group of patients, left gastric arterial lymph node resection was performed by dividing the left gastric artery, and lymph node metastasis was more common in the left gastric arterial lymph node, which might have a more prominent influence on survival.<sup>12</sup> However, a few studies have verified the necessity of common hepatic arterial lymph node resection. The common hepatic arterial lymph node is adjacent to the coeliac cisterna chyli, and complete dissection occasionally leads to chyle leakage.<sup>13</sup> Controversy exists in terms of the necessity of dissection of this site. By combining multi-centre data, this research study assessed the necessity of intraoperative resection of the common hepatic arterial lymph node for patients with ESCC without coeliac trunk peripheral lymph node metastasis indicated by preoperative abdominal enhanced CT.

## GENERAL MATERIAL

### Study design, setting and participants

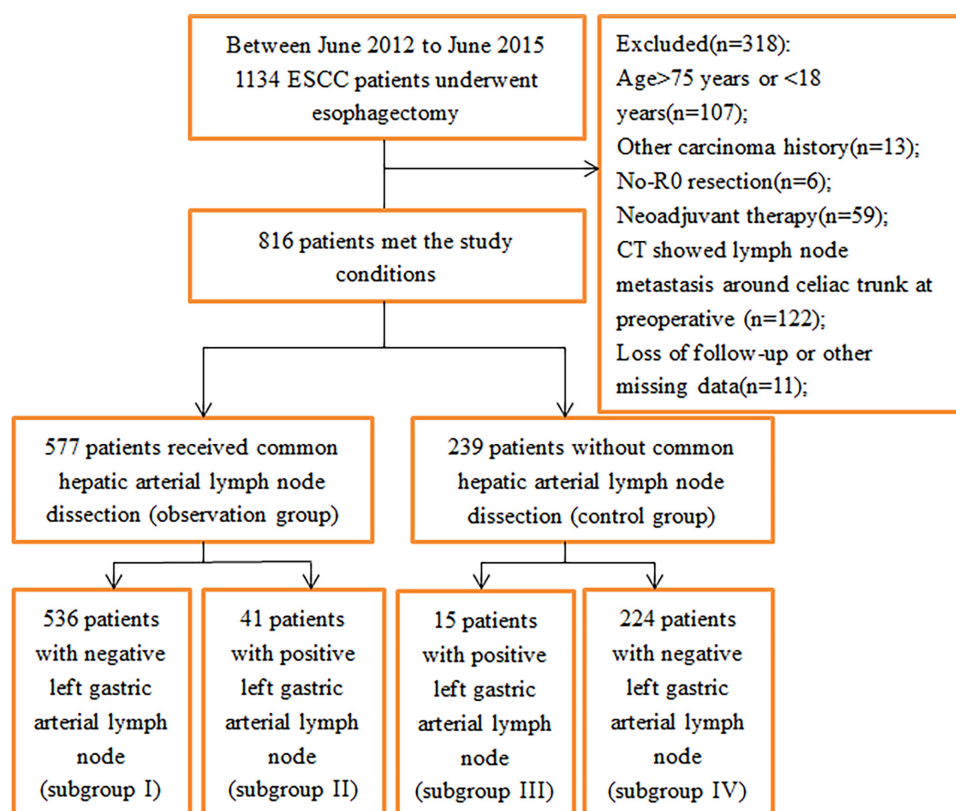
Samples from patients with ESCC who underwent surgical treatment in the cardiothoracic surgery department of four diagnostic and treatment centres within 3 years, from June 2012 to June 2015, were retrospectively analysed in this study. Inclusion criteria consistent with the research requirements were established as follows:

- ▶ Age between 18.0 and 75.0 years.
- ▶ Pathologically diagnosed with ESCC.

- ▶ No neoadjuvant therapy.
- ▶ No combined malignant tumours or malignant tumour history.
- ▶ No distant metastasis on a preoperative examination.
- ▶ A thoracoabdominal two-incision or neck-thoracoabdominal three-incision operation and complete R0 dissection.
- ▶ No coeliac trunk peripheral lymph node metastasis on preoperative abdominal enhanced CT.
- ▶ Thirty-six months of follow-up or follow-up services until the patients died.

The qualified patients were divided into groups: patients receiving intraoperative common hepatic arterial lymph node dissection were included in the observation group, and patients without common hepatic arterial lymph node dissection were included in the control group. Due to economic conditions, Positron Emission Tomography (PET) was not used as a routine preoperative examination for oesophageal cancer before 2016 in hospitals participating in the study. PET data were available for only a few patients. Therefore, the effect of PET was ignored in this study. The flow chart of this study is shown in figure 1.

Before this research study, imaging materials were re-extracted and read, and previous opinions from past studies summarised by two imaging experts were used as references to determine the characteristics described below.<sup>14–16</sup>



**Figure 1** The flow chart of this study. ESCC, oesophageal squamous carcinoma.

- ▶ The short diameter of the upper abdominal lymph node was greater than or equal to 8 mm. Margins were clear and sharp.
- ▶ Low-density necrotic masses were located in the central region.
- ▶ More than three lymph nodes were massed into a group or cluster.
- ▶ Lymph node envelope invasion or a lack of boundary with a surrounding fat gap was observed.

If any one of the aforementioned criteria were met, possible lymph node metastasis was considered. According to these criteria, one radiologist determined that 829 patients did not present coeliac trunk peripheral lymph node metastasis, and while the other considered that 830 patients did not present coeliac trunk peripheral lymph node metastasis. Among them, 827 patients were accepted by both imaging experts as not presenting with coeliac trunk peripheral lymph node metastasis. The results reported by the two imaging experts showed very high consistency.

Postoperative follow-up involved phone follow-up and household registration for joint confirmation. The follow-up period was 6.3 to 42.4 months, and the median follow-up time was 38.4 months. Eleven of the 827 patients failed to complete follow-up.

Finally, 816 qualified patients were included in the study, comprising 577 in the observation group and 239 in the control group. Table 1 contains general clinical information for the patients in those two groups. No significant differences were observed in basic clinical data, such as patient age, sex, tumour location and tumour stage. Tumour stage was defined as the pathological stage (pTNM) according to the eighth version of AJCC/UICC staging. The data were comparable.

#### Patient and public involvement

Patients and public were not involved in this study.

#### STATISTICAL METHODS

Data were compared across subgroups using  $\chi^2$  or Fisher's exact tests (for categorical variables) and t-tests (for continuous variables) where appropriate. Associations between common hepatic arterial lymph node resection and OS or disease-free survival (DFS) were estimated using the Kaplan-Meier (K-M) method to generate survival curves and assessed using log-rank tests. Multifactor Cox proportional hazards models were used as our primary analyses. A factorial design was used to determine which factors interacted with common hepatic arterial lymph node metastasis. We conducted the same analyses in subgroups stratified according to left gastric arterial lymph node metastasis to better understand the impact of common hepatic arterial lymph node resection on the survival of patients with ESCC. All reported p values were obtained from two-sided tests. A  $p < 0.05$  was considered statistically significant. All statistical analyses were performed using SPSS software V.20.0.

#### RESULTS

##### High-risk factors for tumour metastasis in common hepatic arterial lymph nodes

The average numbers of dissected lymph nodes in patients in the observation and control groups were  $22.6 \pm 8.3$  and  $20.3 \pm 7.4$ , respectively, resulting in a statistically significant increase in the observation group ( $p < 0.001$ ). The average number of common hepatic arterial lymph nodes among the 577 patients in the observation group were  $2.6 \pm 2.3$  (1–9), among which 19 postoperative pathology results indicated positive common hepatic arterial lymph node metastasis, and the average number of metastatic lymph nodes was  $1.93 \pm 0.6$  (1–3). Metastasis was not observed in the common hepatic arterial lymph nodes in the remaining 558 patients.

Among those 19 patients with common hepatic arterial lymph node metastasis in the observation group, 18 had left gastric arterial lymph node metastasis, and 1 patient did not have left gastric arterial lymph node metastasis. The result of the factorial design indicated that the common hepatic arterial lymph node metastasis in the observation group was closely related to the distance of the tumour from the incisor ( $F = 3.63$ ,  $p < 0.001$ ), differentiation degree ( $F = 217.59$ ,  $p < 0.001$ ) and left gastric arterial lymph node metastasis ( $F = 377.15$ ,  $p < 0.001$ ).

##### Relationship between common hepatic arterial lymph node dissection and postoperative surgery-related complications

The differences in the surgical time ( $243.52 \pm 37.44$  min vs  $239.08 \pm 32.69$  min,  $p = 0.131$ ), intraoperative haemorrhage ( $117.34 \pm 57.60$  mL vs  $109.71 \pm 60.77$  mL,  $p = 0.099$ ), postoperative ICU stay ( $1.03 \pm 0.20$  days vs  $1.05 \pm 0.17$  days,  $p = 1.00$ ) and anastomotic leakage (23/577 vs 14/239,  $p = 0.242$ ) between the observation and control groups were not statistically significant. However, the incidence rate of postoperative chyloperitoneum (21/577 vs 1/239,  $p < 0.001$ ) in the observation group was much higher than in the control group. The postoperative shunt removal time ( $2.62 \pm 1.70$  days vs  $1.90 \pm 0.71$  days,  $p < 0.001$ ) in the observation group was significantly prolonged compared with the control group, as was the average postoperative hospital stay ( $10.90 \pm 2.22$  days vs  $9.80 \pm 1.34$  days,  $p < 0.001$ ). The definition of chyloperitoneum in our study was a positive finding of chylus in abdominal drainage postoperatively. Twenty-one patients with chyloperitoneum were cured after conservative treatment (sufficient peritoneal drainage, intravenous nutrition supplementation, suitable application of preventive antibiotics, etc).

##### Relationship between common hepatic arterial lymph node dissection and postoperative survival

The postoperative median follow-up period was 38.2 months, and 354 deaths occurred (56.62% survival rate (462/816)); among these deaths, 248 occurred in the observation group (57.02% survival rate, 329/577) and 106 occurred in the control group (55.65% survival rate, 133/239). No obvious difference in tumour-related

**Table 1** General data for patients in the observation and control groups

Variables	Dissection of common hepatic arterial lymph node (n=577 )	No dissection of common hepatic arterial lymph node (n=239 )	P value
Gender			
Male	293	158	0.612
Female	185	81	
Age	62.70±9.21	61.44±9.98	0.092
COPD	91/577	36/239	0.799
Smoking history	247/577	113/239	0.242
Alcohol history	232/577	107/239	0.229
Distance between tumour to incisor teeth	26.40±5.32	25.81±5.77	0.153
Tumour location			0.749
Cervix segment	59	21	
Upper thoracic segment	106	51	
Middle thoracic segment	279	110	
Lower thoracic segment	133	57	
TNM stage			0.633
IA	46	18	
IB	58	27	
IIA	93	36	
IIB	133	57	
IIIA	109	42	
IIIB	110	49	
IVA	28	10	
Total lymph nodes	22.6±8.3	20.3±7.4	<0.001
Operation time (min)	243.52±37.44	239.08±32.69	0.131
Intraoperation bleeding	117.34±57.60	109.71±60.77	0.099
Postoperative abdominal complications (Clavien Dindo)			<0.001
I	33*	6*	
II	5	2	
III	2	2	
IV	0	0	
Postoperation chyloperitoneum	21	1	<0.001
Duration of ICU stay	1.03±0.20d	1.05±0.17d	0.987
Duration of abdominal drainage tube	3.52±1.70	1.90±0.71	<0.001
Postoperative duration	10.90±2.22	9.80±1.34	<0.001
Postoperative chemotherapy	429/577	187/239	0.239
Postoperative radiotherapy	411/577	163/239	0.389
Tumour-related death	232/577	97/239	0.921
3 years DFS	314/577	123/239	0.441
3 years OS	329/577	133/239	0.719

\*Includes patients with postoperative chyloperitoneum.

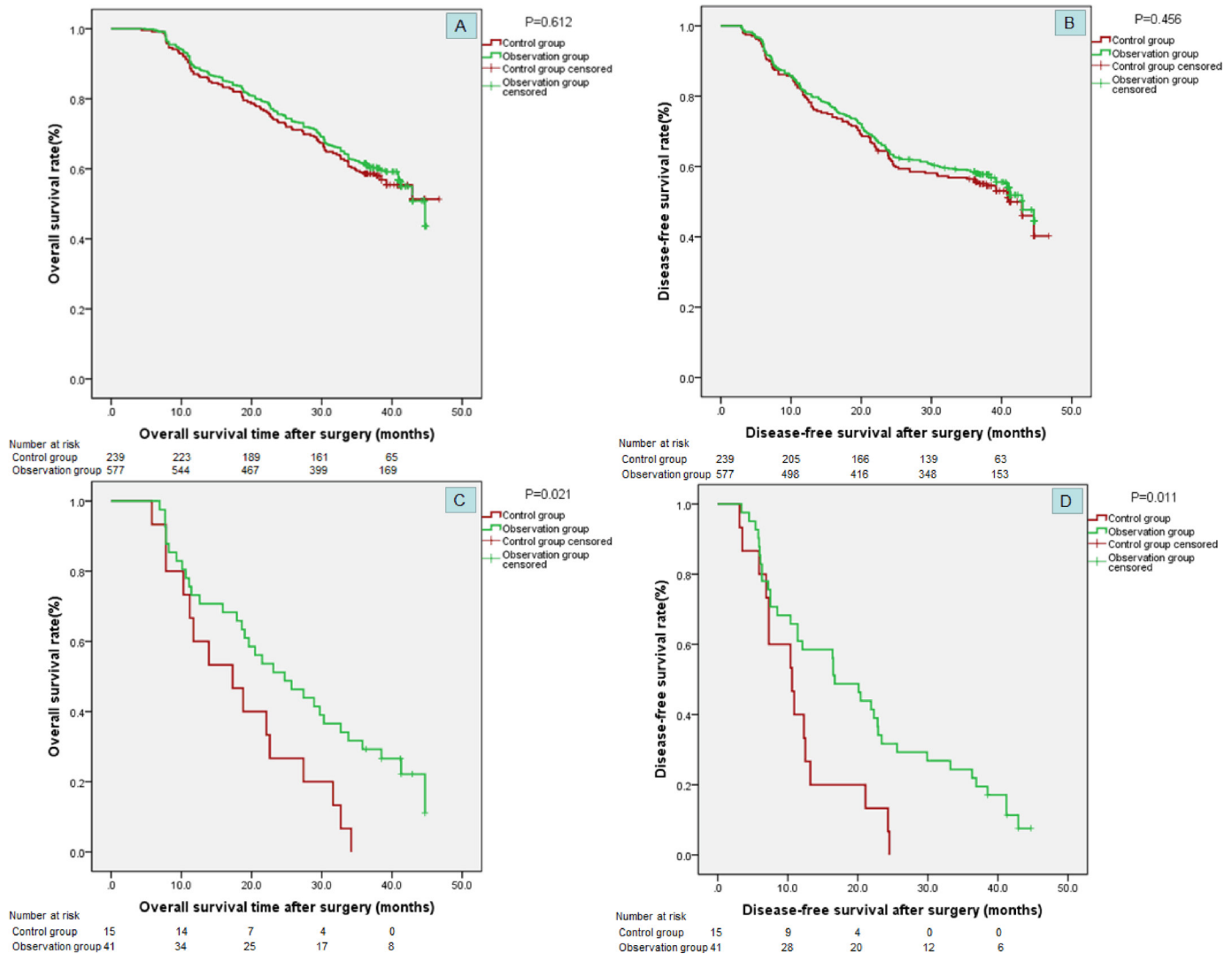
COPD, Chronic Obstructive Pulmonary Disease; COPD, Chronic obstructive pulmonary disease; DFS, disease-free survival; ICU, Intensive Care Unit; OS, overall survival; TNM, tumor node metastasis classification.

death was identified between the observation and control groups (232/577 vs 97/239,  $p=0.920$ ).

An analysis of the K-M curves (see [figure 2A,B](#)) and log-rank tests showed that common hepatic arterial lymph

node dissection did not significantly improve patient survival during follow-up (OS:  $p=0.612$ ; DFS:  $p=0.456$ ). The patients' age, sex, TNM stage, the distance of the tumour from the incisor, differentiation degree, total





**Figure 2** (A) Kaplan-Meier curve of OS of patients stratified by the removal of the common hepatic arterial lymph node. Removal of the common hepatic arterial lymph node was not associated with OS in patients with oesophageal squamous cell carcinoma ( $P_{\log\text{-rank}}=0.612$ ). (B) Kaplan-Meier curve of DFS of patients stratified by the removal of the common hepatic arterial lymph node. Removal of the common hepatic arterial lymph node was not associated with DFS in patient with oesophageal squamous cell carcinoma ( $P_{\log\text{-rank}}=0.456$ ). (C) Kaplan-Meier curve of OS of patients stratified by the removal of the common hepatic arterial lymph node. Removal of the common hepatic arterial lymph node was associated with a longer OS of patients with oesophageal squamous cell carcinoma presenting with metastasis in left gastric arterial lymph node (subgroup II vs subgroup III,  $P_{\log\text{-rank}}=0.021$ ). (D) Kaplan-Meier curve of DFS of patients stratified by the removal of the common hepatic arterial lymph node. Removal of the common hepatic arterial lymph nodes was associated with a longer DFS of patients with oesophageal squamous cell carcinoma presenting with metastasis in the left gastric arterial lymph node (subgroup II vs subgroup III,  $P_{\log\text{-rank}}=0.011$ ). DFS, disease-free survival; OS, overall survival.

number of dissected lymph nodes, left gastric arterial lymph node metastasis, and common hepatic arterial lymph node resection were comprehensively considered in a multifactor Cox proportional hazards model. The Cox regression analysis did not reveal remarkable effects of common hepatic arterial lymph node dissection on OS (adjusted HR (HR<sub>adj</sub>)=0.91; 95% CI 0.73 to 1.13,  $p=0.404$ ) and DFS (HR<sub>adj</sub>=0.86; 95% CI 0.69 to 1.07,  $p=0.179$ ) during postoperative follow-up. The detailed results of the multifactor Cox proportional hazards model are shown in [tables 2 and 3](#).

The factorial design revealed a close correlation between common hepatic arterial lymph node metastasis

and left gastric arterial lymph node metastasis ( $F=377.15$ ,  $p<0.001$ ). A sensitivity analysis was subsequently performed. For patients with positive left gastric arterial lymph node metastasis (41 in the observation group were included in subgroup II and 15 in the control group were included in subgroup III), a K-M curve (see [figure 2C,D](#)) and log-rank testing revealed that common hepatic arterial lymph node dissection significantly prolonged patient survival during follow-up (OS:  $p=0.021$ ; DFS:  $p=0.011$ ). The patients' age, sex, TNM stage, the distance of the tumour from the incisor, differentiation degree, total number of dissected lymph nodes and common hepatic arterial lymph node resection were comprehensively

**Table 2** HRs for overall survival among patients with ESCC stratified according to clinicopathological characteristics

Variables	Univariate		Multivariate	
	HR (95% CI)	P value	HRadj (95% CI)	P value
Age (years)	1.12 (1.02 to 1.23)	0.018	1.13 (1.02 to 1.25)	0.019
Gender				
Female	Reference		Reference	
Male	0.86 (0.63 to 1.18)	0.351	0.89 (0.69 to 1.15)	0.378
Stage	1.81 (1.11 to 2.95)	0.017	2.07 (1.13 to 3.78)	0.016
Distance of tumour to incisor	0.74 (0.58 to 0.95)	0.017	0.71 (0.54 to 0.94)	0.015
Differentiation degree	2.17 (1.58 to 2.98)	<0.001	2.42 (1.63 to 3.58)	<0.001
Left gastric arterial lymph node metastasis	3.13 (2.15 to 4.56)	<0.001	1.91 (1.19 to 3.07)	0.007
Total no lymph nodes	0.89 (0.81 to 0.98)	0.016	0.99 (0.98 to 1.00)	0.051
Common hepatic arterial lymph node resection				
No	Reference		Reference	
Yes	0.94 (0.75 to 1.18)	0.613	0.91 (0.73 to 1.13)	0.404

ESCC, oesophageal squamous carcinoma; HRadj, adjusted HR.

considered in the multifactor Cox proportional hazards model. The results showed remarkable effects of common hepatic arterial lymph node dissection on OS (HRadj=0.63; 95% CI 0.44 to 0.97,  $p=0.035$ ) and DFS (HRadj=0.58; 95% CI 0.36 to 0.94,  $p=0.026$ ) during follow-up. The detailed results of the multifactor Cox proportional hazards model are shown in [tables 4 and 5](#).

#### Analysis of tumour recurrence or metastasis in abdominal cavity

A total of 354 patients had tumour recurrence or metastasis during follow-up, including 247 cases in the observation group and 107 cases in the control group. There was no difference in DFS between the two groups (see KM curve, [figure 2](#)). Further analysis of recurrence or

metastasis site after operation, 193 cases of recurrence or metastasis occurred in abdominal cavity after operation (including the first postoperative recurrence or metastasis, simultaneous recurrence or metastasis of multiple sites, and recurrence or metastasis secondary to other sites), including 126 cases in the observation group and 67 cases in the control group, there was no significant difference in the proportion (126/577 vs 67/239,  $p=0.077$ ).

In 56 patients with lymph node metastasis near the left gastric artery, tumour recurrence occurred in 52 cases and tumour recurrence or metastasis occurred in the abdominal cavity in 39 cases. A total of 760 cases had no lymph node metastasis near the left gastric artery. During the follow-up period, 302 cases had tumour recurrence or

**Table 3** HRs for disease-free survival among patients with ESCC stratified according to clinicopathological characteristics

Variables	Univariate		Multivariate	
	HR (95% CI)	P value	HRadj (95% CI)	P value
Age (years)	1.10 (1.07 to 1.15)	<0.001	1.11 (1.07 to 1.16)	<0.001
Gender				
Female	Reference		Reference	
Male	0.90 (0.74 to 1.09)	0.291	0.86 (0.69 to 1.07)	0.179
Stage	2.35 (1.41 to 3.92)	0.001	2.88 (1.89 to 4.38)	<0.001
Distance of tumour to incisor	0.89 (0.80 to 0.99)	0.032	0.83 (0.71 to 0.98)	0.023
Differentiation degree	2.89 (1.43 to 5.84)	0.003	3.11 (1.59 to 6.08)	0.001
Left gastric arterial lymph node metastasis	3.44 (2.42 to 4.88)	<0.001	2.07 (1.35 to 3.17)	0.001
Total no lymph nodes	0.79 (0.63 to 1.00)	0.046	0.98 (0.95 to 1.01)	0.198
Common hepatic arterial lymph node resection				
No	Reference		Reference	
Yes	0.92 (0.74 to 1.15)	0.458	0.86 (0.69 to 1.07)	0.179

ESCC, oesophageal squamous carcinoma; HRadj, adjusted HR.

**Table 4** HRs for overall survival among patients with ESCC presenting with left gastric arterial lymph node metastasis and stratified according to clinicopathological characteristics

Variables	Univariate		Multivariate	
	HR (95% CI)	P value	HRadj (95% CI)	P value
Age (years)	1.09 (1.01 to 1.19)	0.039	1.12 (1.14 to 1.26)	<0.001
Gender				
Female	Reference		Reference	
Male	0.92 (0.81 to 1.05)	0.21	0.96 (0.79 to 1.06)	0.598
Stage	2.03 (0.98 to 4.21)	0.057	1.89 (1.12 to 3.19)	0.003
Distance of tumour to incisor	0.86 (0.73 to 1.02)	0.077	0.91 (0.74 to 1.11)	0.368
Differentiation degree	1.63 (1.04 to 2.55)	0.032	1.07 (1.01 to 1.13)	0.018
Total no lymph nodes	0.89 (0.76 to 1.04)	0.146	0.81 (0.66 to 0.99)	0.041
Common hepatic arterial lymph node resection				
No	Reference		Reference	
Yes	0.48 (0.25 to 0.91)	0.024	0.63 (0.41 to 0.97)	0.035

ESCC, oesophageal squamous carcinoma; HRadj, adjusted HR.

metastasis, and 154 cases had tumour recurrence or metastasis in the abdominal cavity. Patients with lymph node metastasis near the left gastric artery had a higher proportion of tumour recurrence or metastasis in the abdominal cavity after operation (39/56 vs 154/760,  $p < 0.001$ ). There was no difference in the proportion of postoperative abdominal recurrence or metastasis between subgroup II and subgroup III (27/41 vs 12/15,  $p = 0.312$ ), however, the proportion of tumour recurrence or metastasis in the abdominal cavity was higher in subgroup 3 than in subgroup 2 (65.85% vs 80%).

## DISCUSSION

Few studies have examined the effects of dissection of the common hepatic arterial, splenic artery and abdominal

aorta lymph nodes. Because the common hepatic arterial lymph nodes are adjacent to the cisterna chyli, injury to the cisterna chyli during lymph node dissection might result in a postoperative complication of chyloperitoneum.<sup>13</sup>

Although most studies indicate that the incidence of chyloperitoneum is related to thoracic duct ligation,<sup>13 17 18</sup> some studies have indicated that chyloperitoneum does not increase the risk of death in patients.<sup>19</sup> However, conservative therapy was ineffective for severe abdominal chyle leakage and repeated surgery was chosen.<sup>19</sup> The risk of chyloperitoneum should be avoided during surgery, and our research showed that common hepatic arterial lymph node dissection would increase this risk (21/577 vs 1/239,  $p = 0.001$ ), which might be associated with the anatomical structure of the abdominal cisterna

**Table 5** HRs for disease-free survival among patients with ESCC presenting with left gastric arterial lymph node metastasis and stratified according to clinicopathological characteristics

Variables	Univariate		Multivariate	
	HR (95% CI)	P value	HRadj (95% CI)	P value
Age (years)	1.07 (1.01 to 1.13)	0.018	1.09 (1.02 to 1.17)	0.014
Gender				
Female	Reference		Reference	
Male	0.90 (0.76 to 1.07)	0.229	0.81 (0.64 to 1.03)	0.082
Stage	1.74 (0.91 to 3.33)	0.094	1.97 (1.25 to 3.11)	0.004
Distance of tumour to incisor	0.93 (0.82 to 1.06)	0.271	0.87 (0.75 to 1.01)	0.067
Differentiation degree	1.47 (0.98 to 2.21)	0.063	2.12 (1.13 to 3.98)	0.019
Total no lymph nodes	0.93 (0.84 to 1.03)	0.164	0.97 (0.86 to 1.09)	0.627
Common hepatic arterial lymph node resection				
No	Reference		Reference	
Yes	0.46 (0.24 to 0.87)	0.017	0.58 (0.36 to 0.94)	0.026

ESCC, oesophageal squamous carcinoma; HRadj, adjusted HR.

chyli. The anatomical location of the abdominal cisterna chyli varied, and most studies suggested that it is located between the abdominal aorta and inferior cava vein. The common hepatic artery is in the front, and after collecting lymphatic fluid in the intestinal trunk, the left and right trunci lumbales lead to the thoracic duct, explaining why common hepatic arterial lymph node dissection, especially with a skeletonised common hepatic artery, might cause chyloperitoneum.

In previous studies, scholars noted that common hepatic arterial lymph node dissection had no obvious survival benefits for patients with early ESCC.<sup>20</sup> We did not determine a relationship between common hepatic arterial lymph node dissection and postoperative survival in patients without coeliac trunk lymph node metastasis indicated by abdominal CT, which motivated us to perform this study. The metastasis rate of common hepatic arterial lymph nodes in previous studies was 9%–13%,<sup>20 21</sup> but in our study, patients with metastasis indicated by CT were excluded. The common hepatic arterial lymph node metastasis rate was not very high in patients without coeliac trunk lymph node metastasis indicated by abdominal CT. A metastasis rate of only 3.29% (19/577) was detected in the observation group. The low metastasis rate might explain the non-obvious difference in survival between the observation and control groups in our study. Meanwhile, common hepatic arterial lymph node metastasis was closely related to the distance from the tumour to the incisor ( $F=3.63$ ,  $p<0.001$ ) and differentiation degree ( $F=217.59$ ,  $p<0.001$ ), consistent with previous studies.<sup>21 22</sup>

Many previous studies have verified that lymph node dissection would produce better survival benefits in patients, regardless of lymph node metastasis.<sup>23 24</sup> Dissecting more lymph nodes would provide more accurate pathological staging, which resulted in the improved survival benefits of dissecting more lymph nodes in previous studies.<sup>23</sup> However, our research study indicated that common hepatic arterial lymph node dissection did not improve patients' survival prognosis. We believed that this finding might be related to the failed discovery of positive isolated common hepatic arterial lymph node metastasis and common hepatic arterial lymph node metastasis combined with metastasis of the remaining lymph nodes, especially the left gastric artery group lymph node ( $F=377.15$ ,  $p<0.001$ ). Therefore, common hepatic arterial lymph node dissection did not significantly change patients' tumour staging and had no effects on the selection of comprehensive postoperative treatment; this finding provides one explanation for the remarkable survival differences between the two groups in our study.

Metastasis of the left gastric arterial lymph node is a high-risk factor for a poor prognosis in patients with ESCC.<sup>12</sup> In our study, a sensitivity analysis was subsequently performed. For patients with positive left gastric arterial lymph node metastasis, the Cox regression analysis showed that common hepatic arterial lymph node dissection exerted obvious effects on OS and DFS during

the follow-up period, helping illustrate that if left gastric arterial lymph node metastasis was present in patients with ESCC without abdominal common hepatic arterial lymph node metastasis indicated by abdominal CT, then common hepatic arterial lymph node dissection improved the patients' prognosis. Therefore, could a sentinel lymph node biopsy of breast cancer be referenced<sup>25 26</sup> and rapid biopsy of left gastric arterial lymph node be used to determine the necessity of common hepatic arterial lymph node dissection? By combining our research results, we are currently conducting a multicentre prospective study to verify the validity of this hypothesis.

A multicentre study and an increased sample volume were used in this study to increase the validity of the research conclusions. However, due to the limitations inherent to retrospective studies, there are still many insurmountable problems that may affect the reliability of the conclusions. First, this is a retrospective study and surgeons decide whether to perform common hepatic artery anatomy and lymph node resection, mainly based on the habits of surgeons. Some surgeons will also perform this operation when abdominal imaging shows no metastatic lymph nodes, while others will not, and the degree of dissection of blood vessels and resection of lymph nodes was also inconsistent. Second, according to the results of this study, it may be more reasonable to conduct a rapid pathological analysis of the lymph nodes of the left gastric artery during the operation, and guide whether to carry out anatomy of the common hepatic artery and lymph node resection according to the rapid pathological results, but this is not done in this study. This research defect can only be supplemented and verified in the next prospective study. Third, although our study has detailed records of the time of postoperative recurrence, there is a lack of statistics on the time of recurrence or metastasis in abdominal cavity. Tumour recurrence or metastasis in abdominal cavity may occur after recurrence in other parts and this may also have an impact on the research conclusions. We did not use KM curve to analyse the effect of abdominal lymph node dissection on tumour recurrence or metastasis in abdominal cavity and only compared the impact of different abdominal lymph node dissections on postoperative tumour recurrence or metastasis in abdominal cavity from the proportion of recurrence or metastasis in abdominal cavity. This is inaccurate, but unfortunately, in retrospective study, we cannot completely overcome this defect. Fourth, patients with lymph node metastasis near the left gastric artery have a higher proportion of postoperative tumour recurrence or metastasis in abdominal cavity, suggesting that abdominal lymph node dissection should be more thorough for this part of patients, but it is not directly proved that clearing lymph nodes near the common hepatic artery in this part of patients will reduce the proportion of tumour recurrence or metastasis in abdominal cavity. With a larger sample size, the comparison of rates of tumour recurrence or metastasis in abdominal cavity between subgroup II and subgroup III may be statistically



significant. Therefore, we plan to verify the conclusions of this study by conducting a multicentre, large-sample, prospective randomised clinical trial.

## CONCLUSIONS

For patients with ESCC without coeliac trunk lymph node metastasis indicated by preoperative abdominal CT, common hepatic arterial lymph node metastasis was closely related to left gastric arterial lymph node metastasis. Routine common hepatic arterial lymph node dissection did not confer survival benefits to patients and increased the possibility of the postoperative complication of chyloperitoneum. However, for patients with left gastric arterial lymph node metastasis, common hepatic arterial lymph node dissection produced significant survival benefits.

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