Review
Omentoplasty in the prevention of anastomotic leakage after oesophagectomy: A meta-analysis


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Accepted 11 July 2014
Available online 28 August 2014

Abstract

Objective: To evaluate the efficacy of omentoplasty for the prevention of anastomotic leakage after oesophagectomy.

Methods: A systemic review of the Cochrane Library database CENTRAL, MEDLINE and EMBASE from inception to March 2014 was performed. Randomized controlled trials comparing omentoplasty with non-omentoplasty after oesophageal resection for a primary oncological indication were included. Meta-analysis was performed for anastomotic leakage, specific complication rates, in hospital mortality, local recurrence and duration of hospitalization. Data was reported as a Peto odds ratio (Peto OR), odds ratio (OR), weighted mean difference (WMD) or relative risk (RR) with 95% confidence intervals (CI).

Results: Three randomized controlled trials with a total of 633 anastomoses were included. The omentoplasty group demonstrated a significantly lower incidence of postoperative anastomotic leakage (Peto OR: 0.26; 95% CI 0.14 to 0.52), and reduced duration of hospitalization (WMD −2.13; 95% CI −3.57 to −0.69). There was no significant difference between the omentoplasty and non-omentoplasty groups in the incidence of anastomotic strictures (RR: 0.91, 95% CI: 0.33 to 2.57), hospital mortality (RR: 0.86, 95% CI: 0.29 to 2.51), pulmonary complications (RR: 0.90, 95% CI: 0.59 to 1.35) and recurrence after surgery (RR: 1.17, 95% CI: 0.95 to 1.43).

Conclusions: Omentoplasty may reduce the incidence of anastomotic leakage following oesophagectomy for oesophageal cancer.

Keywords: Omentoplasty; Oesophageal cancer; Anastomotic leakage; Meta-analysis

Introduction

Oesophagectomy followed by reconstruction is the standard of care for oesophageal cancer. A primary anastomosis is formed between the residual oesophagus and the stomach, translocated to the chest or neck. Anastomotic leakage is a severe complication of oesophagectomy, which contributes to considerable morbidity and mortality.1

In has been proposed that Omentoplasty, the technique of wrapping the greater omentum around a gastrointestinal anastomosis, may decrease the incidence and severity of anastomotic leakage.2

The omentum has a unique functionality in inducing neovascularization and localizing potentially malignant inflammatory processes. The pedicled omentum serves to seal microscopic leakage and remodel tissue. However this is not without risk. Necrosis of the pedicled graft and local cancer recurrence have been reported in animal and human models.2,3

We conducted a meta-analysis of randomized controlled trials comparing omentoplasty with an uncovered anastomosis for the prevention of anastomotic leakage after oesophagectomy.

Methods

Literature search

We searched the electronic databases of the Cochrane Library database CENTRAL, MEDLINE, EMBASE from their...
inception to March 2014 for randomised controlled trials comparing omentoplasty with non-omentoplasty after oesophageal resection for a primary oncological indication. The following index terms were used: (oesophagus [and MeSH Terms] OR esopha* OR *esopha*) AND (esophagostomy [and MeSH Terms] OR anastomosis) AND (omentum [and MeSH Terms] OR omentoplasty OR omental). We reviewed the reference lists of included articles and scanned published conference proceedings to identify further relevant studies. No language limitations were imposed.

Study eligibility

Potential studies were evaluated for their eligibility by two independent investigators. Disagreement was resolved by consensus. Anastomotic leakage was defined as clinical symptoms of leakage and/or radiographic evidence of anastomotic or peri-anastomotic leakage. The inclusion criteria were as follows:

1. Randomised controlled trial (RCT) comparing omentoplasty with non-omentoplasty after oesophageal resection
2. Primary oncological indication
3. Anastomotic leakage reported as a primary or secondary outcome
4. Included sufficient data to be included in pooled analysis

Data extraction

The following data points were extracted from all included studies: cohort characteristics study design, intervention(s) performed and outcomes. If there was any missing data, attempts were made to source these from the study authors.

Risk of bias assessment

The methodological quality of the included studies was evaluated according to quality check lists from the Cochrane Handbook for Systematic Reviews Interventions.4

Meta-analysis

The data extracted from the included studies were combined and pooled estimates of the Peto odds ratio (Peto OR), odds ratio (OR), relative risk (RR) and risk difference (RD) was calculated for dichotomous variables. The weighted mean difference (WMD) was generated for continuous variables. 95% confidence intervals were reported. If the results obtained from these different methods disagreed, an analytical method according to the data characteristics was used. If the results were very similar, only the relative risk was reported.5 Statistical heterogeneity among studies was evaluated with a Box–Pierce test (Q-statistic) and the $I^2$ statistic. A significance threshold of $P < 0.1$ for the Q-statistic or $I^2 > 50\%$ was determined to be heterogenous.6 We explored heterogeneity with subgroup analysis according to anastomotic site (thoracic or cervical), anastomotic method (manual or mechanical), anastomotic configuration (end-to-end, end-to-side, side-to-side) and surgical approach (trans-thoracic, transhiatal, thoracotomy). If there was significant heterogeneity amongst data points, a random-effects model was used. Otherwise a fixed-effects model was used. The publication bias was examined by Egger test.7 Analyses were performed using Review Manager, V5.1.2 (Cochrane Collaboration, Oxford, UK).

Results

Results of the literature search

The systematic literature search yielded a total of 120 citations, excluding duplicates. Three RCTs, which included a total of 633 anastomoses, were ultimately included in the analysis8–10 (Fig. 1). All included studies were published in English language. All of the included studies compared omentoplasty to non-omentoplasty after oesophagectomy for patients with oesophageal cancer. The studies included 3 surgical approaches to oesophagectomy: transthoracic oesophagogastrectomy with intrathoracic anastomosis (TTE), transhiatal oesophagogastrectomy with left-sided neck anastomosis (THE) and right thoracotomy with three-field lymphadenectomy and a cervical anastomosis. With regard

Figure 1. Flowchart of publication selection.
to anastomotic technique, stapled end-to-side oesophago-
gastric anastomoses was performed in Dai’s study, manual
end-to-side oesophagogastric anastomoses in Bhat’s study
and variable manual oesophagogastric anastomoses in
Zheng’s study. The characteristics of the included trials
are summarised in Table 1. The risk of bias assessment in
summarised in Table 2.

### Anastomotic leakage

All three studies reported the incidence of anastomotic
leakage. The incidence of anastomotic leakage was signif-
icantly lower in the omentoplasty group than the control
(Peto OR: 0.26, 95% CI: 0.14–0.52, \( P < 0.0001 \)). This re-
mained consistent amongst a variety of sensitivity analyses
(Table 3). No evidence of heterogeneity was detected
\( [I^2 = 0\% , \ P = 0.85] \) (see Fig. 2).

### Anastomotic strictures

The anastomotic stricture rate was reported in all three
studies. There were no significant differences in the anastomotic stricture rate between the omentoplasty and non-
omentoplasty groups (RR: 0.91, 95% CI: 0.33–2.57; \( P = 0.87 \)). There was considerable heterogeneity between
the studies (\( I^2 = 65\% ; \ P = 0.06 \)) (Fig. 3).

In subgroup analysis the incidence of anastomotic stric-
ture in the stapled anastomosis cohort was significantly lower in the omentoplasty group (RR: 0.40, 95% CI:
0.18–0.87; \( P = X \)).

### Hospital mortality

In-hospital mortality was reported in all three studies. There were no significant differences in mortality between
the two groups (RR: 0.86, 95% CI: 0.29–2.51; \( P = 0.78 \)),
with low heterogeneity (\( I^2 = 0\% ; \ P = 0.94 \)) (Fig. 4).

### Length of hospital stay

All three studies reported the length of hospital stay. Length of stay was significant shorter in the omentoplasty
group in comparison with the control (WMD -2.13; 95% CI
\(-3.57 \) to \(-0.69 ; \ P = 0.004 \)), with unsubstantial hetero-
genesis (\( I^2 = 0\% ; \ P = 0.71 \)) (Fig. 5).

### Recurrence after surgery

Zheng’s study alone reported recurrence after surgery,
with patients follow-up to 3-years post-operatively. Omen-
toplasty did not significantly increase the risk of recurrence
after surgery (RR: 1.17, 95% CI: 0.95–1.43; \( P = 0.13 \)).

### Pulmonary complications

Pulmonary complication rate was available from two
studies, with no significant difference between the two
groups (RR: 0.90, 95% CI: 0.59–1.35; \( P = 0.60 \)). Hetero-
genesis was low (\( I^2 = 0\% ; \ P = 0.65 \)).

### Discussion

This study aimed to compare omentoplasty following
oesophageal resection with none. Three randomized
controlled trial were meta-analysed for the anastomotic
leakage and a range of operation specific compilations.
Omentoplasty may demonstrated to decrease the frequency
of anastomotic leakage and reduce the duration of in-
hospital stay. It had negligible effects on the anastomotic

<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention</th>
<th>No. patients</th>
<th>Age (years, mean ± SD)</th>
<th>Tumour stage</th>
<th>Anastomotic site</th>
<th>Anastomotic configuration</th>
<th>Anastomotic method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOP</td>
<td>97</td>
<td>NA</td>
<td>II/III</td>
<td>Mixed</td>
<td>End-to-side</td>
<td>Manual</td>
</tr>
<tr>
<td>Dai</td>
<td>OP</td>
<td>128</td>
<td>62 ± 9</td>
<td>I/II/III</td>
<td>Mixed</td>
<td>End-to-side</td>
<td>Stapled</td>
</tr>
<tr>
<td></td>
<td>NOP</td>
<td>127</td>
<td>64 ± 8</td>
<td>I/II/III</td>
<td>Mixed</td>
<td>End-to-side</td>
<td>Stapled</td>
</tr>
<tr>
<td>Zheng</td>
<td>OP</td>
<td>92</td>
<td>67.5 ± 11.2</td>
<td>I/II/III</td>
<td>Cervical</td>
<td>NA</td>
<td>Manual</td>
</tr>
<tr>
<td></td>
<td>NOP</td>
<td>92</td>
<td>65.7 ± 9.4</td>
<td>I/II/III/IV</td>
<td>Cervical</td>
<td>NA</td>
<td>Manual</td>
</tr>
</tbody>
</table>

OP omentoplasty; NOP non-omentoplasty; NA not available; SD Standard deviation.

### Table 1

Characteristics of included studies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Random sequence generation</th>
<th>Allocation concealment</th>
<th>Blinding of participants and personnel</th>
<th>Blinding of outcome assessment</th>
<th>Selective reporting</th>
<th>Other bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhat</td>
<td>Low risk</td>
<td>Unclear risk</td>
<td>Low risk</td>
<td>Unclear risk</td>
<td>Unclear risk</td>
<td>Unclear risk</td>
</tr>
<tr>
<td>Dai</td>
<td>Low risk</td>
<td>Unclear risk</td>
<td>Low risk</td>
<td>Unclear risk</td>
<td>Unclear risk</td>
<td>Unclear risk</td>
</tr>
<tr>
<td>Zheng</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Unclear risk</td>
<td>Unclear risk</td>
<td>Unclear risk</td>
</tr>
</tbody>
</table>
stricture rate, in-hospital mortality, the pulmonary complication rate and tumour recurrence.

Anastomosis leakage is a severe and life-limiting consequence of oesophagectomy. The absence of the serosa, inadequacy blood supply and the tension across anastomotic site are all well-established risk factors for anastomotic leak. With only a minor modification of surgical technique, omentoplasty may pose a cost-effective and pragmatic solution to the problem of anastomotic leakage post-oesophagogastomy.

It is regarded that a cervical anastomosis of stomach to oesophagus is placed under greater tension and imparts greater risk of ischaemia to the gastric conduit than thoracic anastomosis. This may go some way to account for previous reports of higher leakage rates in cervical anastomoses. We conducted a subgroup analysis, stratified anastomotic leak rate by anastomotic site. This showed that the incidence of leakage following both of cervical anastomosis and thoracic anastomosis was significantly lower in the omentoplasty group. In the higher risk cervical

<table>
<thead>
<tr>
<th>Outcome or subgroup</th>
<th>Studies</th>
<th>Participants</th>
<th>Statistical method</th>
<th>Effect estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Anastomotic leakage</td>
<td>3</td>
<td>633</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.26 [0.14, 0.52]</td>
</tr>
<tr>
<td>1.2 Anastomotic leakage</td>
<td>3</td>
<td>361</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.29 [0.14, 0.63]</td>
</tr>
<tr>
<td>1.3 Anastomotic leakage</td>
<td>2</td>
<td>272</td>
<td>Peto Odds Ratio (Peto, Fixed, 95% CI)</td>
<td>0.21 [0.05, 0.80]</td>
</tr>
<tr>
<td>1.4 Anastomotic strictures</td>
<td>3</td>
<td>631</td>
<td>Risk Ratio (M–H, Random, 95% CI)</td>
<td>0.91 [0.33, 2.57]</td>
</tr>
<tr>
<td>1.5 Hospital stay</td>
<td>3</td>
<td>633</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>–2.13 [–3.57, –0.69]</td>
</tr>
<tr>
<td>1.6 Hospital mortality</td>
<td>3</td>
<td>633</td>
<td>Risk Ratio (M–H, Fixed, 95% CI)</td>
<td>0.86 [0.29, 2.51]</td>
</tr>
<tr>
<td>1.7 Recurrence</td>
<td>1.7.1 Lymphatic metastasis</td>
<td>1</td>
<td>184</td>
<td>Risk Ratio (M–H, Fixed, 95% CI)</td>
</tr>
<tr>
<td>1.7.2 Haematogenous metastasis</td>
<td>1</td>
<td>184</td>
<td>Risk Ratio (M–H, Fixed, 95% CI)</td>
<td>1.03 [0.70, 1.51]</td>
</tr>
<tr>
<td>1.8 Pulmonary complications</td>
<td>2</td>
<td>449</td>
<td>Risk Ratio (M–H, Fixed, 95% CI)</td>
<td>0.90 [0.59, 1.35]</td>
</tr>
</tbody>
</table>

Table 3
Omentoplasty versus non-omentoplasty meta-analysis results.
anastomosis cohort, this may therefore be of particular utility. As for anastomotic method, a subgroup analysis demonstrated superior effects of omentoplasty in stapled anastomoses beyond manual anastomoses.

Anastomotic strictures after oesophagostomy also have a deleterious effect on the quality of patients’ lives. The pooled analysis of anastomotic stricture rates demonstrated no significant differences in the risk of developing anastomotic strictures across the three included studies. Substantial heterogeneity was detected. A subgroup analysis according to anastomotic method revealed that the incidence of anastomotic strictures following manual anastomosis was similar between the omentoplasty and non-omentoplasty groups. However the incidence of anastomotic strictures following stapled anastomosis was much lower in the omentoplasty group than non-omentoplasty group. Literature reports suggest that end-to-side anastomosis is associated with a lower rate of anastomotic stricture than end-to-end anastomosis. However we had insufficient data here to perform specific subgroup analysis according to anastomotic configuration. Anastomotic method and configuration may contribute to the changing incidence in anastomotic stricture rate, however we are underpowered here to make recommendations for future practice.

This meta-analysis showed that the omentoplasty group was associated with a reduced length of hospital stay. We could extrapolate that this was due to a lower complication rate, specifically including anastomotic leakage.

A potential for increased risk of tumour recurrence in omentoplasty has been previously reported. The omentoplasty technique was demonstrated here to be safe, with no associated increase in pulmonary complications rate, lymphatic or haematogenous metastasis, or in-hospital mortality.

Since only three studies met inclusion criteria, the sample size was relatively small (n = 633). Heterogeneity was low throughout, except for in subgroup analyses of anastomotic stricture. Due to insufficient data availability, some of the preplanned subgroup analyses and bias calculations were not able to be performed. Furthermore none of the included studies reported blinding, which may have biased procedural selection and outcome reporting.

The studies outline failed to relay the broad spectrum of manifestations of anastomotic leakage, ranging from asymptomatic radiologically detected leaks, to fulminant leaks with systemic sepsis and multiple organ dysfunction. This lack of a cohesive definition of anastomotic leak may go some way to explaining variation in its incidence. Long-term survival measures and patient reported outcomes were also neglected.

Conclusions

The use of pedicled omentum to oversew and oesophagogastric anastomosis after oesophagectomy may decrease the incidence of anastomotic leakage and reduce the duration of hospital stay. No increased risk prevailed for mortality rates, pulmonary complication rate, and recurrence after surgery, suggesting that omentoplasty may be a safe and effective treatment modification.
Authors contributions

The study design and concept was formulated by LC, FL and KW. Studies were evaluated for inclusion by LC and FL. LC and KW extracted the relevant data points. LC and WZ assessed the methodological quality of studies included. Data analysis and statistical methods were performed by LC, FL and WZ. The manuscript was prepared by LC and reviewed by all contributors.

Conflict of interest statement

None declared.

References