Carcinogenesis and treatment of adenocarcinoma of the oesophagus and gastric cardia
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Chapter 11

Hospital volume and hospital mortality for oesophagectomy

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Adapted from:
Abstract

Background. Hospital mortality after oesophagectomy has decreased from 29% to 7.5% over the last decades, due to improved surgical techniques and better peri-operative care. Suggestions have been made that a further decrease in hospital mortality might be achieved by centralisation of oesophagectomies in high volume centres.

Patients and Methods. The effect of hospital volume on hospital mortality after oesophagectomy in the Netherlands was analysed based on data from the Dutch National Medical Registry and the Dutch Network and National Database for Pathology over the period 1993-1998.

Results. Annually ca. 310 (range 264 – 321) oesophagectomies are performed in the Netherlands. Fifty-two percent are performed in 43 - 55 low volume centres (1 - 10 resections/year). Six percent are performed in 1 - 3 medium volume centres (11 - 20 resections/year). The remaining 42% are performed in two high volume centres (>50 resections/year). Hospital mortality is 12.1%, 7.5% and 4.9% respectively (p<0.001), while there seem to be slightly more advanced tumours in the high volume centres.

Conclusions. There is a significant (inverse) relation between hospital mortality and hospital volume for oesophageal resection in the Netherlands. Although hospital mortality is not the only measure for quality of care, these data suggest a potential beneficial effect of centralisation of oesophagectomy in the Netherlands.

Introduction

The great majority of oesophageal resections are performed because of malignant disease. Oesophageal carcinoma is an aggressive disease with a poor chance of survival. As yet surgery offers the best hope for definite cure, but even after ‘curative’ surgery five-year survival rates do not exceed 25%. Due to the advances in peri-operative care hospital-mortality after oesophageal resection has decreased over the last decades from 29% in the period 1953-1978 to 7.5% in the period 1990 – 2000.

Suggestions have been made that centralisation of oesophagectomies in dedicated centres with experienced oesophageal surgeons might help to decrease hospital mortality even further. Nowadays, in experienced hands hospital mortality is below 5%. To assess the relation between hospital volume and hospital mortality after oesophagectomy for carcinoma of the oesophagus in the Netherlands a nation-wide retrospective analysis was performed over the period 1993 – 1998.
Patients and Methods

Generally, only patients without evidence of locally irresectable disease or distant metastases are considered candidates for potentially curative oesophagectomy, as surgery is not widely accepted as a means of palliation in the Netherlands. This is the case in approximately 50% of patients presenting with oesophageal carcinoma.

The Dutch National Medical Registry (DNMR) provided anonymised data of hospital mortality after oesophageal resection. This was done in such a way that the number of resections performed annually could be calculated for each centre, while the individual centre and patient could not be identified. Centres were divided into three categories: low volume centres (1-10 oesophagectomies/year), medium volume centres (11-20 oesophagectomies/year) and high volume centres (>20 oesophagectomies/year).

The DNMR-database collects data of every patient discharged from any hospital in the Netherlands. These data include diagnosis and procedures performed. Patients were included in the present study if they had undergone oesophagectomy (followed by reconstruction with a gastric tube or colon interposition, or “not otherwise described”).

The Dutch Network and National Database for Pathology (DNNDP) is a nation-wide pathology database (Stichting Pathologisch Anatomisch Landelijk Geautomatiseerd Archief, PALGA) with records of all pathology results, also coded for disease. To compare the case mix of low, medium and high volume centres, demographic data (age and gender), indication for surgery (malignant, non-malignant) and pathology results (pTNM-stage and histologic type of the tumour) were provided by DNNDP. To ensure the privacy of patients and hospitals, these results were divided into two categories: high volume hospitals performing over 20 oesophagectomies/year and low/medium volume hospitals performing 20 or less oesophagectomies/year. Data from DNNDP were cross-checked with data from the database of one of the high-volume centres (AMC, Amsterdam) to obtain insight in the accuracy of the DNNDP data.

Statistical analysis was performed using the SPSS package. For categorical variables such as gender and histologic type the chi-square statistic was used. To compare pTNM stages the Mann Whitney U test was used with the pTNM stages as categories. The chi-square statistic for linear trend was used to compare the mortality rates between high, medium and low volume hospitals. The mean of continuous variables was compared with Student’s t-test. All tests were performed two-tailed; a p-value < 0.05 was considered statistically significant.
Annually approximately 310 oesophagectomies (range 264 – 321) are performed in the Netherlands according to the DNMR and DNNDP. The distribution of the resections over high -, medium, and low volume centres is shown in table 1.

When cross-checked with the database of one of the high volume centres (AMC, Amsterdam), the number of resections performed corresponded exactly, and the pathological diagnosis regarding tumour stage or histological diagnosis differed only in 10/379 patients (2.6%). We therefore consider the DNNDP database as reliable for staging purposes.

Patient and tumour-characteristics are shown in table 2. From this table it becomes clear that there is no significant difference in age, gender or histologic type of tumour between the two groups of hospitals. In the two high volume centres there are slightly but significantly more advanced tumours than in the low-volume centres. (p = 0.003, Mann Whitney U-test).

Hospital mortality is depicted in figure 1. There is a significant (inverse) relation between hospital volume and hospital mortality, decreasing from 12.1% in low-/medium volume centres to 7.5% in medium volume centres and 4.9% in high volume centres (p<0.001). This relation can also be seen in figure 2.

Discussion

This study shows that there is a significant inverse correlation between hospital volume and hospital mortality after oesophagectomy for cancer in the Netherlands, while high volume centres seem to operate more advanced cases.

There is no difference in age or gender distribution between low-/medium and high volume centres, but insight in co-morbidity (e.g. American Society of Anesthesists -ASA- classification) could not be obtained, as nation-wide registration is not available. In the two high-volume centres approximately 85% of patients fall into ASA classes I or II, the others are ASA class III. There seems to be no reason to assume that in the low volume centres this distribution would be different, the most severe cases might even be referred to a high volume centre.

The present study does not differentiate between different resection forms. In the Netherlands, most surgeons prefer a transhiatal resection for carcinomas distal to the carina, and a transthoracic resection for carcinomas proximal to or at the level of the carina. A formal lymph node dissection is hardly ever performed in the abdomen and chest in the low or medium volume centres. During the study period a randomised trial comparing transhiatal resection with transthoracic resection with extended
lymphadenectomy has been performed in the two high volume centres of the present study. This might affect the staging of the disease as in the extended arm a formal lymph node dissection was performed in the abdomen, including lymph nodes near the celiac axis, common hepatic - and splenic artery. The presence of tumour positive nodes in these stations is considered as metastatic disease (M1) for oesophageal carcinoma. The presence of a higher percentage of stage IV tumours in the high volume centres might therefore reflect stage migration due to this more extended resection, and not necessarily a difference in case mix. However, the performance of a more extended lymph node dissection has also led to a slightly but not significantly increased early post-operative mortality in the two high-volume centers. The higher percentage of later stage tumours in the high volume centres might also be a reflection of referral pattern; patients with more advanced tumours being referred to a high volume centre while patients with an early tumour are operated upon in the centre of first diagnosis. Selection bias based on an extensive surveillance program is, given the current state of surveillance programs for Barrett’s oesophagus in the Netherlands, unlikely.

The results of the present study are based on a retrospective analysis of data from two nation-wide databases. The accuracy of such databases can be disputed, but they are the best available. Cross-checking of the pathology results of DNNDP with the pathology results of one of the high volume centres showed a good matching of the results. The data provided by the DNMR and DNNDP seem to be reliable to an extent useful for the present purposes.

Is it the experience of the individual surgeon or the experience of the hospital, which is a predominant factor influencing the outcome after major surgery? For oesophageal resection, Miller suggested, just as Matthews and co-workers did in the eighties, that the experience of the surgeon is a major factor influencing mortality rates: frequent surgeons (performing six or more oesophagectomies/year) showed significantly lower mortality rates. However, in that study the experience of the hospitals in which the operations were performed was not assessed. In the present study oesophagectomies in the high volume series were performed by or supervised by one of three experienced surgeons (H.W.T., H.O. and J.J.B.v.L.), mixing the influence of surgeon-volume and hospital-volume. However, surgeon experience and hospital experience will almost always be related.

Patti et al. performed a study to evaluate the relationship between a hospital’s annual rate of oesophagectomy for oesophageal cancer and the clinical outcome of the operation in California. In their series hospital mortality was 4.8% in hospitals with more than 30 oesophagectomies/year, versus 16% for hospitals with less than 30 oesophagectomies/year. These numbers correspond well with the numbers of the present series. However, in the report of Patti et al. the high volume centres performed only 1.8% of all oesophagectomies, while in the present series this is approximately 40%.

Hospital volume might theoretically be a better parameter for comparison of mortality rates than surgeon volume. Hospital volume shows the experience of the whole hospital, including surgical, anaesthesiologic, medical, and nursing staff, with major surgery. It is probably not the single surgeon that makes the difference, but the whole environment in which the operation is performed. All
contributors to the multidisciplinary treatment probably influence the outcome after major surgery, whether it is pancreatico-duodenectomy, cardiac surgery, rectal surgery or oesophagectomy. Ideally, hospital mortality should not be the only parameter for quality of care. Other parameters, such as long-term survival and quality of life should preferably also be taken into account. Although the overall long-term survival is known for the two high volume centres (median survival is approximately two years for all stages combined), these data are not known for the low- and median volume centres. However, the present data are an argument in favour of centralisation of oesophagectomies in dedicated centres (although the minimum number of operations required per year needs further study).

Centralisation is appropriate for procedures with high baseline mortality risks and high costs. Oesophagectomy is a procedure that fits these criteria. Centralisation of oesophagectomy in the Netherlands, a small, densely populated country in which travelling distances are small, would imply the designation of a few more centres in which oesophagectomies are performed. A comparison can be made with acute trauma care: the Dutch government has designated recently eleven dedicated trauma-centres, including three large non-academic centres.

Another option could be the establishment of regional surgical networks in which experienced surgeons travel around and perform elective oesophagectomies in different (smaller) centres. However, although this last solution does spread surgical experience, the other members of the multidisciplinary team might not become acquainted with the complex peri-operative care, and late complications would be left to local providers and not to the experienced surgeon.

A drawback of centralisation is the loss of experience in complex surgery, which could reduce the proficiency in delivering emergency care that cannot be referred. Moreover, the loss of complex surgery may have a negative impact on the image of a hospital, even with regard to less complex procedures, which might reflect on the ability to recruit and retain both surgeons and patients. Another threat is the ever increasing waiting-list, which might have implications for the stage of the disease at the time of operation as well. Logistic measures are necessary to avoid this problem.

Oesophageal resection is a relatively infrequent operation, performed only 300 times per year in the Netherlands (with a general population of 15 million). Mostly it is performed for oesophageal carcinoma or its precursor, high-grade dysplasia in a Barrett’s oesophagus. Limiting oesophageal resection to a few centres can be done as long as the referring specialists and/or family practitioners do not delay referral to such a centre, thereby losing the ‘window of opportunity’ to cure this aggressive disease.

Although this study was performed in the Netherlands, the Dutch health care system is comparable with that of most Western countries, except maybe for the travelling distances. The epidemiology of oesophageal carcinoma is also comparable: there is an increase in the incidence of adenocarcinoma (at this moment 2.2 per 100,000 person years), now equalling the incidence of squamous carcinoma (2.3 per 100,00 person years), which has also been reported for other Western countries.
Conclusion

There is an inverse correlation between hospital volume and hospital mortality for oesophageal resection in the Netherlands, while case mix suggests the presence of more advanced tumours in the high volume centres. These data favour centralisation of oesophageal resection in dedicated centres. Additional studies, investigating other essential parameters for quality of care (e.g. long-term survival, quality of life and costs), are needed before centralisation can definitely be recommended.

References

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13) Wijnhoven BPL, Louwman MWJ, Tilanus HW, Coebergh JWW. Increased incidence of adenocarcinomas at the gastrooesophageal junction in Dutch males since the 90’s. Eur J Gastroenterol Hepatol 2002; 14: 115-22
Table 1: Distribution of resections over High Volume Hospitals (> 20 resections/year), Medium Volume Hospitals (10 – 20 resections/year), and Low Volume Hospitals (1-9 resections/year) according to the Dutch National Medical Registry (DNMR) and the Dutch Network and National Database for Pathology (DNNDP) in the period 1993 -1 998.

<table>
<thead>
<tr>
<th>Hospital Category</th>
<th>DNMR</th>
<th></th>
<th>DNNDP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=1792</td>
<td>%</td>
<td>N=1900</td>
<td>%</td>
</tr>
<tr>
<td>High volume hospitals</td>
<td>757</td>
<td>(42)</td>
<td>686</td>
<td>(36)</td>
</tr>
<tr>
<td>Medium volume hospitals</td>
<td>107</td>
<td>(6)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Low volume hospitals</td>
<td>928</td>
<td>(52)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Medium-/low volume hospitals combined</td>
<td>1035</td>
<td>(58)</td>
<td>1214</td>
<td>(64)</td>
</tr>
</tbody>
</table>

Table 2: Patient and tumour characteristics of patients registered in the Dutch Network and National Database for Pathology (DNNDP), and operated upon in High Volume Hospitals (>20 resections/year) and Low-/medium Volume Hospitals (1-20 resections/year) in the period 1993-1998.

<table>
<thead>
<tr>
<th>Variable</th>
<th>High volume</th>
<th>Low/median volume</th>
<th>P-value</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>N = 686</td>
<td>N = 1214</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>63 ± 22</td>
<td>62 ± 11</td>
<td>0.13</td>
</tr>
<tr>
<td>Sex (Male/Female)</td>
<td>498/188</td>
<td>890/324</td>
<td>0.20</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>398 (58)</td>
<td>741 (61)</td>
<td></td>
</tr>
<tr>
<td>Squamous cell carcinoma</td>
<td>223 (33)</td>
<td>370 (31)</td>
<td>0.39†</td>
</tr>
<tr>
<td>Other</td>
<td>65 (9)</td>
<td>103 (8)</td>
<td></td>
</tr>
<tr>
<td>PTNM Stage* I</td>
<td></td>
<td></td>
<td>0.003‡</td>
</tr>
<tr>
<td>IIa</td>
<td>149 (24)</td>
<td>327 (29)</td>
<td></td>
</tr>
<tr>
<td>IIb</td>
<td>45 (7)</td>
<td>89 (8)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>288 (46)</td>
<td>506 (46)</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>61 (10)</td>
<td>49 (4)</td>
<td></td>
</tr>
</tbody>
</table>

*: pTNM stages are only provided for adeno – and squamous cell carcinomas. Used is the 1997 IUAC TNM classification for oesophageal carcinoma.
†: p-value is based on adeno - vs squamous - vs Other
‡: p-value is based on all stages combined.
Figure 1: Hospital mortality (%) in low volume hospitals (<10 esophageal resections/year), medium volume hospitals (11-20 resections/year) and high volume hospitals (>20 resections/year) according to the DNMR data. There is a significant inverse correlation between hospital volume and hospital mortality (p<0.001, Chi² test for linear trend).

<table>
<thead>
<tr>
<th>Low volume</th>
<th>Medium volume</th>
<th>High volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.1</td>
<td>7.5</td>
<td>4.9</td>
</tr>
</tbody>
</table>
Figure 2: Hospital volume and hospital mortality

Resections/year

Mortality