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Effect of surgical volume and hospital type on outcome in non-small cell lung cancer surgery: A Finnish population-based study

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Summary
Objective: Hospital mortality and long-term survival in major cancer surgery seems to be affected by hospital related factors. We evaluated the effect of university versus non-university hospital type, and surgical volume (0—4, 5—10, 11—20, and >20 average of cases/year) on the immediate and long-term survival of surgical non-small cell lung cancer (NSCLC) patients.
Patients and methods: Between 1988 and 2002, the number of NSCLC resections with curative intent in Finland was 5339. Follow-up until the end of 2003 from national registries was available on 91% (4878 of 5339) of patients.
Results: Multivariate analysis showed that hospital mortality was unaffected by hospital type or volume, but delay of >4 months from diagnosis to surgery did have an adverse effect. Surgery at university hospitals was associated with significantly better cancer-related and overall survival, as also was surgery at very low-volume but mainly private hospitals (0—4 cases/year).
Conclusions: Undergoing surgery for non-small cell lung cancer at a university hospital may offer an advantage for long-term survival, but large hospital volume in itself did not.
Summary: Multivariate analysis on the effect of hospital type and surgical volume on immediate and long-term survival of 4878 lung cancer surgery patients, 1988—2002, showed that surgery at university hospitals was associated with significantly better cancer-related and overall survival, but hospital mortality did not differ. Large hospital volume did not independently predict a better outcome.

Abbreviations: CI, confidence interval; GDA, open biopsy; GDB, less than lobectomy procedures; GDC, lobectomy or bilobectomy; GDD, pneumonectomies; ICD-9, International Classification of Diseases, 9th revision; ICD-10, International Classification of Diseases, 10th revision; NOMESCO, The Nordic Medico-Statistical Committee; NSCLC, non-small cell lung cancer; NS, not significant; OR, odds ratio; STAKES, The National Research and Development Centre for Welfare and Health; TNM, tumour node metastasis

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1. Introduction

The results of surgery for esophageal, pancreatic, and hepatobiliary cancer appear to depend on the surgeon, hospital type, and volume [1—7]. Some authors have found no such association regarding lung cancer surgery [7—9], especially when all participating centers had uniform protocols for treatment and staging [9]. Lung cancer surgery is hazardous and incapacitating. Hospital mortality is still 3% for lobectomy and 5—10% for pneumonectomy [10]. Over 12% of the survivors die within 6 months, and functional health status in comparison to the preoperative status remains significantly impaired [11].

The surgeon should do the minimum lung resection that offers a chance for cure, maintain a balance between operative risk and chance of cure, and accurately stage the patients in order to provide treatment results comparable with other centers [12]. This objective might not be achieved without a dedicated multidisciplinary lung cancer team that has access to extensive facilities.

We carried out this study to learn whether the hospital mortality and long-term survival of lung cancer patients depends on the surgical volume and hospital type.

2. Patients and methods

2.1. Patients

From 1988 to 2002, 5339 patients in Finland underwent thoracotomy or thoracoscopy with curative intent for non-small cell lung cancer. Of these, 328 patients underwent multiple procedures during the study period, usually a definitive resection after an initial open biopsy or a completion procedure due to a non-radical resection margin. Each patient was accounted for only once, and follow-up began after the first definitive lung resection. Registry data was available until the end of 2003 on 4878 patients. The follow-up was 91% (4878/5339) complete. All surgeries were done by specialists in thoracic and cardiovascular surgery, or under the supervision of one. The surgeries done in the private hospitals were done by specialists who held a main practice in a university hospital. Otherwise, the surgeons did not have multiple practices.

This study was approved by the ethical committee of the Helsinki University Central Hospital.

2.2. Registry data

Every hospital patient in Finland with the non-small cell lung cancer diagnosis code 162.0—162.9 from the International Classification of Diseases, 9th revision (ICD-9) from 1987 to 1995, and C34.0—C34.9 from the 10th revision (ICD-10) from 1996 onwards was selected into the study. The surgical procedures were specified by a code from the List of Procedures of the National Union of Hospitals of Finland between 1986 and 1996, and from The Nordic Medico-Statistical Committee (NOMESCO) list of surgical procedures from 1997 onwards. The corresponding procedure codes were 5821—5839: per operative needle biopsy, open biopsy, wedge or segmental resection, lobectomy, bilobectomy, pneumonectomy, pleuropneumonectomy, or other comparable procedure in this category. The NOMESCO codes were GDA (open biopsy), GDB (less than lobectomy procedures), GDC (lobectomy or bilobectomy), and GDD (pneumonectomies). The HILMO database at the National Research and Development Centre for Welfare and Health (STAKES) database identified all patients with both the lung cancer diagnosis code and the procedure code. These were linked with the Finnish Cancer Registry database, which stores specific data from every cancer patient in Finland regarding age, sex, histology, extent of disease, date and type of procedure, result of surgery, administration of adjuvant therapy, hospital name, delay from diagnosis to surgery, status as dead or alive at end of follow-up, and cause and time of death.

2.3. Definitions

A university hospital is a tertiary level of reference center, one in each hospital district, which is responsible for the training of medical students and specialists in medicine. There are five such institutions in Finland.

The average total hospital volume was calculated by dividing the yearly number of patients that underwent surgery for curative intent for NSCLC in each institution by the duration of the study (1988—1992; 15 years).

Simple surgical biopsy and less than lobectomy/excision biopsy were pooled into a ''less than lobectomy'' category here because the ICD-9 classification did not differentiate between these procedures.

TNM data was unavailable for the initial years of the study period, so a division into categories available from the Cancer Registry database was made. The ''localized disease'' group comprised those patients without observed metastases, and the ''metastatic disease'' group those with lymph nodal or other metastases detected during the same hospital stay as for lung resection.

A complete resection was defined as one with no macroscopic tumor tissue left behind, clean microscopic resection margins, and no mediastinal metastases present. A non-anatomical wedge excision of the tumor was considered an incomplete resection. Anatomical segmental resection was a rarity, and was not considered separately.

Hospital mortality was defined as death within 30 days or during the same hospital stay.

2.4. Statistics

Differences in the distribution of variables between groups were evaluated with the Chi-squared test or Fischer's exact test. Factors affecting hospital mortality were investigated by use of a univariate and multivariate logistic regression mode. Cancer-related and overall survival was evaluated with univariate and multivariate Cox models.

3. Results

Surgery was carried out in 26 hospitals. During the study period, eight hospitals had an average of zero to four cases per year, nine hospitals had 5—10, five hospitals had