

Hospital cost-analysis of complications after Major Abdominal Surgery

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Background

Major abdominal surgery (MAS) may be defined as all upper gastrointestinal (UGI), hepatopancreatobiliary (HPB) and colorectal surgery (CRS) with either primary anastomosis and/or stoma. MAS is associated with an overall morbidity rate of 35%. There is a 20% rate of major complications, which require invasive treatment and intensive monitoring.

Besides intensive treatment these complications are associated with increased morbidity, mortality, hospital stay and intensive care stay. Postoperative complications induce stress in patients and importantly affect their quality of life. Moreover, postoperative complications lead to an increased consumption of resources.

As part of rising costs in health care, we regard postoperative complications to be a major factor affecting hospital costs. There are insufficient data as to the degree to which complications increase these costs.

Aim

The aim of this study is to assess how high the overall costs of postoperative complications are and how this affects the budget of a Surgical Department.

Materials & Methods

Patient data

Patients that underwent Major Abdominal Surgery, defined as all resections with either primary anastomosis and/or creation of stoma, in 2009 and 2010 in the Vrije Universiteit Medical Center (VUMC), Amsterdam, the Netherlands. Postoperative complications were classified as either minor, labelled by Clavien-Dindo grades I and II or major complications, consisting of grades III, IV and V.

Cost-analysis was considered from a hospital perspective. Information on prices of resources were provided by the cost management Department of the VU University Medical Centre Amsterdam, the Netherlands and by the Dutch health care standards of 2010.

| Parameter | Cost (€) | Uncomplicated | Minor complication | Major complication |
|------------------------------|-----------|------------------|--------------------|---------------------|
| Hospital admission (per day) | €588,92 | 9,7 (9,1 - 10,3) | 17,8 (14,3 - 22,1) | 34,96 (27,7 - 43,2) |
| Intensive Care (per day) | €2.217,96 | 2,7 (1,8 - 3,9) | 10,2 (1,8 - 22,2) | 17 (11,5 - 23,4) |
| Laboratory* | | | | |
| CRP | €3,33 | 3,6 (3,3 - 4) | 6,2 (5,4 - 6,9) | 6,8 (6,2 - 7,4) |
| Leucocytes | €2,73 | 4 (3,6 - 4,3) | 6,4 (5,6 - 7,1) | 8,7 (7,8 - 9,5) |
| Hemoglobin | €2,73 | 4,3 (3,9 - 4,6) | 6,8 (5,9 - 7,6) | 9,4 (8,5 - 10,2) |
| CT-scan imaging | €218,04 | 0,14 (0,09-0,19) | 0,42 (0,28-0,58) | 1,83 (1,44-2,26) |
| Reoperation (per min)** | €17,00 | NA | NA | 1,8 (1,7 - 2,1) |
| Percutaneous drainage | €424,21 | NA | NA | 17 (11-22) |

Table 1: Overview of relevant costs and frequencies of these parameters. * All laboratory costs include standard documentation fee. ** price includes operating room, materials, personel (two nurses, one surgeon, one assistant and one anesthetist)

Statistical analysis

In order to correct for skewness and possible bias in cost data and to allow for an estimation of confidence intervals, applied bias-corrected accelerated bootstrapping techniques were used. Multivariate backward stepwise linear regression analyses was performed in order to assess the effect of patient characteristics and type of operation on the total costs.

Results

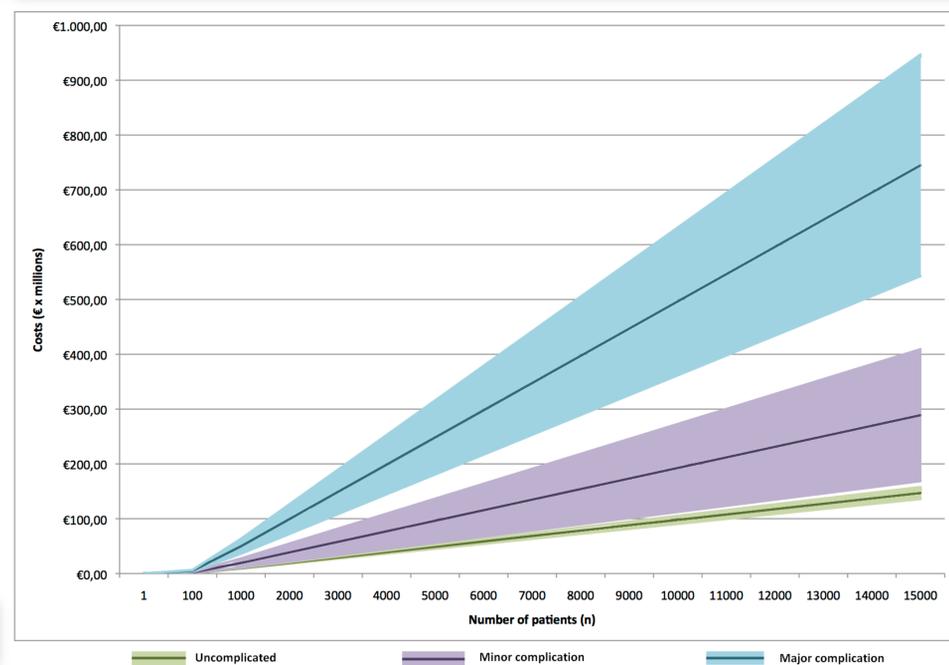


Figure 1: Average costs (€) for uncomplicated, minor, and major complicated patients, with confidence intervals based on bootstrapping with 2000 samples.

Between January 2009 and December 2010, 399 patients underwent major abdominal surgery. Fifty-nine patients (14,8%) experienced minor complications and 83 patients (20,8%) experienced major complications.

The average cost for a patient with an uncomplicated postoperative course was €9787,46 (95% CI €9069,23 - €10505,68); the average cost for a patient with minor complications was €19.258,51 (95% CI €11.245,84 - €27.271,17); and finally the cost for a patient with a major complication was €49.646,86 (95% CI €36.175,31 - €63.118,41). T-test analysis between groups showed significant differences in costs between all groups ($p > 0,001$).

| | B | Std. Error | Beta | Sig. | 95% CI for B | |
|-----------------------------------|--------|------------|--------|-------|--------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| (Constant) | 4,02 | 0,042 | | 0,000 | 3,937 | 4,104 |
| major/minor | 0,232 | 0,017 | 0,535 | 0,000 | 0,198 | 0,266 |
| Type of surgery (HPB, colorectal) | -0,229 | 0,043 | -0,509 | 0,000 | -0,313 | -0,145 |
| Type of surgery (Upper GI) | 0,241 | 0,067 | 0,338 | 0,000 | 0,11 | 0,373 |
| ASA classification | 0,095 | 0,022 | 0,171 | 0,000 | 0,052 | 0,138 |

Table 2: Backward stepwise regression analysis for the effect of patient characteristics and type of operation on total hospital costs.

Conclusions

In conclusion the present study depicts the extent of costs associated with postoperative complications after major abdominal surgery. The total costs, adjusted for ASA-classification and type of surgery) for a patient with an uncomplicated postoperative course is €8.584,81, versus €15.412,96 in patients with minor complications, and €29.198,23 in patients with major complications ($p < 0,001$). Major complications occur in around twenty percent of patients and these patients account for more than fifty percent of the total costs in patients undergoing major abdominal surgery.