Impact of surgeon volume on outcomes of rectal cancer surgery: a systematic review and meta-analysis
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CRD summary
This review concluded that rectal cancer patients of surgeons with higher case-load volume were associated with better overall survival, and lower risk of permanent stoma and abdominoperineal excision. These findings appeared to be supported by the evidence, but limitations in the included studies suggest that the conclusions should be interpreted with caution.

Authors’ objectives
To investigate the impact of surgeon case-load volume on outcomes in patients undergoing rectal cancer surgery.

Searching
MEDLINE and EMBASE were searched from 1990 to March 2010. Search terms were reported. Conference abstracts from the European Society of Surgical Oncology and the Association of Coloproctology of Great Britain and Ireland meetings (2006 to 2008) were searched. A locally available MD degree dissertation was retrieved. Reference lists of included studies were checked for additional studies. Both published and unpublished studies were sought with no limitations placed on language.

Study selection
Any study that reported surgeon case-load and patient outcomes for colorectal surgery and rectal cancer surgery, in patients undergoing treatment after 1990, were eligible for inclusion in the review. Patients with rectosigmoid tumours were eligible for inclusion. Eligible studies had to report at least one of the following outcomes: post-operative or 30-day mortality; overall survival; anastomotic leak rate; local recurrence rate; permanent stoma; and abdominoperineal excision of the rectum rates. Prospective studies had to include patients with a histological diagnosis and retrospective studies with a diagnosis using the International Classification of Diseases, 9th Revision (ICD-9-CM). Studies with mixed patient types that did not present separate data for rectal cancer patients were excluded from the review.

Included studies predominantly assessed rectal cancer patients undergoing abdominal resective surgery. Most of the studies used registry data. The mean age of included patients was 70 years (where reported). Approximately 60% of the included studies were in male patients only and 20% in female patients only; the remaining studies included mixed gender populations. Most studies reported the mode of presentation of patients which ranged from 3 to 42% for emergency and unplanned procedures. Comorbidity scores were not reported in most studies, but three studies used the charlson-deyo and Romano-charlson’s scoring systems and one study used the American Society of Anaesthesiologists system. Total mesorectal excision rate was reported in three studies as 76%, 81% and 59 to 79%. Just under half of the studies reported using disease staging criteria according to the American Joint Committee on Cancer and the International Union Against Cancer staging; half of the studies used Duke Staging. Studies were conducted in UK, USA, Norway, Sweden and Australia.

Two reviewers independently assessed each study for inclusion; disagreements were resolved through consensus.

Assessment of study quality
The risk of bias within each study was assessed using the modified newcastle-ottawa scoring system; criteria included representativeness of cohort, ascertainment of surgeon volume, comparability of volume groups on basis of design or analysis, adequacy of outcome measure assessment, and adequacy of follow-up (over 20% was judged satisfactory).

The authors did not state how many reviewers performed the validity assessment.

Data extraction
Two reviewers independently extracted the study data using a standardised structure; disagreements were resolved through discussion. The number of surgical procedures performed over a year or over another specified study period were extracted for each surgeon and categorised as high volume or low volume according to the definition in the original research. Outcome data were extracted in order to calculate odds ratios (ORs) and 95% confidence intervals (CIs); or for survival outcomes, hazard ratios (HRs) with 95% confidence intervals. If necessary hazard ratios were estimated from survival curves. Additional data were obtained from the study authors where necessary.

Methods of synthesis
Studies were grouped according to outcome and both unadjusted and adjusted meta-analyses were performed using a random-effects model. Studies were excluded from the analysis if they did not report rectal and rectosigmoid tumour separately. Pooled odds ratios with 95% confidence intervals were converted to pooled relative risk reductions. Heterogeneity was assessed using $I^2$.

Subgroup analyses investigated effect sizes in separate rectal and rectosigmoid tumour patients.

Publication bias was assessed using a funnel plot.

Results of the review
Eleven studies (n=18,031 patients, number taken from table one), including four prospective studies and six retrospective studies, met the inclusion criteria, but only 10 were included in the meta-analysis. All studies were judged to be representative of rectal cancer patients. The adequacy of follow-up was satisfactory in 10 studies. The ascertainment of surgeon case-load volume was satisfactory in seven studies. Comparability of volume groups was satisfactory in five studies. Four studies fulfilled five of the six assessment criteria.

Patients treated by the surgeons with high case-load volume had a significantly lower 30-day postoperative mortality rate (unadjusted OR 0.57, 95% CI 0.43 to 0.77; three studies; n=4809 patients) than those treated by surgeons with a lower case-load volume.

Patients had an increase in overall survival (unadjusted HR 0.75, 95% CI 0.65 to 0.86; two studies; n=2,917 patients) when treated by high case-load volume surgeons compared with lower case-load volume surgeons.

Patients treated by high case-load volume surgeons had a lower rate of permanent stoma formation (adjusted OR 0.75, 95% CI 0.64 to 0.88; two studies; n=9,685 patients) and a lower rate for abdominoperineal excision of the rectum (unadjusted OR 0.58, 95% CI 0.45 to 0.76; six studies; n=3,921 patients) compared with those treated by lower case-load volume surgeons.

The findings did not change when one study was removed as it included patients with rectosigmoid cancers. However, there was no significant difference between the two surgeon groups when only adjusted analyses were pooled for 30-day or post-operative survival (two studies).

There was no significant difference between high and low case-load volume surgeons groups for anastomotic leak rate. The level of heterogeneity was low in most cases, with the exception of two small studies which showed a large benefit for high case-load volume surgeons.

There was no evidence of publication bias.

Authors' conclusions
Rectal cancer patients of surgeons with higher case-loads were associated with better overall survival, and lower risk of permanent stoma and abdominoperineal excision of the rectum.

CRD commentary
This review answered a well-defined review question, but included a wide range of study designs. Appropriate attempts were made to reduce the risk of both publication and language bias. Precautions were taken to minimise reviewer error and bias when selecting studies and extracting the study data.
The risk of bias within the individual studies was evaluated using appropriate criteria, but it was unclear whether the assessments were independently verified by another reviewer. The reviewers also reported that most of the studies did not carry out appropriate analyses to account for the effects of clustering of patients within surgeons and that only four studies fulfilled all of the quality assessment criteria. The included studies varied in study design, outcomes and the definition of surgeon case-load volume, although statistical heterogeneity was generally low. For some outcomes only a small number of studies were included. The authors also acknowledged the potential bias in outcome selection within studies.

Overall, the findings of the review appeared to be supported by the evidence, but limitations in the included studies suggest that the conclusions should be interpreted with caution.

**Implications of the review for practice and research**

**Practice:** The authors stated that the evidence suggests that patients with challenging tumours in the lower third of the rectum should be referred to higher case-load surgeons given the evidence for lower permanent stoma rates and rates of abdominoperineal excision of the rectum.

**Research:** The authors stated that further research is required to provide standardised definitions for surgeon case-load volume, which can be used to provide more robust evidence for the effect of surgeon volume on patient outcomes including overall survival for up to at least five years. They also stated that future studies should distinguish between rectal and colon cancer, and adjust for clustering and case mix using agreed prognostic factors; both unadjusted and adjusted data should be presented.

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