A Meta-Analysis of Selective Versus Routine Nasogastric Decompression After Elective Laparotomy

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Objective
A meta-analysis of all published clinical trials comparing selective versus routine nasogastric decompression was performed in an attempt to evaluate the need for nasogastric decompression after elective laparotomy.

Background
Many studies have suggested that routine nasogastric decompression is unnecessary after elective laparotomy and may be associated with an increased incidence of complications. Despite these reports, many surgeons continue to practice routine nasogastric decompression, believing that its use significantly decreases the risk of postoperative nausea, vomiting, aspiration, wound dehiscence, and anastomotic leak.

Methods
A comprehensive search of the English language medical literature was performed to identify all published clinical trials evaluating nasogastric decompression. Twenty-six trials (3964 patients) met inclusion criteria. The outcome data extracted from each trial were subsequently “pooled” and analyzed for significant differences using the Mantel-Haenszel estimation of combined relative risk.

Results
Fever, atelectasis, and pneumonia were significantly less common and days to first oral intake were significantly fewer in patients managed without nasogastric tubes. Meta-analysis based on study quality revealed significantly fewer pulmonary complications, but significantly greater abdominal distension and vomiting in patients managed without nasogastric tubes. Routine nasogastric decompression did not decrease the incidence of any other complication.

Conclusions
Although patients may develop abdominal distension or vomiting without a nasogastric tube, this is not associated with an increase in complications or length of stay. For every patient requiring insertion of a nasogastric tube in the postoperative period, at least 20 patients will not require nasogastric decompression. Routine nasogastric decompression is not supported by meta-analysis of the literature.
It is well recognized that nasogastric tubes cause significant patient discomfort. Multiple clinical trials, reviews, and editorials have suggested that routine nasogastric decompression is unnecessary after elective laparotomy, and some studies have demonstrated that nasogastric tubes may be associated with an increased incidence of complications (fever, pneumonia, nasal, and pharyngeal injuries). These studies have advocated selectively placing nasogastric tubes in only those patients who develop a need for decompression in the postoperative period. Despite these reports, however, many surgeons continue to practice routine nasogastric decompression, believing that its use significantly decreases the risk of postoperative complications including nausea, vomiting, aspiration, wound dehiscence, and anastomotic leak, and may lead to a shorter length of stay. This, coupled with longstanding surgical tradition, may explain why previous studies have not been successful in dissuading surgeons from routinely placing nasogastric tubes in their patients postoperatively.

Meta-analysis is a statistical method for systematically combining data from multiple studies to allow conclusions regarding the studies as a whole. It is particularly useful when the existing studies are small and do not have the individual power to arrive at statistically significant conclusions or have not demonstrated clear differences in outcome between patient groups. We performed a meta-analysis of all published clinical trials comparing selective versus routine nasogastric decompression in an attempt to more fully evaluate the true need for nasogastric decompression after elective laparotomy.

METHODS

Literature Search

A comprehensive search of the English-language medical literature was performed to identify all published clinical trials evaluating nasogastric decompression. This was accomplished through detailed searches of electronic databases including the National Library of Medicine’s MEDLINE and Current Contents. The references of clinical trials identified through these methods were reviewed to further ensure that all appropriate studies had been collected. Unpublished studies were not considered in the literature search. Routine nasogastric decompression was defined as nasogastric decompression beginning preoperatively or intraoperatively and continuing until an unspecified point in the patient’s postoperative course (i.e., return of bowel sounds, passage of flatus, decrease in nasogastric output, etc.). Selective nasogastric decompression was defined as either no nasogastric decompression or intraoperative decompression that was discontinued in the operating or recovery room and re-insti-
tuted only if the patient developed a clinical need for decompression in the postoperative period.

Data Collection

The methods and results section of each clinical trial evaluating nasogastric decompression was photocopied, blinded, and submitted for quality review and data extraction by two of the authors. This was performed independently using a detailed study protocol and standardized data collection form. Each trial was evaluated for patient demographics (age, sex, operative procedure), nature of decompression (no tube vs. routine nasogastric tube), reported patient outcome (incidence of fever, atelectasis, pneumonia, aspiration, nausea, vomiting, abdominal distension, wound infection, wound dehiscence, anastomotic leak; total length of hospital stay; days to first oral intake; and 30-day mortality), and study design (prospective randomized, nonrandomized, case-control, uncontrolled).

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Study quality was assessed using a detailed scoring method modified from Chalmers et al., which results in a calculated "quality score" based on each study's design, statistical analysis, and data presentation. On completion of the blinded study review, the data extracted by each reviewer were compared. When a difference in data interpretation occurred, the discrepancy was resolved through joint review of the study. Data extraction accuracy was assessed using the correlation coefficient between the two reviewer's data. Data that could not be obtained from the published manuscripts were pursued through direct communication with the original authors where necessary.

Inclusion/Exclusion Criteria

All published clinical trials evaluating nasogastric decompression were considered initially. Inappropriate studies were subsequently excluded based on the predefined study protocol. Clinical trials involving both elective and emergency procedures were excluded when the outcome data for the elective laparotomy patients alone were unavailable. Trials evaluating gastrostomy as a decompressive maneuver were considered only to the extent that data regarding selective versus routine nasogastric decompression could be obtained. When the same patients were reported in more than one trial, care was taken to ensure that those patients were included only once in the meta-analysis. Studies in which the necessary data could not be extracted from the published manuscript or obtained from the original investigators were excluded. Uncontrolled case reports also were excluded from analysis.

"Combinability" and Tests of Homogeneity

All clinical trials included in the meta-analysis were similar because they compared patients who were treated either with or without nasogastric decompression after elective laparotomy. The patient outcome measures used in the studies were largely the same, i.e., the need for nasogastric tube placement (or replacement in the case of patients treated with routine decompression), nausea, abdominal distension, vomiting, fever, pulmonary complications (pneumonia, atelectasis, aspiration), wound complications (wound infection, dehiscence, or anastomotic leak), total hospital length of stay, days to first oral intake, and death. To more critically evaluate the appropriateness of combining data from these studies, the overall complication rates associated with selective and routine nasogastric decompression were plotted for each study as described by L'Abbe et al. to identify trials in which outcome differences might be related to confounding factors and differences in study design rather than a true treatment difference. The calculated study quality score also was used to determine the appropriateness of combining individual trials.

Pooling of Data

The outcome data extracted from each trial were subsequently pooled and analyzed for significant differences using the Mantel-Haenszel estimation of combined relative risk. This method weights the results of each study according to its size and calculates the cumulative relative risk for each outcome variable. Student's t test was used to assess significant differences in total hospital length of stay or the number of days to first oral intakes. A p value of ≤ 0.05 was considered significant.

Publication Bias

Publication bias refers to the fact that "negative studies," which demonstrate no treatment effect, are less likely to be published than studies that demonstrate significant differences in outcome. These unpublished studies theoretically could influence the results of a meta-analysis, had they been published, by virtue of the fact that they did not demonstrate a treatment difference. The potential impact of publication bias on the results of a meta-analysis varies with the likelihood that negative studies on the subject of interest will be published. Publication bias particularly is important when a meta-analysis identifies that a significant difference in outcome does exist. The potential effect of publication bias on this meta-analysis was determined using mathematical estimates of the number of unpublished negative studies.
evaluating selective versus routine nasogastric decompression.

Sensitivity Analysis

Sensitivity analysis involves assessing the changes that occur in the meta-analysis as different subsets of the data are evaluated. It is performed to determine how sensitive the meta-analysis results are to changes in the data. If a true treatment difference exists, it will be apparent in all subsets of the data. Therefore, meta-analysis was performed on all clinical trials that met the inclusion criteria, as well as only those trials that had a calculated study quality score of at least 0.50. The comparison of overall complication rates for selective versus routine nasogastric decompression (Fig. 2) also was considered in identification of appropriate studies for pooling and subsequent meta-analysis.

RESULTS

Thirty-seven clinical trials (6850 patients) comparing selective versus routine nasogastric decompression after elective laparotomy were identified in the medical litera-
ture (Table 1). Of these, 11 studies were excluded from further analysis because they did not meet one or more of the inclusion/exclusion criteria described previously. Nine of the 11 trials included patients undergoing emergency laparotomy, whose outcome data could not be separated from that of elective patients. Five of the 11 had inadequate data reporting, and either the original investigators could not be contacted or they no longer had the raw data for further evaluation. Three trials were uncontrolled case reports. One trial evaluated nasogastric decompression in outpatient surgery and was not believed to be appropriate for comparison with the other trials of inpatient management. Twenty-six clinical trials (3964 patients) met the criteria for inclusion in the meta-analysis.

The two authors who performed the data extraction interpreted the data identically 91% of the time. When differences in interpretation occurred, they usually were related to poor or ambiguous data reporting in the original manuscripts or when the trial involved patients undergoing both elective and emergent laparotomy, requiring more detailed data interpretation. The correlation coefficient for the two paired sets of data was 0.98 with an $R^2$ of 0.96.

The initial meta-analysis evaluated all 26 clinical trials (3964 patients) that met the inclusion criteria (Table 2). The total number of complications was significantly greater in patients treated with routine nasogastric decompression. Fever, atelectasis, and pneumonia were significantly less common and the number of days to first oral intake were significantly fewer in patients treated without nasogastric tubes. Selectively decompressed patients also had fewer wound complications (infection and dehiscence) and a shorter hospital length of stay, although the differences did not achieve statistical significance. Nasogastric tube placement was required in 5.2% of patients treated without a nasogastric tube, whereas nasogastric tube replacement was required in 1.8% of routinely decompressed patients, despite their having been decompressed postoperatively. The relative risk of nasogastric tube placement in patients treated selectively was 2.9. The reciprocal of the relative risk difference (i.e., the number of patients who could be treated without nasogastric decompression for each patient who required tube placement postoperatively) was 30.5 patients.

Sensitivity analysis was subsequently performed in which only those trials that had a calculated study quality score of at least 0.50 were included. Quality scores ranged from 0.10 to 0.90, with 20 trials having a score of 0.50 or greater (Table 1). Included in the 20 trials were all 15 prospective randomized controlled studies and 5 of the higher quality case-control studies. When only these 20 trials were considered, fever, atelectasis, and pneumonia remained significantly less common in selectively decompressed patients (Table 3). Abdominal distension and vomiting were significantly more common in selectively decompressed patients, however. The relative risk of nasogastric tube placement in selectively decompressed patients was 2.95. The reciprocal of the relative risk difference was 21.3 patients. In this subgroup analysis, 7.2% of selectively decompressed and 2.8% of routinely decompressed patients required postoperative tube placement or replacement. The incidence of wound complications (infection and dehiscence) continued to

| Table 2. META-ANALYSIS OF ALL 26 CLINICAL TRIALS (3964 PATIENTS) |
|----------------|----------------|-----------|----------|
|                | Selective | Routine | p Value  | RR       |
| Patients       | 1986     | 1978    | <0.0001 | 2.9      |
| Tubes placed/replaced | 103     | 36      | 0.03    | 0.76     |
| Complications  | 833      | 1084    | 0.03    | 0.76     |
| Deaths         | 13       | 25      | 0.22    | 0.36     |
| Pneumonia      | 53       | 119     | <0.0001 | 0.49     |
| Atelectasis    | 44       | 94      | 0.001   | 0.46     |
| Aspiration     | 8        | 13      | 0.88    | 0.61     |
| Fever          | 108      | 212     | 0.02    | 0.51     |
| Nausea         | 179      | 181     | 0.31    | 0.98     |
| Vomiting       | 201      | 168     | 0.11    | 1.19     |
| Abdominal distension | 163     | 165     | 0.36    | 0.98     |
| Wound dehiscence | 12    | 33      | 0.06    | 0.36     |
| Wound infection | 49      | 76      | 0.29    | 0.62     |
| Anastomotic leak | 12     | 16      | 0.93    | 0.75     |
| Oral feeding (days) | 3.53 | 4.59 | 0.04     |
| Length of stay (days) | 9.32 | 10.10 | 0.22     |

RR = relative risk.
Bold type indicates significant results (p < 0.05).

| Table 3. META-ANALYSIS OF 20 CLINICAL TRIALS SELECTED BY QUALITY SCORE >0.5 (2915 PATIENTS) |
|----------------|----------------|-----------|----------|
|                | Selective | Routine | p Value  | RR       |
| Patients       | 1413     | 1502    | <0.0001 | 2.95     |
| Tubes placed/replaced | 100     | 36      | 0.79    | 0.93     |
| Complications  | 770      | 877     | 0.31    | 0.60     |
| Deaths         | 13       | 23      | 0.01    | 0.59     |
| Pneumonia      | 51       | 92      | 0.002   | 0.52     |
| Atelectasis    | 44       | 90      | 0.91    | 0.94     |
| Fever          | 100      | 158     | 0.05    | 0.67     |
| Nausea         | 148      | 144     | 0.33    | 1.09     |
| Vomiting       | 197      | 144     | 0.005   | 1.45     |
| Abdominal distension | 150     | 119     | 0.02    | 1.34     |
| Wound dehiscence | 11      | 31      | 0.06    | 0.38     |
| Wound infection | 47      | 68      | 0.28    | 0.73     |
| Anastomotic leak | 11     | 15      | 0.85    | 0.78     |
| Oral feeding (days) | 3.46 | 4.53 | 0.07     |
| Length of stay (days) | 9.50 | 10.20 | 0.30     |

RR = relative risk.
Bold type indicates significant results (p < 0.05).
be lower in selectively treated patients, but again, did not achieve statistical significance. Analysis of publication bias estimated that the following number of negative studies demonstrating no difference in complication rate would have to have been performed, but not published, to significantly affect the results of the quality score-based meta-analysis: pneumonia, 14 trials; atelectasis, 37 trials; abdominal distension, 16 trials; and vomiting, 52 trials.

**DISCUSSION**

Meta-analysis is a systematic statistical method for analyzing pooled data from multiple studies. It is particularly useful when 1) existing studies are too small to detect a significant difference in outcome, 2) the conclusions of the existing studies differ, or 3) a trial with sufficient patients to detect statistically significant differences would be too costly or impossible to perform. Meta-analysis is well-suited to the evaluation of selective nasogastric decompression because a prospective randomized clinical trial of several thousand patients would be required to identify significant differences in outcome, given the infrequency of complications noted in this study. Thus, this meta-analysis allows surgeons to answer questions regarding nasogastric tube efficacy that probably will never be available in a single clinical trial.

Routine nasogastric decompression is widely practiced after elective laparotomy. This practice is based largely on tradition and the perception that nasogastric decompression protects patients from postoperative complications such as nausea, vomiting, aspiration, wound complications, and anastomotic leak, and may allow for an earlier hospital discharge. Nasogastric decompression has changed dramatically through improvements in tube design and intended use since its popularization by Wangesteen and Paine more than six decades ago.38,59 Many of the early studies advocating nasogastric decompression allowed patients an ad libitum oral intake with the nasogastric tube in place, a practice that would not be advocated by most surgeons today. Thus, the foundation on which the use of routine nasogastric decompression is based has changed over the past several decades, necessitating a re-evaluation of its use.

Few patients would argue that a nasogastric tube is one of the most unpleasant aspects of their postoperative course. Several studies have attempted to quantitate patient discomfort, but this is subjective and difficult to assess.17,29,31,33,39 Therefore, we did not attempt to analyze this aspect of nasogastric decompression in the meta-analysis. The discomfort caused by routine nasogastric decompression is, however, one of the major reasons that surgeons have considered selective nasogastric decompression. This meta-analysis demonstrates that although the incidence of abdominal distension and vomiting is increased in the absence of nasogastric decompression, patients may develop these complications even with a nasogastric tube in place. In the meta-analysis of all 26 clinical trials, 8.2% of selectively decompressed and 8.3% of routinely decompressed patients developed abdominal distension, whereas 10.1% of selectively decompressed and 8.5% of routinely decompressed patients developed vomiting. Similar results were found in the subgroup analysis based on quality score. Thus, routine nasogastric decompression neither prevents the development of abdominal distension and vomiting nor precludes the need for nasogastric tube replacement once it is discontinued. These complications do not necessarily require placement of a nasogastric tube because only 5.2% of selectively managed patients (7.1% in the quality score based meta-analysis) required nasogastric tube placement. In fact, for each patient managed selectively who subsequently requires nasogastric tube placement for nausea, vomiting, or abdominal distension, at least 20 patients can be managed without a nasogastric tube, thus sparing 95% of elective laparotomy patients the significant discomfort and risk of pulmonary complications associated with nasogastric decompression. Furthermore, based on this meta-analysis, routine nasogastric decompression does not prevent wound infection or dehiscence, nor does it decrease total hospital length of stay or the number of days to first oral intake.

This analysis does not address the issue of nasogastric decompression after emergency operations. Although several of the studies analyzed patients undergoing emergency laparotomy, there currently are insufficient data to address this question. We believe that the use of nasogastric decompression after emergency laparotomy is best considered on a case-by-case basis.

There are limitations to any meta-analysis. Perhaps the most important limitation is the quality of the data in the original trials. Although every attempt was made to ensure accuracy in the data extraction, it must be remembered that, by definition, a meta-analysis is a retrospective review. Further, although we originally hoped to stratify the analysis by type of procedure (gastric, biliary, small bowel, and colonic), the manner in which data were reported in the published trials made it impossible to stratify data in this fashion.

**CONCLUSIONS**

Routine nasogastric decompression after elective laparotomy results in a significantly increased incidence of pulmonary complications (fever, atelectasis, and pneumonia) and does not decrease the incidence of wound complications (infection and dehiscence). Although abdominal distension and vomiting are increased without nasogastric decompression, nasogastric tube insertion is required in only 5% to 7% of selectively treated patients,
whereas nasogastric tube replacement is required in 2% of routinely treated patients. Through the use of selective nasogastric decompression after elective laparotomy, at least 20 patients can be spared the discomfort of a nasogastric tube for every patient who requires decompression. Routine use of nasogastric decompression after elective operations is not supported by meta-analysis of the literature.

References

44. Trepianer CA, Isabel L. Perioperative gastric aspiration increases
Discussion

DR. J. LYNNWOOD HERRINGTON, JR. (Nashville, Tennessee): President McDonald, Secretary, Members and guests. An enormous amount of work has gone into this study. Meta-analysis is relatively new, and I know absolutely nothing about it; therefore, I am going to confine my remarks to some practical points and mention my personal experience with the selective use of decompression.

First, I would like to compliment the authors for bringing this subject to our attention. The routine use of postoperative nasogastric suction was questioned back in the 1930s by surgeons who trained at the Mayo Clinic, but it was by no means widely accepted at the time. I’m going to confine my remarks largely to patients who underwent a definitive operation for gastroduodenal ulcer, either vagotomy-antrectomy or vagotomy pyloroplasty. From the late 1940s to 1962, we routinely employed postoperative nasogastric decompression in all cases. However, we became interested in eliminating routine postoperative suction following the publications of Alex Gerber of southern California and Henley and Hendry of England in the late 1950s and early 1960s. These authors, beginning back in the 1940s, eliminated its routine use. This shows that Snyder in 1923 used decompression in a large series in only 15% of the cases. Matheny used it in only 10% of 3000 cases. Gerber, in 2000 cases, did not use decompression in a single case. And these were all major abdominal operations. From January 1962 to November 1970, a 9-year period, in a personal series of 904 patients, 815 underwent an elective definitive gastric procedure, and 89 patients were subjected to an emergency gastric operation. Nasogastric decompression was used postoperatively in only 13% of the entire group. Further breakdown shows that of the 815 patients undergoing elective operation, nasogastric suction was omitted in 92.4%; whereas suction was required in 7.6%. Of the 62 patients who comprised the latter group, suction was used because the patients presented technical problems such as a difficult gastroduodenal anastomosis or a difficult duodenal stump closure. In a few cases, postoperative nausea and vomiting developed or else abdominal distention occurred and, according to our judgment, required the insertion of the nasogastric tube. Of the 89 patients subjected to an emergency operation, postoperative decompression in our opinion was necessary in over half of the group, 63%. These patients largely represented massive bleeders who had a gastrointestinal tract filled with blood and were distended, or else patients with an acute perforation where the abdominal cavity was filled with gastric contents. Such patients are prone to develop postoperative ileus. Persistent suture line bleeding was an indication for the use of the tube in a few cases. And in 33 patients, or 37% of the emergency patients, postoperative decompression was deemed unnecessary.

From 1970 through the 1980s, a period of around 20 years, this regime was carried out in a much larger series of personal patients, over 2000, undergoing vagotomy-antrectomy or vagotomy pyloroplasty, and the results were about the same as in the earlier published report. Therefore, we did not think that we needed to make additional reports on this subject.

We agree with the authors that routine nasogastric suction is not necessary, and the main advantages of not using decompression are diminished house staff and nursing care and diminished respiratory complications—not striking in our cases, 8%, occurring mostly in patients with coexisting cardiopulmonary disease. The greatest advantage according to our thinking in not using the tube is diminished patient discomfort. I agree with the late Bert Dumphy, who stated that the use of or nonuse of postoperative decompression is a judgment call on the part of the surgeon, and you do not need a double-blind study to give you the answer.

In the words of David Sprong, “Some patients are going to need nasogastric decompression and should have it. Many others will do well without it.” Thus, he stated, avoid routinely using nasogastric suction; avoid not routinely using nasogastric suction. One question to the authors. Do you use nasogastric decompression after a parietal cell vagotomy? As you know, about one third of these patients develop significant postoperative fullness and stasis. I appreciate the opportunity to discuss the paper, and I enjoyed reading the manuscript.

DR. RICHARD J. FIELD, JR. (Centreville, Mississippi): Dr. McDonald, Dr. Copeland, Fellow Members of the Southern Surgical, and Guests. I appreciate the privilege of the floor.

In Dr. McDonald’s outstanding presidential address a few moments ago, he talked about the many monumental papers that have been delivered at the Southern Surgical, and I cer-