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The Impact of a Clinical Pathway for Gastric Bypass Surgery on Resource Utilization

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Background. **Clinical pathways are believed to improve patient care and reduce costs. Our hypothesis was that a gastric bypass pathway would decrease hospital resource utilization and cost of care without adversely affecting patient care.**

Methods. **The prepathway (Pre) group consisted of 16 gastric bypasses (6/98 to 3/99). The postpathway (Post) group includes 12 gastric bypass procedures performed after institution of the clinical pathway (4/99 to 12/99). The impact of the clinical pathway on hospital length of stay (LOS) and resource utilization was investigated. A comparison of costs was performed using cost/charge ratios. Hospital readmissions and postoperative complications were also examined.**

Results. **Despite increased obesity/medical acuity of the Post group, hospital LOS decreased by 3 days ($P < 0.0001$). Total hospital costs decreased by over $1600/case (>15%). Postpathway savings were greatest for room and board (34%), supplies (41%), and lab/radiology costs (50%). An increase in OR costs (22%) was observed in the Post group. This was due to an increase in anesthesia time (epidural catheter placement) and equipment costs (ultrasonic shears). Despite reductions in hospital LOS and resource utilization, the complication rate (Pre 12%, Post 16%) was similar and two patients in each group required brief readmission.**

Conclusions. **A pathway for gastric bypass decreased hospital LOS and resource utilization. OR-related expenses account for 34–50% of total costs and must be monitored closely for surgical patients. The reduction in costs observed with this clinical pathway was not associated with an increase in postoperative complications or hospital readmission.** © 2001 Academic Press

Key Words: **clinical pathway; morbid obesity; gastric bypass; management protocol.**

INTRODUCTION

More than half of Americans are overweight or obese, and approximately 5% have serious weight-related medical problems [1]. Body mass index (BMI = kg/m^2) is a term used to describe body composition. Although overweight (BMI 25–29.9) and obese (BMI >30) individuals are at increased risk for medical problems, clinically severe or "morbidly obese" individuals (BMI >35) are also noted to have an increased mortality rate [1, 2].

In 1991, the National Institute of Health Consensus Conference established indications for the surgical treatment of patients with severe obesity (i.e., BMI >35) [3, 4]. To be considered for surgical weight loss procedures, patients should have one or more weight-related medical conditions, failure of medically supervised weight loss, and be without behavioral or psychiatric contraindications [3, 4].

The Roux-en-Y gastric bypass is a commonly performed operative procedure in patients with clinically severe obesity [3, 4]. The Roux-en-Y gastric bypass procedure creates a small (30 to 60 ml) proximal gastric pouch which is drained into a segment of jejunum and therefore "bypasses" the majority of the stomach and proximal jejunum. Although the surgical technique of gastric bypass is relatively standard, patients with severe obesity are at increased risk for complications following upper abdominal surgery [5]. Differences in perioperative care may influence length of

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stay, complication rates, and/or cost of care. In this study, we examined the impact of a standardized patient care regimen or clinical pathway on hospital LOS, resource utilization, and postoperative complications following gastric bypass surgery.

METHODS

A clinical pathway for gastric bypass surgery was developed by scrutinizing conventional management, reviewing the literature, and discussing proposed changes in care with a multidisciplinary team of health care providers. Representatives from the Departments of Surgery, Nursing, and Clinical Nutrition participated in pathway design. The clinical pathway for gastric bypass surgery was initiated April 1999 at the Penn State Hershey Medical Center. Educational materials explaining the standard perioperative regimen for gastric bypass surgery were distributed to patients and health care providers. To investigate the impact of the clinical pathway on patient care we compared prepathway (Pre) and postpathway (Post) patients.

For a 9-month period from June 1998 to March 1999 sixteen gastric bypass procedures performed by a single surgeon constitute the Pre group. Twelve gastric bypass procedures performed by the same surgeon, from April to December 1999, after institution of the clinical pathway are referred to as the Post group. Patients in both groups had extensive preoperative evaluations including nutritional counseling, psychological evaluation, surgical consultation, and work-up of medical comorbidities. Obesity-related medical conditions were documented preoperatively using objective data (sleep studies, pH probe tests, radiographs of painful weight-bearing joints, and clinical laboratory tests).

Prepathway patients received preoperative instructions from the surgical resident or attending physician. There was no standard regimen for deep venous thromboembolism (DVT) prophylaxis or pain control. The nasogastric tube was generally left in place until bowel function returned following surgery. Many patients had routine upper gastrointestinal series before initiating oral intake. In addition, there was no schedule for postoperative laboratory testing which was frequently ordered daily by the surgical housestaff.

In contrast, the Post group and their families received standard teaching with educational brochures regarding the surgical procedure and anticipated perioperative course prior to surgery. At their preadmission visit, preoperative testing was performed (as clinically indicated), informed consent for anesthesia was obtained, and options for pain control (epidural catheter verses patient-controlled analgesia) were discussed. On the morning of surgery, the patient reports to the same day surgery unit where a nursing assessment was completed and additional preoperative teaching, including training with incentive spirometer (ISB) was performed. An intravenous catheter was placed and a pregnancy test performed if the patient was of childbearing age. Patients choosing epidural analgesia were sent to the anesthesia block room or the operating room for the placement of the epidural catheter, depending on room and staff availability. Post patients were started on subcutaneous heparin, 5000 units the day before surgery, and maintained on twice daily heparin until discharge. Lower extremity sequential compression devices were applied prior to the induction of anesthesia and maintained until the patient was ambulatory.

Following surgery, Post patients were routinely admitted to the surgical intermediate care unit. Standard postop orders were utilized for fluid management (normal saline or Ringers lactate), pulmonary care (ISB and breathing exercises every 2 h), activity (out of bed to chair the night of surgery), and pain control with PCA or epidural catheter. The Post group was kept NPO overnight with the nasogastric tube to low continuous suction, urinary catheter to gravity, and "bariatric beds" were utilized for patients over 450 pounds.

On Postoperative Day 1 a complete blood count and electrolytes were obtained, the nasogastric tube was removed, and sips of water (30 cc/h) were started. The patient was ambulated three times a day and transferred to the surgical ward later that day. Patients with severe obstructive sleep apnea were restarted on CPAP or BiPAP as clinically indicated. The next day patients were started on either Optifast 800 or sugar free Carnation instant breakfast at 30–60 cc/h, oral medications were restarted, and urinary catheters were removed. Epidural catheters were routinely removed on Postop Day 3 (sooner if not working), diet was advanced to goal, and the intravenous fluids were stopped. Discharge plans were made for the afternoon of Postop Day 3 or the following morning depending on the adequacy of mobility, po intake, and pain control. Standard discharge instructions included incentive spirometry, medication dose and schedule, patient activity, wound care, and guidelines for physician contact (wound erythema with purulent drainage, severe abdominal pain, persistent vomiting, etc.).

The demographics and associated medical conditions for the patient groups were compiled from hospital and physician medical records (RNC). Information on length of stay (LOS), resource utilization, and cost of care was obtained from the hospital financial information system creating a report for the time period of interest on the diagnosis-related group 288 (surgical procedures for obesity). Only patients having gastric bypass surgery during the time periods of interest were entered into the study.

Cost of care was determined using cost/charge ratios. Cost data were analyzed by category: total costs (Total$) were subdivided into room and board (Room$), operating room (OR$), supplies (Sup$), laboratory and radiology (Lab/Rad$), and miscellaneous (Misc$) costs.

Operating room utilization costs were analyzed further using information obtained from the operating room information system. Operating room time (ORT) was subdivided into anesthesia time (AT), patient preparation time (PrepT), surgical time (SurgT), and "wake up" time (WakeT). Anesthesia time was utilized to place intravenous catheters, establish physiologic monitoring for the procedure (oximetry, hemodynamic, etc.), placement of epidural catheters for postoperative pain management, and the induction of anesthesia. Preparation time includes patient positioning, urinary catheter placement, as well as preparation and draping of the surgical site. Surgical time represents the elapsed time from surgical incision to wound closure and "wake up" time reflects recovery from anesthesia, extubation, and transfer from operating table to bed for transport to postanesthesia care unit. Perioperative complications and hospital readmission were monitored prospectively by the operating surgeon and tabulated by group.

Data are presented as means ± standard error. Statistical evaluation of the data was performed using Instat software (San Diego, CA). Student's t test was used to compare the means of the two groups. Differences among means were considered significant at $P < 0.05$.

RESULTS

The patients in the Pre and Post groups were generally well matched as shown by the demographics outlined in Table 1. The mean age of the patients was similar in both groups. There was a preponderance of female patients in both the Pre and Post groups. However, the BMI of the Post group was higher and the number of weight-related medical conditions was also increased in the Post group (4.8 diagnoses/patient vs 3.7 diagnoses/patient).

The incidence of weight-related medical diagnoses for the Pre and Post groups is shown in Table 2. The most common diagnosis related to obesity was degen-

TABLE 1

Demographics of Gastric Bypass Patients

Group	Pre	Post
Age (years)	40.9 ± 1.91	39.9 ± 3.68
Gender (F:M)	11:5	7:5
BMI (kg/m^2)[a]	55.5 ± 3.02	65.6 ± 5.08
Medical diagnoses	3.7/patient	4.8/patient

[a] BMI, body mass index.

erative joint disease which was identified clinically and radiographically in over 80% of patients presenting for gastric bypass surgery. Sleep apnea, hypertension, gastroesophageal reflux, and hypercholesterolemia were also commonly identified (more than 40% of patients) in both groups. The incidence of these obesity-related diagnoses was increased in the Post group. However, the differences were not statistically significant. Other weight-related medical diagnoses such as type II diabetes mellitus, coronary artery disease, and asthma were identified to a similar extent in both Pre and Post groups.

Despite increased obesity and medical acuity, the mean hospital length of stay was decreased by 3 days in the Post group ($P < 0.0001$ vs. Pre) (Fig. 1). Total hospital costs were decreased by 15% in the Post group. The reduction in hospital costs was due primarily to the decreased length of stay observed in the Post group which accounted for approximately 75% of the total cost savings observed following introduction of the clinical pathway. As one might expect, both laboratory and supply costs were significantly decreased in Post group after institution of the clinical pathway (Table 3).

Interestingly, the OR costs were significantly increased (22%) in the Post group ($P < 0.05$ vs. Pre). To further investigate this finding, a more in-depth analysis of OR costs was performed. Operating room costs

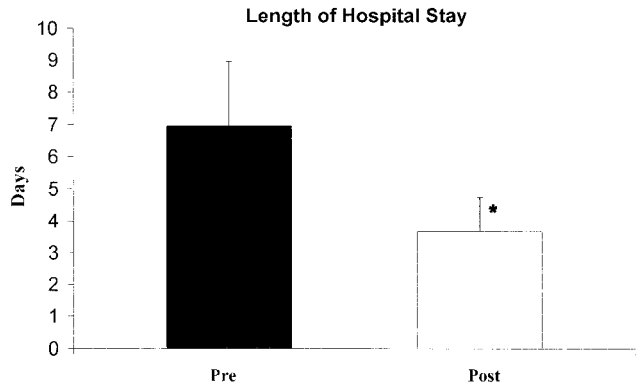

FIG. 1. Impact of gastric bypass pathway on hospital length of stay. The mean hospital length of stay (days) for patients undergoing gastric bypass surgery before initiating a clinical pathway (Pre) was compared with postpathway patients (Post). *$P < 0.001$.

may be subdivided into time-related charges for room utilization and equipment-related charges for suture materials, stapling devices, and other equipment. As shown in Table 4, the total OR time was similar for both groups. However, an increase in mean PrepT (6 min) and anesthesia time (12 min) was observed in the Post group. The increase in AT and PrepT in the Post group accounts for approximately $300 (or 38%) of the increased OR costs in the Post group. The remainder of the increased OR cost in the Post group is due to equipment-related costs (use of the ultrasonic shears, and difference in utilization of stapling devices). Interestingly, despite a significant increase in the Post group BMI, the mean surgical time was reduced by approximately 10% in this group.

Despite the reduction in hospital LOS and cost of care observed in the Post group, the overall incidence of complications (Pre 12%, Post 16%) was not significantly increased. Two patients in each group required brief readmission to the hospital. One patient in the

TABLE 2

Weight-Related Medical Diagnoses in Gastric Bypass Patients

Group (*n*)	Pre (16)	Post (12)
DJD	13	10
Apnea	9	9
HTN	7	8
GERD	7	8
CHO	6	7
DM	3	2
Asthma	4	2
CAD	2	2

Note. DJD, degenerative joint disease; Apnea, obstructive sleep apnea; HTN, hypertension; GERD, gastroesophageal reflux disease; CHO, hypercholesterolemia; DM, diabetes mellitus; CAD, coronary artery disease.

TABLE 3

Impact of the Gastric Bypass Clinical Pathway on Resource Utilization

Group	Pre	Post	Difference	*P* value
Room$	$3,641 ± 398.35	$2,389 ± 346.82	$−1,252	0.013
OR$	$3,467 ± 253.31	$4,251 ± 152.19	$+784	0.02
Sup$	$1,152 ± 194.06	$679 ± 106.89	$−473	0.06
Lab/Rad$	$629 ± 84.34	$312 ± 112.29	$−317	0.03
Other costs	$1,098 ± 121.74	$878 ± 179.34	$−220	0.30
Total$	$10,176 ± 788.71	$8,511 ± 762.60	$−1,665	0.15

Note. Room$, hospital room charge for length of stay; OR$, operating room costs; Sup$, cost of supplies for patient during the in hospital stay; Lab$/Rad$, cost of in-house laboratory studies in addition to the radiology exams performed; Misc$, miscellaneous cost which are those costs not contained in the above.

TABLE 4

Operating Room Utilization by Gastric Bypass Patients

Group	Pre (min)	Post (min)	*P* value
AT (min)	39 ± 5.0	51 ± 5.9	0.08
PrepT (min)	16 ± 1.23	22 ± 2.7	0.42
SurgT (min)	238 ± 11.61	215 ± 13.71	0.175
WakeT (min)	13 ± 1.39	15 ± 2.12	0.87
ORT (min)	306 ± 15.79	303 ± 12.72	0.55

Note. AT, anesthesia time (time in the door till beginning of prep time); PrepT, prep time including positioning and skin preparation; SurgT, total surgery time (from incision to dressing); WakeT, time from dressing to postanesthesia recovery; ORT, operating room time total.

Pre group requiring readmission was hospitalized for a pulmonary embolus that necessitated anticoagulation 6 weeks after surgery. The second admission in the Pre group was for endoscopic dilation of a narrowing at the gastro-jejunal anastamosis. The patient presented with significant nausea and vomiting which left him dehydrated. He was discharged Postprocedure Day 1. One patient in the Post group required brief readmission to the hospital for respiratory distress which developed 48 h after discharge. The second was readmitted for 23-h observation due to intractable nausea and diarrhea with dehydration, felt to be secondary to gastroenteritis.

DISCUSSION

Clinical pathways have been employed in many institutions around the country as a reaction to the market forces demanding high-quality, "cost-efficient" patient care. These pathways are designed to meet the specific needs of the patient population of interest. Consequently, the fundamental steps of creating and implementing a clinical pathway are similar. Every phase of care is evaluated to determine whether it needs to be included in the pathway. In this case, the process of recovery from the gastric bypass surgical procedure was described as various phases or steps of care (postoperative pain control, fluid and electrolyte balance, pulmonary function, gastrointestinal function, DVT prophylaxis, mobility, etc.). The criteria for evaluating recovery, anticipated time course, and changes in therapeutic intervention are outlined for both patient and caregivers alike. The result is an improved understanding of the factors involved in recovery from surgery and a standardized approach to patient care.

Introduction of a clinical pathway for gastric bypass surgery at our institution significantly decreased hospital LOS and perioperative resource utilization. The reduction in hospital LOS was largely the result of early postoperative feeding. Patients on the pathway have their nasogastric tube removed on Postoperative Day 1 and are started on sips of water. Over the next 48 h they are advanced to nutritional goals on a low calorie, high protein formula as tolerated. Routine laboratory tests are performed on a predetermined schedule and standard deep venous thromboembolism prophylaxis is employed. Incentive spirometry and breathing exercises are utilized to prevent pulmonary complications such as atelectasis. Postoperative activity and ambulation goals are clearly stated for both patients and providers as well.

Although difficult to quantitate with our study design, both patient and provider expectations also appear to influence hospital LOS. After reading the preoperative educational materials, patients are eager to "stay on track" for their postoperative care. Nursing and other providers are able to anticipate the plan of care and respond appropriately as well as keeping the patient informed. Consequently, patients "expect" to be discharged home on Postoperative Day 3 or 4.

The decrease in room costs accounted for the majority of total postpathway cost savings (approximately 75%). However, reductions in supply, laboratory, and radiology-related costs were also significant in the postpathway group. As one might expect, the OR phase of care accounts for 34–50% of total costs in patients undergoing gastric bypass surgery. Consequently, efficient utilization of OR resources is an important aspect of cost containment in these patients. The impact of increased anesthesia time caused by inserting intravenous and epidural catheters in the operating room is currently being addressed through use of a preoperative "block room." Although utilization of the "ultrasonic shears" for hemostasis contributed to increased OR costs, the surgery is now performed via a minilaparotomy incision (6–8 inches), which helps to decrease postoperative pain and LOS. Perhaps most importantly, postpathway reductions in hospital LOS and resource utilization were not associated with a perceptible increase in postoperative complication or hospital readmission, and are similar to those reported by others [8].

The reduction in hospital length of stay and cost of care following introduction of the gastric bypass pathway is similar to the results of others for surgical procedures of similar magnitude [6–11]. Introduction of a clinical pathway for bowel resection decreased hospital length of stay by 2.2 days and reduced the mean hospital cost by 30% [6]. Similarly, a clinical pathway for hepaticojejunostomy was associated with a decreased length of stay by 3 days, reduced hospital costs by $3000, and decreased hospital mortality [7].

In summary, development and institution of a clinical pathway for gastric bypass surgery significantly reduced hospital LOS and resource utilization. In con-

junction with patient education, the coordinated perioperative management by nursing, nutrition, anesthesia, physical therapy, surgical attending, and resident physicians appeared to improve the efficiency of patient care without adversely affecting outcome. However, variance tracking and ongoing data analysis of patient care are integral to the process of continuous quality improvement initiated by developing the clinical pathway itself. Given the significant costs associated with operating room utilization in surgical patients, this phase of care must be closely monitored to ensure optimal efficiency.

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