Postoperative Chest Percussion with Postural Drainage in Obese Patients following Gastric Stapling*

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Vigorous respiratory therapy can prevent the development of postoperative pulmonary complications which occur with increased frequency after upper abdominal surgery. Obesity poses an additional risk factor. To study the effects of postoperative chest percussion with postural drainage (CPT), 53 consecutive patients undergoing Roux-en-Y gastric stapling procedures for treatment of morbid obesity were randomized to two groups. Both received identical postoperative respiratory care, except the study group received additional CPT. It was concluded that the addition of CPT to patients without prior chronic lung disease undergoing upper abdominal surgery caused patient discomfort, increased hospital cost, and failed to affect the incidence of postoperative pulmonary complications.

The risk of postoperative pulmonary complications following upper abdominal surgery is well-known.[1-4] Obesity is an additional risk factor.[1,2] Undoubtedly, the awareness and prevention of these potential problems constitute the most important factors in the decreased operative morbidity and mortality of modern surgery.[3,5] Respiratory therapists have assumed a critical role as the members of the health care team responsible for patients' pulmonary hygiene. Various respiratory therapy treatment modalities have been utilized in postoperative patients and include blow bottles,[6] incentive spirometry (IS),[6-8] intermittent positive pressure breathing (IPPB),[6] aerosol treatment,[9] and chest percussion with postural drainage (CPT).[10-13] The efficacy and comparability of these methods are difficult to determine because of conflicting or nonexistent data.

In order to assess the impact of one specific modality of therapy, CPT, a group of high-risk patients was selected. These 53 consecutive patients, all morbidly obese, had undergone Roux-en-Y gastric bypass surgery. They were randomly assigned to two groups which received identical preoperative and postoperative respiratory therapy support except for the addition of CPT in half of the patients.

Methods

Some 53 consecutive patients undergoing Roux-en-Y gastric bypass surgery for treatment of morbid obesity were randomized to the treatment and control groups. All patients were operated upon within a six-month period of time in 1982 by the same surgeon (DES), and received identical preoperative evaluations. Of the 53 patients, four dropped out of the study. Of the three treatment group patients who were deleted, two refused the postoperative therapy protocol, and one had surgery cancelled. One control patient was excluded because of refusing the respiratory therapy protocol.

All patients received counseling regarding IPPB therapy and IS prior to surgery. Following surgery, the patients averaged 24 hours in the intensive care unit, before being transferred to the ward. For the first 48 postoperative hours, all patients received the following aggressive respiratory therapy program: (1) IBBP with normal saline solution every four hours; (2) IS every four hours, spaced between IBBP treatments; (3) nebulized mist driven by compressed air via face mask for 30 minutes following each IBBP or IS treatment; and (4) deep breathing and coughing after each IBBP or IS treatment. In addition, following each IBBP treatment, the CPT group received manual chest percussion to each hemithorax for five to ten minutes, after the bed had been positioned in Trendelenburg position and the patient was lying on his back and/or sides.

The two groups of patients were compared by a variety of preoperative criteria, including age and sex distribution, cigarette smoking history, history of pulmonary diseases (asthma, pneumonia, and other), dyspnea level, percentage of ideal body weight, and operative procedures performed.

Postoperatively, a variety of parameters were assessed intensively for 48 hours. These included temperature measurements, chest examination, sputum production, arterial blood gas analysis, daily chest x-ray, and daily spirometry. Temperatures were recorded on

Table 1—*Current Smoking History*

	Nonsmokers	Former Smokers	Current Smokers	
			<20 Pack yrs	≥20 Pack yrs
CPT	15	3	4	2
No CPT	14	2	3	6

Table 2—*History of Pulmonary Diseases*

	Pneumonia	Asthma	Other
CPT	8	3	1. Pulmonary emboli 2. Smoke inhalation
No CPT	5	0	1. Hyperventilation syndrome 2. Chronic bronchitis

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Table 3—*Dyspnea Level**

	I	II	III	IV
CPT	4	10	7	3
No CPT	5	7	5	8

*Modified from Committee on Rating of Mental & Physical Impairment: Guides to the evaluation of permanent impairment—The respiratory system. (JAMA 1965; 194:919)

Table 4—*Surgical Procedures*

	CPT	No CPT
Roux-En-Y	17	15
Roux-En-Y + Cholecystectomy	3	5
Roux-En-Y + JI Bypass reconstruct	2	4
Roux-En-Y + ABD Wall Herniorrhaphy	1	1
Roux-En-Y + JI Bypass reconnect; appendectomy, small bowel resection, ABD herniorrh	1	

each patient at two to four hour intervals by members of the nursing staff. Chest assessments and clinical approximations of sputum production were performed by members of the Respiratory Therapy Department (all certified respiratory therapy technicians and registry-eligible or registered therapists). Arterial blood gases (PaO_2, $PaCO_2$, and PaH) were drawn without supplemental oxygen and run in the hospital laboratory on a blood gas analyzer, which is automatically calibrated. Daily portable anteroposterior chest x-ray films were obtained with patients lying in the supine position, and were interpreted by four board-certified radiologists, who were unaware that a clinical study was in progress. Forced spirometric measurements were performed with a Vitalograph calibrated weekly, and at least three efforts were obtained daily on each patient preoperatively and postoperatively. Results were corrected to BTPS and forced vital capacity (FVC), forced expired volume in one second (FEV_1), percentage of forced expiratory volume in one second ($FEV_{1\%}$), and maximum midexpiratory flow (MMEF) were calculated. The forced vital capacity values were compared to predicted values, using the data of Kory. The duration of the surgical procedure and the number of postoperative hospital days until discharge were extracted from each patient's hospital record.

All clinical parameters were measured between the two groups and were compared and evaluated statistically. In cases where nonordinal data were present, analysis was made by the Chi-square analysis. Ordinal data were compared by the Student's *t*-test. Sequential ordinal data were analyzed by the sequential analysis of variance. In each case, statistical significance was assumed at a level of p less than 0.05.

Results

The CPT and no CPT (control) groups were compared by a variety of parameters. The mean age of the CPT patients was 39.9 years with a range of 15 to 57 years. In the control patients, the mean age was 37 years, and the age range 22 to 62 years. The sex distributions within the two groups showed 20 women and four men in the CPT group, and 21 women and four men in the control group. Comparison of additional

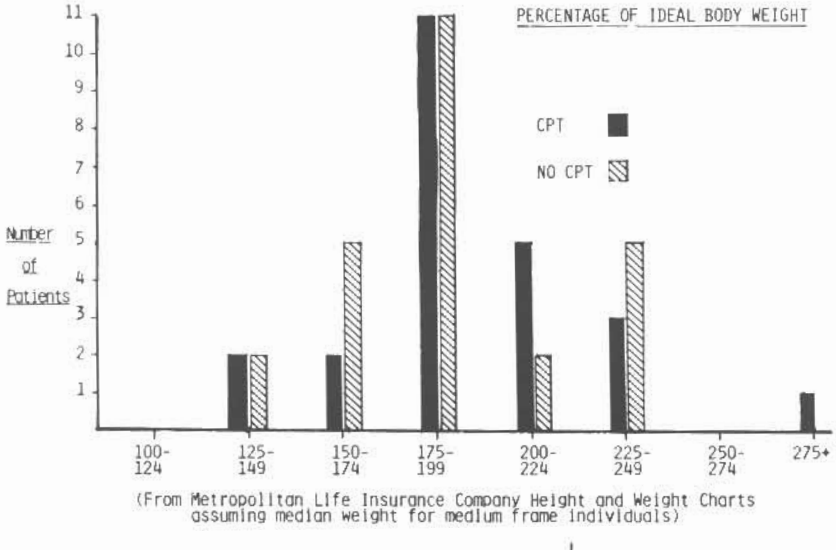

FIGURE 1. Weight distribution of all patients operated, comparing CPT and control patients. No significant differences are seen.

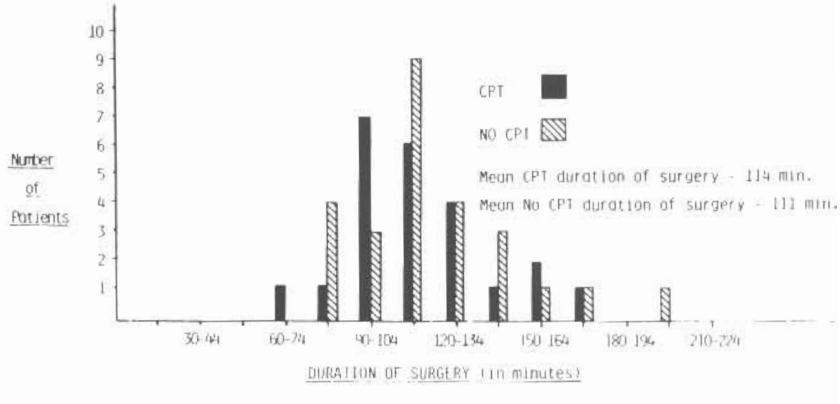

FIGURE 2. Duration of surgery for CPT and control groups. No significant differences are seen.

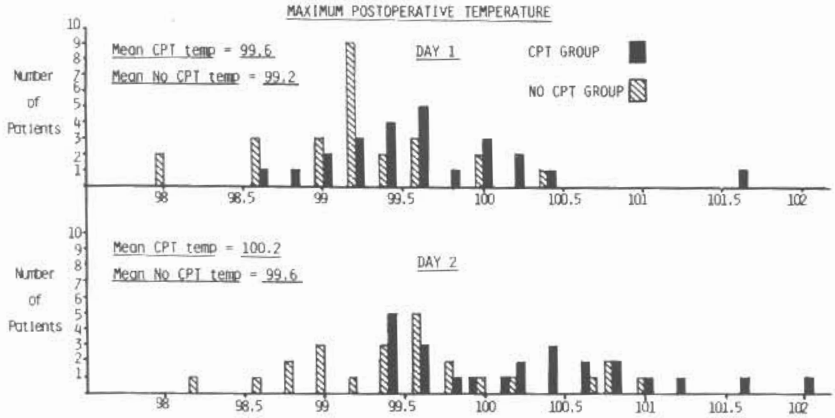

FIGURE 3. Maximum temperature elevations on the first and second postoperative days. Mean temperatures differed between the CPT and control patients on both postoperative days and were statistically significant ($p<0.05$). The CPT patients experienced higher fevers.

parameters included cigarette smoking history, history of prior pulmonary diseases, dyspnea level, percentage of ideal body weight, duration of surgery, and surgical procedure(s) performed (Tables 1 to 4 and Fig 1 and 2). No statistically significant differences between the two groups were found.

Of the postoperative parameters assessed, the CPT group was found to have higher temperature elevations (p less than 0.05), both within 24 and 48 hours following surgery (Fig 3). Results of ausculatory chest examinations performed by the participating respiratory therapists revealed the development of adventitious sounds on both postoperative days in roughly one half of the patients in each group (Table 5). There was no statistically significant difference between the groups. Inspiratory crackles (rales) constituted the majority of the adventitious sounds. Sputum production was estimated clinically. Preoperatively, almost all patients produced no sputum, whereas postoperatively, greater than 75 percent produced sputum (Table 6). Although the no CPT group had more patients with larger volumes of sputum, the results were not statistically significant.

Arterial blood gas levels were measured preoperatively and at random times on the first and second postoperative days. The mean levels of PaO_2 measured preoperatively in both groups (75.7 mm Hg and 74.8 mm Hg) are normal for Boise (elevation 2,800 feet above sea level). The development of hypoxemia was an almost universal finding, with the exception of two patients in the no CPT group, who may have received supplemental oxygen when the blood gases were drawn (Fig 4). A few patients in each group failed to have arterial blood gases drawn on either the first or second postoperative day. There was a tendency for oxygenation to improve toward baseline in most patients by the second postoperative day. The other parameters assessed by arterial blood gas determinations, $PaCO_2$ and pH, were also similar between the two groups (data not shown). Both groups were found to have a mild chronic hyperventilation, compatible with Boise's elevation. In addition, a mild metabolic alkalosis developed postoperatively, probably related to intravenous fluid replacement or to nasogastric suctioning.

Table 5—*Physical Findings on Chest Examination**

	Preop		POD 1		POD 2	
Clear	24	24	14	10	13	10
Rales	0	1	8	14	9	13
Rhonchi	0	0	2	1	1	0
Wheezes	0	0	0	1	1	2

*Shaded area is no CPT group.

Table 6—*Sputum Production or Expectoration**

	Preop		POD 1		POD 2	
No sputum	23	23	7	6	10	4
Minimal sputum	1	1	5	11	6	10
Swallowed sputum	0	0	10	4	8	9
Mod/large sputum	0	1	2	4	0	3

*Shaded area is no CPT group.

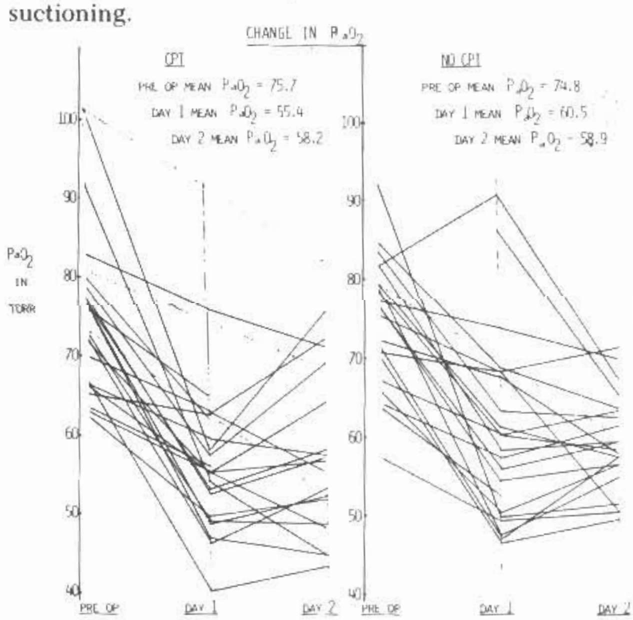

FIGURE 4. Serial PaO_2 values recorded preoperatively and postoperatively. Most patients develop a severe drop in PaO_2 on the first postoperative day, and tend to improve on the second postoperative day. There is no difference between the CPT and control groups.

Table 7—*Chest Roentgenographic Findings**

	Preop		POD 1		POD 2	
Normal	21	21	5	4	5	4
Volume loss	0	1	11	11	11	12
Atelectasis	0	2	8	10	8	8
Elevated diaphragm	0	1	1	2	0	1
Pleural effusion	0	0	1	3	0	4
Infiltrate	0	0	1	1	1	2
Other	3	1	1	0	2	0

*Shaded area is no CPT group.

Serial chest x-ray films were evaluated. Preoperatively, greater than 80 percent of the roentgenograms in each group were interpreted as being normal, whereas fewer than 20 percent remained normal on the first or second postoperative days (Table 7). Of the postoperative abnormalities noted (some patients had more than one), no significant differences were found between the two groups. The most frequently observed abnormalities, volume loss and atelectasis, tended to occur bilaterally. Other postoperative changes, such as diaphragmatic elevation, pleural effusion, and infiltrate, occurred less frequently.

Serial spirograms also revealed the development of marked postoperative abnormalities in both groups. Mean forced vital capacities decreased from normal preoperative values by more than 50 percent in both groups (Fig 5). Every patient was found to have a drop in FVC on the first postoperative day. Similar striking changes in FEV_1 and MMEF were noted (data not shown). The $FEV_{1\%}$ did not change predictably and is not a parameter worth measuring (data not shown).

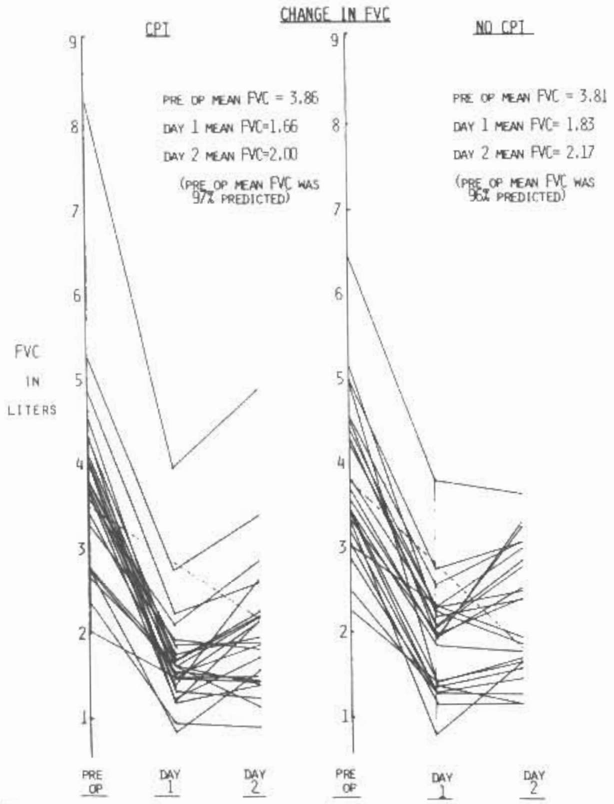

FIGURE 5. Serial FVC values recorded preoperatively and postoperatively. Mean preoperative values are normal (97 percent and 96 percent predicted) in both groups. All patients experience a severe reduction in FVC on the first postoperative day (46 percent of preoperative level for the mean of both groups). Most are improved on the second postoperative day. The CPT and control groups are not significantly different.

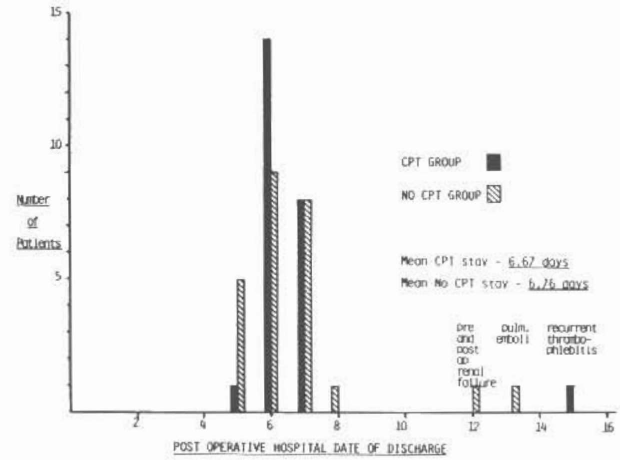

FIGURE 6. Length of postoperative hospital stay for all patients, comparing CPT and control patients. No significant differences are seen.

Each patient's hospital record was reviewed to determine the postoperative day on which discharge was accomplished. The average length of hospital stay was similar and was approximately seven days in both groups (Fig 6). Again, no statistically significant difference was noted between the two groups.

Discussion

In this study, patients at high risk for postoperative pulmonary complications were randomly divided into two groups so that the value, if any, of postoperative chest physiotherapy could be assessed. All of these obese patients (125 percent to greater than 225 percent of ideal body weight) underwent Roux-en-Y gastric bypass surgery, with a number of additional upper abdominal procedures being performed. This patient group was chosen because of the well-accepted observation that upper abdominal surgery predisposes to postoperative pulmonary problems,[1-4] together with the generally agreed upon theory that obesity is an additional risk factor.[1,2] Other acknowledged risk factors, such as sex, age, history of lung diseases, and cigarette smoking,[5] were evaluated between the age groups. Two operative risk factors, the surgical procedure(s) performed and the duration of surgery, were also assessed. Analyses of the data were performed, utilizing the Student's *t*-test for ordinal data, the Chi-square test for nonordinal data, and the sequential analysis of variance for sequential ordinal data. There were no statistically significant differences (p less than 0.05) between the two groups for any of the preoperative or operative risk factors.

In the majority of patients in both groups, significant postoperative changes developed in physical findings, sputum production, chest x-ray films, arterial blood gases, and spirometry. However, the magnitudes of the changes were similar in the two groups. The question, therefore, arises whether these findings represent "surgical complications" or simply expected aberrations caused by the altered postoperative physiology.

Specific postoperative changes present in both patient groups included the presence of inspiratory crackles in almost one half of the patients and the development of increased sputum in 72 percent of the patients on the first postoperative day. Chest physiotherapy did not improve sputum mobilization. Arterial blood gas determinations demonstrated a striking reduction in PaO_2 in almost all patients. This process has been described previously, with the pathophysiologic mechanisms believed to be caused by ventilation perfusion mismatching or by shunting.[12] In 1980, Connors et al[12] reported that CPT predisposed to severe desaturation in nonbronchitic patients. However, *all* of our patients, of whom only one was a chronic bronchitic, developed similar degrees of hypoxemia whether they received CPT or not. The small changes observed in $PaCO_2$ were not significant. We believe that the development of a mild metabolic alkalosis was due to intravenous fluid management, nasogastric suctioning, or a combination of the two.

Our study agrees with previous reports of the marked reduction in forced vital capacity that follows upper abdominal surgery.[2] Also, it confirms the usefulness of measuring MMEF postoperatively, when one needs to follow a parameter of air flow.[5] Calculation of the $FEV_{1\%}$, on the other hand, is not useful. Postoperative chest x-ray film findings became abnormal in greater than 80 percent of the cases. A wide variety of changes were seen, the most common being volume loss and atelectasis, which tended to occur bilaterally. Chest physiotherapy did not affect the presence or absence of the reported roentgenographic findings. In addition, CPT did not affect the date of hospital discharge.

The one statistically significant variation between the two patient groups was the development of higher postoperative temperatures in the CPT patients. While the higher fevers may have been due to increased splinting from pain due to CPT, our data failed to show greater numbers of pulmonary roentgenographic abnormalities (*ie*, atelectasis) or greater hypoventilation in the CPT patients. Laszlo and others[13] believe that almost all fevers occurring within the first 48 hours following surgery are due to pulmonary problems. Our data do not disagree with this hypothesis, but they fail to explain the presence of higher fevers in the CPT group.

The CPT is a time-consuming procedure, completely occupying the respiratory therapist for 15 minutes or more. At our hospital, the patient is charged $12.50 for each treatment. If these patients had been billed for the 48 hours of CPT, which they received at four-hour intervals, an additional $150 would have been added to each patient's hospital bill. Based on our study, we believe that in patients of this type, CPT should not be ordered routinely because of its lack of efficacy and because of its cost. We would echo the previous recommendations of Hughes, who editorialized, "Do no harm—cheaply."[14] It is possible, however, that there may be a use for postoperative CPT in patients with chronic difficulty clearing secretions as those with cystic fibrosis, chronic bronchitis, or bronchiectasis. We believe that future studies are needed to assess the value of CPT in such patients. Finally, we recommend that the other therapeutic modalities (IPPB and IS) utilized in all of our patients receive additional study, since either or both of them may also be ineffective.

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