Prevention of postoperative respiratory complications

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Pulmonary complications are the most common cause of morbidity and mortality in the postoperative period; they occur in from 20% to 40% of patients after major abdominal or thoracic operations.[1-3] The sequence of postoperative hypoventilation leading to atelectasis, bronchiolar or bronchial plugging with secretions, alveolar collapse, hypoxia, tachypnea, fever, and pneumonitis is familiar to all who care for patients during the postoperative period. The measures used to prevent or to lessen the threat of these complications vary. They include careful preoperative evaluation of pulmonary function and recognition of existing bronchopulmonary disease; discouragement of cigarette smoking during the preoperative period; training in deep breathing and coughing exercises; careful choice of anesthetic techniques; avoidance of excessive use of atropine or other sputum drying agents during the operative period; and a variety of measures employed during the postoperative period to encourage deep breathing, coughing, and the liquefaction of inspirated secretions.

For many years, one of us (R.E.H.) has employed "blow bottles" as a breathing device for use by patients during the postoperative period

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to encourage deep inspirations and alveolar expansion. Recently, a nursing directive ordered the replacement of "blow bottles" with balloons as a simpler and cheaper way to accomplish the same goals. This prospective change in hospital procedure challenged us to question the superiority of either device and the role of other measures in preventing postoperative respiratory complications.

Methods

Three types of postoperative respiratory measures were selected for study and comparison: (1) chest physiotherapy, (2) the use of "blow bottles," or (3) the use of balloons. Intermittent positive pressure breathing (IPPB) was not evaluated in this study. Chest physiotherapy was supervised by trained therapists who saw all patients once or twice daily and instructed them in voluntary, sustained deep inspirations and in effective coughing. Patients were instructed to practice breathing exercises and coughing each hour while awake. The use of "blow bottles" and balloons was supervised and taught by the nursing staff. Both of these measures are essentially expiratory maneuvers against resistance, but emphasis was placed on deep inspiration prior to blowing into the bottle or the balloon and on effective coughing after the maneuver. Patients were encouraged to use the bottles or balloons on an hourly basis.

Clinical material

Forty-seven patients were studied for 5 days following operation; all patients had undergone major upper abdominal surgical procedures. Daily clinical assessment of the patients by the resident staff, daily temperature readings, and postoperative chest roentgenograms (third postoperative day) were used to determine the presence of pulmonary complications.

The patients were randomly selected for one of the three types of postoperative respiratory measures. Those patients selected for chest physiotherapy fell almost evenly into three age groups: 20 to 40, 40 to 60, and 60 to 80 years. Most patients selected to use "blow bottles" or balloons were in the 40- to 60-year age group. About one fourth of the entire group were obese; another one fourth were debilitated and had had a substantial weight loss (9 kg or more) prior to surgery.

Six patients had a history of previous respiratory disease: two had had recent pleural effusion, one had metastatic carcinoma to the lungs, one had a history of asthma, one had a history of bronchiectasis for which a left lower lobectomy had been performed previously, and one had been treated for an upper respiratory infection a week before admission. One half of the group studied were cigarette smokers; the majority smoked a pack or more a day.

The diagnoses in this group of 47 patients were acute and chronic cholecystitis, common bile duct obstruction, chronic pancreatitis, chronic duodenal ulcer, Crohn's disease, small bowel obstruction, carcinoma of the stomach and upper gastrointestinal tract, and Hodgkin's disease. Operations performed were cholecystectomy with or without common bile duct exploration, hiatus hernia repair, gastric and small bowel resections, vagotomy and pyloroplasty, biliary by-

Table. Incidence of pulmonary complications

	No. of patients	Cigarette smokers	Fever	Atelectasis	Pneumonia
Chest physiotherapy	16	9/16	7/16	4/16	1/16
"Blow bottles"	15	8/15	8/15	3/15	0/15
Balloons	16	6/16	7/16	8/16	1/16

pass procedures (cholecystojejunostomy and choledochoduodenostomy), splenectomy, staging operations for Hodgkin's disease, and lysis of adhesions for small bowel obstruction. Incisions included both midline upper abdominal and subcostal incisions.

Results

Twenty-two of the 47 patients studied had temperatures above 100F recorded during the postoperative study period, and 15 of the 47 patients had evidence of atelectasis on chest roentgenograms or diagnosed by postoperative physical examinations (*Table*). The diagnosis of pneumonia was made in only 2 of the 47 patients.

As shown in the *Table,* the only significant difference in complications in any of the groups was an increased incidence of atelectasis in the group of patients using balloons. This was usually a roentgenographic finding and was not always clinically evident nor treated with antibiotics (*Fig. 1*). The two patients in whom pneumonia developed had symptoms of fever, tachypnea, and evident roentgenographic changes (*Fig. 2*). The history of preexisting pulmonary disease or of smoking did not appear to be a highly significant factor in this study. Discharge from the hospital was not delayed for reasons of pulmonary complications in any of the patients studied.

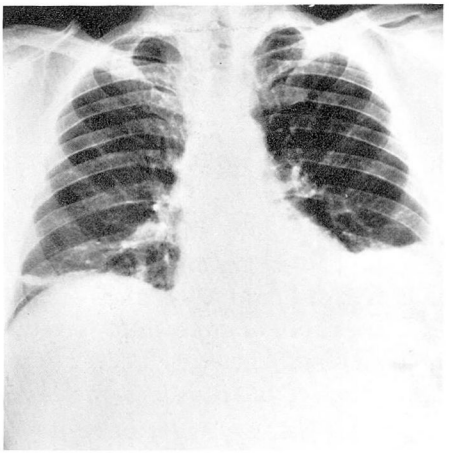

Fig. 1. Chest roentgenogram shows discoid atelectasis and a small bilateral pleural effusion.

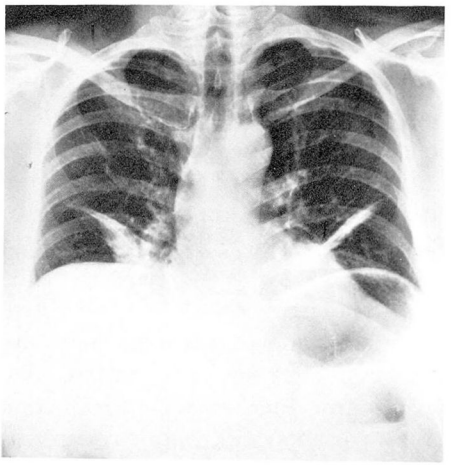

Fig. 2. Chest roentgenogram shows progression of bilateral discoid atelectasis with pneumonitis of the middle lobe of the right lung.

Three patients died later in their postoperative course, two from cerebrovascular accidents and one from massive pulmonary edema related to congestive heart failure.

Discussion

There have been many published reports on the use of a variety of respiratory maneuvers to prevent postoperative pulmonary complications. One of the best of these is the review of Bartlett et al.[3] They have classified these maneuvers into expiratory, carbon dioxide breathing, positive pressure, and inspiratory. In their review, they emphasize that any maneuver to be effective should be carried out at least every hour and preferably several times an hour. They conclude that the most effective maneuvers are those that emphasize a sustained, deep inspiratory effort.

In the early 1960s, intermittent positive pressure breathing (IPPB) was widely advocated as the most effective method to reduce the incidence of postoperative pulmonary problems. A number of conflicting reports have been published on the use of IPPB, most of which have shown no clear benefit from its use.[4] The major problems appear to be reliance on pressure rather than on volume to trigger the ventilator, the occasional cross-contamination which can occur, the fact that IPPB is used only two or three times daily, and that it is not individually regulated for each patient. We have found that postoperative, conscious patients will frequently resist the efforts of the machine to force deep breathing, because of pain in the incision or the operative site; occasionally air is swallowed rather than breathed. For these reasons, we did not include IPPB in this study.

In the present study, chest physiotherapy was individually administered and instructions in deep breathing and coughing were given. A busy respiratory therapist, however, is only able to see and spend time with each patient once or twice daily. The patients were instructed to practice these maneuvers hourly. "Blow bottles" and balloons were demonstrated and the patients were instructed in their use on an hourly basis. A significant and unmeasurable variable is how frequently these maneuvers were actually used by the patients. In follow-up visits, we found it a rare occurrence to have any of the measures used more than every 2 or 3 hours, six to eight times a day. Because of the stiffness and inelasticity of some new balloons and the incisional discomfort in trying to blow them up, we frequently found that patients were not able to (or did not) use their balloons at all for the first few days after surgery.

Comparison of a similar control group of patients with no postoperative respiratory therapy would be of interest. Just the explanation of any respiratory maneuver, the emphasis on postoperative ambulation, and the interest and concern of physicians and nurses in postoperative respiratory care serve to make the patient aware of the importance of pulmonary function and are important factors in therapy. Patient motivation may be the most important factor in preventing pulmonary complications. Nursing staffs have a prime role in assisting patients with postoperative respiratory maneuvers to prevent pulmonary complications. Increased emphasis should

be placed on developing the nurse's understanding of pulmonary anatomy, physiology, and on basic concepts of chest physiotherapy.

Summary

Forty-seven patients were studied for 5 days after major upper abdominal surgery to compare the effectiveness of three different respiratory maneuvers in preventing postoperative pulmonary complications: chest physiotherapy, "blow bottles," and balloons. No one method eliminated the occurrence of atelectasis or fever, but an increased incidence of atelectasis was encountered in the patients using balloons. This may be related to a lack of usage of the method by the patients because of incisional pain. Frequent use of any postoperative respiratory maneuver is important; a skilled nursing staff to assist and instruct patients is also important.

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