THE EFFICACY OF INCENTIVE SPIROMETERS IN POST-OPERATIVE PROTOCOLS FOR LOW-RISK PATIENTS

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Respiratory complications, including fever, atelectasis, pneumonia and respiratory failure, are the most frequent cause (20-40%) of postoperative morbidity and mortality (Bartlett, Gazzaniga & Geraghty, 1973). These complications are attributed to postoperative alveolar collapse with decreased vital capacity, functional residual capacity, absence of spontaneous sighs and retained secretions (Jackson, 1988; Peters & Turnier, 1980; Van De Water, 1980).

Incentive spirometry (IS) is the most widely used technique to minimize these postoperative complications (O'Donohue, 1985). In a 1985 random survey of hospitals of varying size and geographic location in the United States, incentive spirometry was used in more than 95% of the hospitals and was used more widely than chest physiotherapy, intermittent positive pressure breathing (IPPB), blow bottles and continuous positive airway pressure (CPAP) (O'Donohue, 1985). In Canadian hospitals the frequency of usage of incentive spirometry had markedly increased. Not only was it being used for postoperative patients at high risk for pulmonary complications, but incentive spirometry was also being used by lower-risk patients on medical, obstetrical, gynecological and orthopedic wards. The increasing annual costs for equipment, distribution and respiratory personnel were of concern to administration.

Hourly incentive spirometry is recommended for the first 48-72 postoperative hours to compensate for the shallow monotonous breathing pattern with anesthesia (Bakow, 1977). The major advantage is that both patients and health care personnel can see evidence of inspiratory effort, by means of a ball that rises in a tube. Improved patient performance and increased motivation are claimed by some users and manufacturers (Jenkins & Soutar, 1986).

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Numerous studies have evaluated incentive spirometry and have found it to be a simple, effective respiratory manoeuvre to prevent postoperative respiratory complications (Alexander, Schreiner, Smiler & Brown, 1981; Bartlett et al.; Craven, Evans, Davenport & Williams, 1974; Dohi & Gold, 1978; Fried, 1977; Minschaert, Vincent, Ros & Kahn, 1982; Oulton, Hobbs & Hicken, 1981; Van De Water, Watring, Linton, Murphy & Byron, 1972). (See Table 1)

On the other hand, there are several reports suggesting that incentive spirometry offers no advantage over other methods of respiratory care (Celli, Rodriquez & Snider, 1984; Dull & Dull, 1983; Gale & Sanders, 1980; Jung, Wright, Nusser & Rosoff, 1980; Lyager et al., 1979; O'Connor, Tattersall & Carter, 1988; Schwieger et al., 1986; Stock et al., 1984). (See Table 2) Furthermore, Zibrak, Rossetti and Wood (1986) demonstrated that marked reduction in all categories of respiratory therapy, including incentive spirometry, did not adversely affect outcomes of patient morbidity, mortality, pulmonary complications and length of hospital stay. A literature review of the research in this field is difficult to conduct because of differences in reported risk factors (age, smoking status, site of operation, duration of anesthesia, past respiratory illness); in definitions of pulmonary complications; presence of control groups; and, in teaching strategies.

Patient compliance is a key factor in evaluating the effectiveness of any program to reduce postoperative respiratory complications. The majority of the studies listed in Table 1 and Table 2 do not evaluate actual patient performance of prescribed exercises. Patients were supervised by a variety of health personnel, including doctors, nurses, respiratory technicians, physiotherapists and research assistants. The frequency of supervision varied from a minimum of once a day to a maximum of every hour. Lyager et al. (1979) reported "a fairly wide difference in the frequency with which the individual patient used the spirometer" (p.315). Craven (1974) noted that only 11 out of 35 patients used IS in the defined satisfactory manner.

There remains considerable controversy in current literature and practice as to the most effective method of preventing postoperative respiratory complications. Considering the increasing use of incentive spirometry and the resultant cost to a surgical population, further carefully-controlled clinical studies are indicated. This study compares the efficacy and cost of three respiratory protocols for deep breathing and coughing exercises in a low-risk, homogenous population, and monitors patient compliance.

Table 2

Studies Not Supporting Incentive Spirometry for Prevention of Postoperative Complications

Reference	Number of Subject's Type of Surgery	Study Groups	Frequency-Type of Staff Supervision	Outcome
Van De Water et al., 1972.	30 bilateral adrenalectomy.	1) IPPB-4x/day x 5 days postoperative. 2) ISx5 days postoperative.	1) Inhalation therapist during the day, nurses at night. 2) Nurses encouraged use of IS 4x/day. Note timing device attached to IS.	1) 6/15 had pulmonary complications. 2) 3/15 had pulmonary complications.
Bartlett et al.,1973.	150 laparotomy.	1) Control. 2) IS to be used 10x/hr. counter attached.	Seen 2x/day by investigators (MD).	1) -19/75 pulmonary complications -35/75 atelectasis/consolidation. 2) -7/75 pulmonary complications -24/75 atelectasis/consolidation.
Craven et al., 1974.	70 upper abdominal surgery.	1) IS 10x/hr. x 5 days postoperative. 2) Routine chest physio 2x/day x 5 days postoperative.	"Closely observed" 1) Note that only 11/35 used IS in a satisfactory manner.	Abnormal chest 1) 40% 2) 63%
Fried , 1977.	150 Thoracic surgery.	1) PEEP and IS. 2) PEEP, IS, IPPB. 3) PEEP. 4) IS. 5) PEEP, IPPB. 6) IPPB. 7) coughing and deep breathing by nurses.	Postoperative therapy q2h. (extubation)	1) Atelectasis least often.
Dohi & Gold, 1978.	64 abdominal surgery.	1) IS x 5 days postoperative. 2) IPPB q4h x 5 days postoperative. Both groups received bronchodilator drug.	Respiratory therapist supervised. 1) 5x/hr. x 8 hrs. 2) 4x/day.	Developed pneumonia atelectasis or bronchitis. 1) 10/34 (29%). 2) 17/30 (57%).

Table continues

Table 1

Studies Supporting Incentive Spirometry for Prevention of Postoperative Complications - (Continued)

Reference	Number of Subject's Type of Surgery	Study Groups	Frequency-Type of Staff Supervision	Outcome
Alexander et al., 1981.	377 Cholecystectomy Hysterectomy Herniorrhaphy.	1) Spirocare IS 3 x daily. 2) Breathing exercise (IS). 3) IPPB. 4) Breathing exercise (IS)+IPPB. 5) Control routine care. 6) Breathing exercise postoperative goal of 80% of preoperative value (IS).	1) Inhalation therapist 3xdaily. 2) No supervision. 3) Therapist 3 x daily. 4) Therapist 3 x daily. 5) No supervision. 6) Therapist 3 x daily.	Postoperative complication rate by X-ray similar in all groups. No difference in complication rate by type of surgery. Lowest complication rate (16.5%) was patients who achieved 80% preoperative inspiratory volume.
Oulton et al., 1981.	25 coronary artery operations.	1) Chest physiotherapy. 2) Chest physiotherapy Triflo IS. 3) Chest physiotherapy and spirocare IS.	1) "Standard physiotherapy". 2) IS 3x/day x 4 days. 3) IS 3x/day x 4 days. supervised by physiotherapists.	Pulmonary complications. 1) 2x group 3. 2) 2x group 3. 3) ½ group 1 or 2.
Minschaert et al., 1982.	22 upper abdominal.	1) Chest physio and IS x 10 days post-op. 2) Chest physio x 10 days post-operative.	1) IS 6x/hr. during day time. 2) Frequency not stated.	1) Faster return to preoperative pulmonary volumes.

Table 1

Studies Supporting Incentive Spirometry for Prevention of Postoperative Complications

Reference	Number of Subject's Type of Surgery	Study Groups	Frequency-Type of Staff Supervision	Outcome
Lyager et al., 1979.	103 Abdominal surgery for gallstones or peptic ulcer.	1) Bartlett IS 4x/hr. during waking hours x 4 days. 2) Control.	Medical Staff 1) Mean use IS 60x/24 hrs. wide frequency noted.	No difference in incidence, severity or course of postoperative complication between groups.
Jung et al., 1980.	126 Upper-abdominal surgery (primarily cholecystectomy).	1) IPPB. 2) Resistance breathing (blow glove). 3) IS (spirocare).	Technician all groups 4x daily through waking hours x 3 days.	No difference among the three groups in atelectasis by Day 3.
Gale & Sanders, 1980.	109 Heart surgery-cardio pulmonary bypass.	1) IPPB. 2) IS - Bartlett Edwards.	Treatments given 4x/day x 3 days.	No difference in rate of atelectasis by X-ray.
Dull & Dull, 1983.	49 Cardiopulmonary bypass surgery.	1) Early mobilization. 2) Early mobilization and breathing exercise. 3) Early mobilization and IS.	Physical therapist 4x/day.	No significant differences in improving lung volumes, airflow or postoperative complications.
Celli et al., 1984.	172 Upper and lower abdominal surgery.	1) Control. 2) IPPB 4x/day. 3) IS 4x/day. 4) Deep breathing exercises 4x/day under supervision.	Treatments supervised by a respiratory technician x 4 days.	Pulmonary complications. 1) 48%. 2) 22%. 3) 21%. 4) 22%.
Stock et al., 1984.	38 Median sternotomy for cardiac operations.	1) Coughing and deep breathing (CDB). 2) IS. 3) CPAP.	Physician or trained respiratory therapist q2h during waking hours x 72 hours.	No difference of X-ray evidence of atelectasis between groups. CPAP was less painful than IS or CDB.
Schwieger et al., 1986.	40 Cholecystectomy.	1) IS (inspiron) 5 min. hourly 12x/day x 3 day. 2) Control.	Specialized respiratory therapist.	No difference between groups in postoperative complications at 2nd and 4th day.
O'Connor et al., 1988.	40 Cholecystectomy.	1) IS (inspiron). 2) Routine chest physio.	Chest physiotherapist.	No significant differences between gorups.

Methods

The project was approved by the hospital research ethics committee. The afternoon prior to the day of surgery, patients scheduled for an abdominal hysterectomy or tuboplasty gave informed consent for participation in the project. All potential subjects were non-smokers, less than 50 years old, no more than 20% above their ideal weight and had no history of cardiac or pulmonary disease. Subjects were obtained from one gynecological ward to maximize control.

Sequential sample assignment to groups was selected to avoid cross-over effects between the groups. Data were collected from a control group (Group I) before the introduction of any change in program. These patients were instructed, preoperatively, on deep breathing and coughing exercises and monitored postoperatively by the individual nurse assigned to their care. In order to control for any change in the usual nursing practice the nurses were not informed of the true purpose or nature of the study.

Group II patients were instructed in a consistent, systematic manner in deep breathing and coughing exercises by one of two research assistants. The preoperative teaching was given at a convenient time on the afternoon prior to surgery. Patients practised the exercises until they could demonstrate them effectively for the research assistant. Patients received instruction forms to keep at their bedside. The research assistant then returned later the same afternoon or evening for a repeat practice session preoperatively. The length of teaching times were recorded. In the postoperative period, the teaching was reinforced and the exercises monitored every two hours, from 9am-9pm. A self-report form was used for patients to record exercises practised and ambulation on an hourly basis, for 72 hours post-operatively during waking hours.

Group III patients were instructed in the same manner and frequency as Group II patients, except that they were taught to use an incentive spirometer (Inspirx). The preoperative inspiratory flow achieved by the patients was recorded and was the goal to be achieved in the postoperative period.

The research assistants were two senior baccalaureate nursing students employed for the summer. Videotaped simulations were made of each of the research assistants demonstrating deep breathing and coughing exercises and incentive spirometry with volunteer subjects. These simulations were scored by two clinical and two research nurses, and a 90% reliability quotient was obtained. The structured teaching protocols and checklists were derived from Lindeman and Van Aerman (1971) and Rice and Johnson (1984). They were evaluated by nursing, medical and respirology personnel and pretested with

revision. The research assistants also received training in pulmonary function testing and graph interpretation in the respirology department. They practised the pulmonary testing until their results were judged to be 90% reliable.

Spirometry tests, including forced vital capacity (FVC), forced expiratory flow 25%-75% (FEF 25%-75%) and forced expiratory volume in one second (FEV_1), were done at the beside using a vitalograph. These tests were done preoperatively as a baseline, then 24, 48 and 72 hours after the operation. The patients wore a noseclip and were sitting upright during the measurement. A minimum of two graphs were obtained to ensure that the patient complied in maximizing their respiratory effort. Measurements were taken from the best graph. The research assistants calculated the pulmonary function values and a random sample of their calculations was checked by respirology staff.

A chest X-ray was taken preoperatively and on the third postoperative day. The X-rays were reviewed in a random order by a qualified chest physician who had no knowledge of patient assignment to group. X-rays were reported in terms of atelectasis or consolidation. Apex to diaphragm height was measured as an index of degree of inflation at total lung capacity. Patient records were reviewed for the incidence of pulmonary complications, frequency of pain, medication intake and length of hospital stay.

Table 3

Characteristics of Treatment Groups

Group	I Control	II Deep Breathing and Coughing	III Incentive Spirometer	Total
Number	9 (35%)	8 (30%)	9 (35%)	26 (100%)
Mean age (years)	42	36	32	37
Mean duration anasthesia (minutes)	163	201	181	182
Mean number analgesics in 72 hrs postoperative	13.1	12.9	13.7	13.2
Mean number days in hospital, postoperative	5.9	6.3	5.0	5.7

Results

A total of 26 subjects participated in the study (Table 3). Ten eligible patients declined participation, primarily because of apprehension of the required additional chest X-rays. Group I (control) had 9 patients, Group II (structured deep breathing and coughing) had 8 patients and Group III (incentive spirometer) had 9 patients. The mean age of the patients was 37 years, with a range of 27-48 years. The mean duration of anesthesia was 181 minutes, with a range 120-305 minutes. The mean number of doses of analgesics for the first 72 hours postoperative was 13.2, with the range of 8-20. The type of drugs used for anaesthesia and analgesia were also compared, with no differences between groups. The mean length of post-operative hospital stay was 5.7 days, with the range from 3-8 days. The frequency of postoperative complications including severe pain, genitourinary and gastrointestinal problems were also compared, with no differences between groups.

Absolute and % predicted values of the preoperative FVC, FEV_1 and FEF (25-75%) were not significantly different between the groups (Table 4). The Kruskal-Wallis test with $p \leq .05$ was used to compare the groups. There was a 28%-40% decrease in the Day 1 postoperative FVC values, compared to the preoperative baseline values. All groups' mean pulmonary function values gradually increased from postoperative Day 1-Day 2-Day 3. (Figure 1). There was no statistically-significant difference when comparing the gain scores of preoperative values and Day 3 values of any of these groups using the Kruskal-Wallis test at $p \leq .05$ level.

Pulmonary complications are reported in Table 5. There were four patients (15%) with fevers over 38°C within 72 hours after surgery, with cough or sputum. The percent reduction in diaphragmatic excursion between the preoperative and Day 3 X-rays were compared; no differences were found between the groups. Atelectasis was reported in 4 patients based on the third day postoperative X-ray (15%). A total of 6 patients (23%) had one or more respiratory complications.

The preoperative teaching time required for deep breathing and coughing exercises and incentive spirometer exercises was similar between Groups II and III (Table 6). The initial preoperative teaching session lasted an average of 7.4 minutes and the repeat preoperative practice session lasted an average of 1.9 minutes, for a mean total of 9.3 minutes. The salary costs were determined on the reported mid-range 1990 pay scales for registered nurses (Table 6).

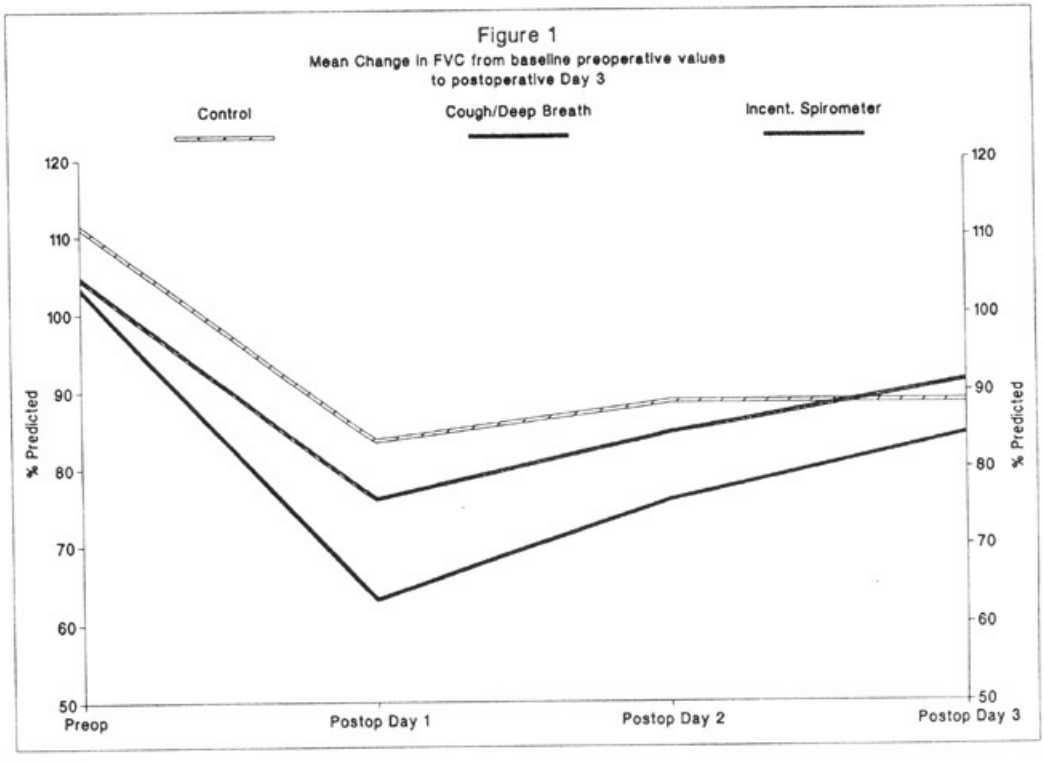
Figure 1
Mean Change in FVC from baseline preoperative values
to postoperative Day 3
Control
Cough/Deep Breath
Incent. Spirometer
% Predicted
120
110
100
90
80
70
60
50
Preop
Postop Day 1
Postop Day 2
Postop Day 3

Table 4

Pulmonary Function Values

Group		I Control N=9 Actual	% Predicted	II Deep Breathing and Coughing N=8 Actual	% Predicted	III Incentive Spirometer N=9 Actual	% predicted
FVC (mean) Preoperative		3.51	111.3%	3.68	104.6%	3.97	103.2%
	Day 1	2.62	83.7%	2.60	76.1%	2.46	63.2%
	Day 2	2.80	88.7%	2.89	84.7%	2.91	75.9%
	Day 3	2.80	88.7%	3.12	91.4%	3.25	84.5%
FEV_1 (mean) Preoperative		2.89	121.6%	2.60	98.9%	2.87	86.6%
	Day 1	1.87	79.1%	1.88	71.2%	1.78	59.0%
	Day 2	2.09	86.1%	2.10	79.7%	2.21	75.0%
	Day 3	2.25	94.0%	2.14	80.9%	2.38	80.7%
FEF 25%-75% (mean)							
Preoperative		3.38	109.8%	2.50	74.9%	2.87	79.7%
Postoperative	Day 1	1.68	54.2%	1.84	54.5%	1.63	45.1%
	Day 2	1.95	62.4%	2.12	62.6%	1.99	55.2%
	Day 3	2.32	74.7%	2.20	64.9%	2.27	62.8%

No statistically-significant differences between the groups.

Table 5

Postoperative Pulmonary Complications

Group	I Control N=9	II Deep Breathing and Coughing N=8	III Incentive Spirometer N=9	Total N=26
Fever > 38°C within 72 hours postoperative with cough or sputum attributed to respiratory complications.	2	1	1	4 (15%)
Atelectasis 3rd day postoperative X-ray	3	1	0	4 (15%)
Total number with one or more complications	3*	2	1	6 (23%)

*Note that two patients had both fever and atelectasis.

Table 6

Preoperative Teaching Time, Cost Analysis

Group		II Deep Breathing and Coughing N=8	III Incentive Spirometer N=9	Total N=17
Mean preoperative	INITIAL	7.0	7.7	7.4
teaching time	REPEAT	2.0	1.7	1.9
(minutes)	TOTAL	9.0	9.4	9.3
Mean total teaching cost ($18.76/hour)				
mid-range RN 1990 salary		$2.81	$2.94	$2.91
Cost incentive spirometer 1990			$11.39	
Total Cost		$2.81	$14.33	

The postoperative teaching contact with Groups II and III was similar because it had been outlined in the protocols that the research assistants would visit patients every two hours, from 9 a.m. to 9 p.m., to assist them with breathing exercises. The patients in Groups II and III initiated the exercises themselves on alternate hours during the postoperative period with very similar frequency. Total mean patient compliance in Group II was 19.4 times over the 3 days compared with a mean of 19.1 times for Group III.

Ambulation, defined as the number of times the patients walked a minimum of 20 feet during the first three postoperative days, was compared in Groups II and III. The mean total for 3 days was 15 times (range 6-28). Group II mean (14) was similar to the Group III mean (16). No record was requested from Group I because the recording itself might have influenced the patient's or nursing staff behaviour. A true control group was deemed of paramount importance. Groups II and III were already recording breathing exercise practice on a self-report form and ambulation was added to the form.

Discussion

The baseline preoperative pulmonary function values are relatively high, most likely because of the deliberate exclusion of risk factors including smoking. The post-operative pattern of pulmonary function values was similar to those reported in the review of literature by Jackson (1988) and Pontoppidan (1980). The pulmonary function values decreased substantially (35%-55%) immediately after the lower abdominal surgery.

The postoperative pulmonary function values from Day 1 to Day 3 gradually increased in all three groups, but there were no statistically-significant differences between the groups in the rate of improvement. These results are in accordance with four studies that specifically compared incentive spirometry to deep breathing and coughing exercises and found no difference in the prevention of postoperative complications (Celli et al., 1984; Dull & Dull, 1983; O'Connor et al., 1988; Schwierger et al., 1986; Stock et al., 1984). There are other studies that also did not support any increased benefits of incentive spirometry. These studies compared incentive spirometer to other respiratory manoeuvres including IPPB, blow glove, early mobilization and CPAP (Gale & Sanders, 1980; Jung et al., 1980; Lyager et al., 1979).

The total number of postoperative complications was 6 (23%) and is within the expected range for this population. The complications are distributed across the groups, with one more in the control group. However, the number of complications per group is small and further statistical analyses would not be appropriate. The total sample size was small because of the strict inclusion criteria for low respiratory risk, specific type of surgery and use of one unit to maximize control.

It is interesting to note that, in the total group, 2 patients had both fever and atelectasis while 4 had only one or the other. The diagnostic accuracy of fever alone as a measure of postoperative pulmonary complication has been questionned because fever was an accurate indicator of X-ray evidence of atelectasis in only 56% of their subjects (Roberts, Barnes, Pennock & Browne, 1988).

An important study by Zibrak, Rossetti and Wood (1986) has demonstrated that marked reduction in all categories of respiratory therapy, including a 55% reduction in incentive spirometry, did not increase patient morbidity and mortality. Furthermore, one American center has devised a preoperative respiratory therapy program (PORT), in an attempt to provide the level of respiratory care most appropriate for postoperative patients (Torrington & Henderson, 1988). They have developed a single preoperative risk assessment form and claim that for low-risk patients, they have been able to restrict excessive use of incentive spirometry successfully.

Given the finding of no statistical differences in the various pulmonary function tests between groups and the small number of complications, it would seem that the usual practice of having the individual nurse assigned to patient care (control group) teach patients deep breathing and coughing exercises is sufficient for patients at low risk of respiratory complications.

Patient compliance during this study was monitored in Groups II and III, as part of the structured program to encourage patient participation. It is interesting to note that patient-initiated exercises on the alternate hours when the research assistant was not present were similar in Group II and Group III. This does not support the claims by manufacturers and other studies that patients are more likely to voluntarily carry out respiratory manoeuvres with an incentive spirometer (Alexander et al., 1981; Bartlett, Brennan, Gazzaniga, Hanson, 1973; Craven et al., 1974; Jenkins & Soutar, 1986). The name "incentive" is a misnomer.

The use of highly-structured teaching protocols for deep breathing and coughing exercises before and after surgery may not be necessary. The pulmonary function values do not indicate any significant differences between Group I (Control) and Group II (Structured). There is a copious amount of literature on various types of preoperative teaching programs. Hathaway (1986) did a meta-analysis of 68 studies and demonstrated a consistently positive effect of preoperative instruction on postoperative outcomes. However, categories of organization of instruction (structured/unstructured) and type of presentation (individual/group) did not produce differences. Similarily, Vallejo (1987) did a meta-analysis and found no difference in effectiveness of structured versus non-structured preoperative information. Lindeman, in a 1988 review of patient education, reported that there was a wide range of teaching strategies, and most were effective. Recent review articles on the method of patient education recommend that a preoperative instruction program be based on individual situational needs (Armstrong, 1989; Hathaway, 1986). Such an individual program was ususal nursing practice on the control group's unit.

The cost of having a registered nurse teach an ideal preoperative program for either deep breathing and coughing exercises or incentive spirometer practice was very low (less than $3.00). The incentive spirometer cost of about $11.00 markedly increases the total cost: it does not seem warranted in a low-risk surgical population. With the widespread use of incentive spirometers and the current trend to use technical devices, this is a useful finding to help control current health care costs.

This study of low-risk patients is an important baseline study, from both ethical and practical viewpoints. Further carefully-controlled research evaluating the efficacy of incentive spirometers with a larger sample size, in

high-risk populations, is now indicated. Risser (1980) has identified both fixed respiratory risk factors (age, site of operation, duration of surgery) and alterable risk factors (obesity, smoking, preexisting health problems). Preventive strategies for these alterable factors should be implemented. For example, smokers should be strongly encouraged to discontinue the habit at least eight weeks before chest or abdominal surgery (Jackson, 1988). In addition, the use of specific teaching protocols and careful monitoring of patient compliance is feasible and important for future research, in order to obtain meaningful results.

Summary

Incentive spirometry offered no statistically significant advantages to pulmonary function when compared to unstructured or structured deep breathing and coughing exercise programs, for patients at low risk of developing pulmonary complications. The additional cost of incentive spirometer equipment does not seem warranted in these patients. Furthermore, patients with or without an incentive spirometer were willing to comply with a structured breathing exercise program with the same frequency of practice sessions. Patients in this diagnostic category did not require a technical device to reward and motivate them for performing maximal inspiratory manoeuvres.

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Funded by the Canadian Lung Association - Ontario Thoracic Society, Ottawa Civic Hospital, Foundation Bard Company.

We acknowledge the assistance of Mrs. G. Graham R.N., Head Nurse on the study ward and the two research assistants, Anne MacLeod and Evelyn Poethko. Statistical assistance was provided by Anahita Shariatmadar, M.Sc., B.Sc., FRSS.

RÉSUMÉ

Évaluation de l'efficacité des spiromètres d'encouragement chez les patients à faible risque: comparaison de trois protocoles respiratoires post-opératoires

Cette étude visait à comparer l'efficacité de la spirométrie d'encouragement (se) à celle des exercices de respiration profonde avec toux (rpt) dans la prévention des complications respiratoires post-opératoires chez les patients à faible risque. Les 26 sujets non fumeurs ont été affectés de manière séquentielle à trois groupes. Le groupe I (groupe témoin; N=9) a reçu les instructions habituelles de rpt d'une infirmière attitrée. Le groupe II (structuré, rpt; N=8) a reçu les instructions de rpt de l'un de deux adjoints de recherche formés à cette fin conformément à un protocole structuré. Après l'intervention chirurgicale, l'entraînement s'est intensifié et les exercices ont été surveillés toutes les deux heures, de 9 h à 21 h pendant 72 heures. Le groupe III (structuré, se; N=9) a reçu un protocole similaire à celui du groupe II, mais comportant des instructions sur l'utilisation d'un spiromètre d'encouragement. Les épreuves de fonction respiratoire post- opératoires n'ont pas affiché de différence marquée, les résultats au test de Kruskal-Wallis étant de $p \leq 0,05$. Les complications respiratoires post-opératoires ont été rares. Statistiquement, la spirométrie d'encouragement ne présente aucun avantage et le coût additionnel de l'équipement ne semble pas justifié chez les patients à faible risque. L'observance du traitement a été comparable avec ou sans se, indiquant que le recours à un petit appareil n'est pas nécessaire pour accroître la motivation.

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DATE D'ENTRÉE EN FONCTION : Janvier ou Juin 1992

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