Fast-tracking pulmonary resections

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Objective: We streamlined our care after pulmonary resection for quality and cost-effectiveness.

Methods: A single surgeon performed 500 consecutive pulmonary resections through a thoracotomy over a 2¼-year period in a university setting. Patients were extubated in the operating room and sent directly to their hospital room. Chest tubes were placed to water seal and removed on postoperative day 2 if there was no air leak and drainage was less than 400 mL/d. Epidural catheters were used and removed by postoperative day 2. The plan for each day and discharge on postoperative day 3 or 4 was reviewed with the patients and families daily during rounds. The patient went home the day the last chest tube was removed. Persistent air leaks were treated with Heimlich valves.

Results: There were 500 patients (338 men), with a median age of 58 years (range, 3-87 years). Of these patients, 293 had pre-existing conditions. Seventy-three (15%) patients had been denied operations by at least one other surgeon. Four hundred nineteen (84%) patients had successful placement of a functioning preoperative epidural catheter. Pneumonectomy was performed in 32 (6%) patients, segmentectomy was performed in 16 (3%) patients, and lobectomy, sleeve lobectomy, and/or bilobectomy was performed in 194 (39%) patients. Nonanatomic resections were performed for metastasectomy. This included a single wedge resection in 161 (32%) patients and multiple wedge resections in 97 (19%) patients. A total of 482 (96%) patients were extubated in the operating room, and 380 (76%) patients were sent to their hospital room. The remaining 120 patients went to the intensive care unit for a median of 1 day (range, 1-41 days). Complications occurred in 107 (21%) patients, and operative mortality was 2.0%. Median day of discharge was postoperative day 4 (range, 2-119 days). A total of 327 (65%) patients left the hospital on postoperative day 4 or sooner. By survey, 97% of patients had excellent or good satisfaction with their care at hospital discharge, and 91% were extremely happy or satisfied at the 2-week follow-up contact.

Conclusions: Most patients who undergo elective pulmonary resection can be extubated immediately after the operation, go directly to their room and avoid the intensive care unit, be discharged on postoperative day 3 or 4, and have minimal morbidity and mortality with high satisfaction both at discharge and at the 2-week follow-up contact. Techniques that seem to accomplish this include the following: the use of a water seal, removal of epidural catheters on postoperative day 2, early chest tube management, treatment of persistent air leaks with Heimlich valves, and daily reinforcement of the planned events for each day, as well as on the date of discharge with the patients and their families.

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Recently, there have been several articles¹⁻³ that discuss fast-tracking protocols, standardized clinical care pathways, and cost-containment measures for patients who undergo operative procedures. However, few studies have examined this process for patients who undergo pulmonary resection. In these previous reports on lung operations,^{4,5} historical controls were used, and costs, charges, length of stay, and patient satisfaction were compared between 2 groups. Some of these factors have been criticized because of the inherent difficulties in evaluating them over time given inflation and changes in medical care. Moreover, some of the models used to calculate cost versus charges have been questioned. In the first study from the Massachusetts General Hospital in 1997, the target day for discharge after lobectomy was 7 days. The actual median length of stay was 7.5 days. In the second article from Johns Hopkins Hospital in 1998, the median length of stay after elective pulmonary resection was 6 days. The purpose of our study was to see whether our protocol, which highlighted a median length of stay of 4 to 5 days, was possible without compromising morbidity, mortality, pain control, quality of care, or patient satisfaction. We also believed that the cost of the intensive care unit (ICU) could be avoided in most patients. Therefore, we designed and evaluated a protocol that achieved these goals.

Patients and Methods

A guideline for each postoperative day (POD) was designed (Table 1). It was applied to 500 consecutive patients who underwent elective pulmonary resection at the University of Alabama at Birmingham after January 1, 1997. All operations were performed at the university hospital in an academic setting and were performed by a single general thoracic surgeon (R.J.C.). Pulmonary resections that were performed at the Veterans Administration Hospital on patients seen as consultations in the university hospital and operated on before discharge or as an emergency procedure were excluded from this trial. Similarly, those patients who underwent any type of lung resection as a minor part of another major procedure (ie, resection of a mediastinal tumor, esophageal resection, or decortication) were also excluded from this series.

The service was made up of one rotating cardiothoracic fellow and one third-year general surgical resident, along with one nurse practitioner (C.B.) and one general thoracic surgeon (R.J.C.). Institutional review board approval was not sought because all patients received standard of care treatment and were already involved in an institutional review board–approved air-leak trial. All patients were seen preoperatively in the clinic and informed of the protocol. The patient and family received a copy of the protocol and were asked to carefully review it and to bring it to the hospital. The routine was then reinforced in the hospital daily during rounds and the expected discharge date of POD 3 or 4 was reinforced. Patients were admitted through the same-day surgical unit on the morning of the operation. Epidural catheters were placed in the holding area before the operation. Standard preoperative eval-

uation and intraoperative care were used. A posterolateral thoracotomy sparing the serratus anterior muscle was used. The rib was undercut from the thoracic artery to the lumbar dorsal fascia. It was not shingled posteriorly and was not cut or removed. Most patients went directly from the recovery room to their hospital room. Patients with significant comorbidities, such as a history of coronary artery disease, a postoperative diffusing capacity of carbon monoxide of less than 40%, or both went to the ICU for a planned overnight stay. Once in their hospital room, patients were monitored with centralized cardiac telemetry and with portable pulse oximetry units placed in each patient's room.

Chest tubes were on suction until the morning of POD 2 and then were converted to water seal in the 64 patients operated on in this trial from January 1, 1997, until April 30, 1997. The remaining 446 patients who had operations after this date had their chest tubes moved to water seal on the morning of POD 1. This constraint was because of a concomitant air-leak study being performed on these patients. Portable chest radiographs were performed every morning at 3 AM as part of the air-leak trials. The resident and fellow checked them at 6 AM, and decisions regarding chest tube management were made on the morning report after discussion with the surgical attending physician (R.J.C.) at 6:45 AM. Afternoon rounds were made as a team with the attending, and the decision to remove more chest tubes or lines was made again. Clinical decisions were made as shown in Table 1. If patients had a persistent air leak, a Heimlich valve was placed for 24 hours, and a chest radiograph was checked. Patients who were free of symptoms were sent home with the Heimlich valve attached to a leg bag with a small hole cut in the top. This allowed air to escape but fluid to be collected.

All patients who underwent pneumonectomies were prophylactically given a calcium channel blocker at the completion of the operation and until discharge. Any patient who had atrial fibrillation received digoxin, a calcium channel blocker, and, if still in an atrial arrhythmia, had a cardiology consult that day. Operative mortality was defined as any death that occurred during the hospitalization or within 30 days of the operation. Results are reported as medians with ranges.

Satisfaction surveys were done at the time of hospital discharge. The patient was asked to fill the survey out anonymously and return it to the nursing station in a sealed envelope before leaving the hospital. Follow-up surveys were administered 2 weeks postoperatively. They were performed in the clinic at the time of the postoperative check-up or over the telephone for those patients who were out of state and were therefore followed up at home.

Results

There were 500 patients (338 men), with a median age of 58 years (range, 3-87 years). Two hundred ninety-three (58.6%) patients had pre-existing conditions. These include 105 (21%) patients with cardiac disease, of whom 56 had a history of coronary artery bypass grafting or angioplasty, 13 had congestive heart failure, and 6 had undergone cardiac transplantation. Thirty-four (7%) patients had insulin-dependent diabetes, 34 (7%) were taking steroids, and 16 (3%) patients were undergoing dialysis. Thirty-five (7%)

TABLE 1. Daily guideline of the typical patient who undergoes thoracotomy and elective pulmonary resection

Day of the operation

Monitor chest tube output and urinary output; continuous centralized monitoring of heart rate and rhythm; pulse oximeter; no blood work unless arrhythmia, unstable, or chest tube output greater than 900 mL

POD 1

Check hemoglobin level

Arterial blood gas measurement performed if patient history of $Paco_2$ of greater than 45 mm Hg on preoperative arterial blood gas measurement or if indicated

Continue monitoring of heart rhythm and oxygen saturation

Ambulation 4 times daily and physical therapy consult/incentive spirometry every hour while awake

Respiratory nebulizers every 4 hours

Chest physical therapy every 8 hours

Chest tube placed to water seal

Advance diet with aspiration precautions

POD 2

Heplock intravenous line; change medications to oral administration; resume home medicines

Discontinue central line

Discontinue epidural catheter

Discontinue urinary catheter 8 hours after removal of epidural catheter

Discontinue one chest tube if no air leak or

Discontinue the only chest tube (if wedge resection) if chest tube drainage < 400 mL for last 24 hours

Begin oral administration of pain medication, hydrocodone

Continue ambulation, incentive spirometry, chest physiotherapy, and nebulizers

Continue monitoring of heart rhythm and oxygen saturation

Wean oxygen

POD 3

Discontinue last chest tube if no air leak and output < 400 mL for 24 hours

Prepare home oxygen, any special needs, or both

Discharge home in afternoon or on POD 4 depending on patient's wishes and level of pain control

TABLE 2. Analysis of data for pathology, age, admission to ICU, stay in ICU, length of hospitalization, and complication rate for each procedure

Type of pulmonary resection	No. of patients	Type of pathology	Age, y (median [range])	No. of patients who went to surgical ICU (%)	LOS in surgical ICU, d (median [range])	LOS in hospital, d (median [range])	Patients (%) with complications
Pneumonectomy	32	Lung cancer, 32	60 (31-75)	32 (100)	1 (0-23)	5 (3-70)	11 (34)
Lobectomy or bilobectomy	194	Lung cancer, 146; metastasectomy, 48	60 (4-84)	40 (21)	0 (0-17)	4 (1-128)	53 (27)
Segmentectomy	16	Lung cancer, 8; metastasectomy, 8	65 (41-78)	6 (38)	0 (0-11)	4 (1-6)	2 (13)
Wedge resection	258	Lung cancer, 3; metastasectomy, 255	58 (3-86)	47 (18)	0 (0-43)	4 (1-125)	94 (36)
P value	—	<.0001	.045	<.0001	<.0001	<.0001	.006

LOS, Length of stay.

patients had at least one previous ipsilateral thoracotomy, 22 (4%) had preoperative radiation treatment, and 29 (6%) had preoperative chemotherapy. Seventy-three (15%) patients had been denied resection by at least one other surgeon because of poor pulmonary function or pre-existing comorbidities or because of the size or location of the mass.

Four hundred nineteen (84%) patients had preoperative epidural catheters successfully placed before the operation.

Thirty-seven patients refused a catheter, and a catheter could not be placed in 44 patients. Epidural catheters were in place for only 1 day in 8 patients (because of lack of function), for 2 days in 375 (75%) patients, and for 3 days in 36 (7%) patients. Epidural catheters remained in place for an extra day in 36 (7%) patients at their request.

Types of pulmonary resections performed were pneumonectomy in 32 patients, lobectomy or bilobectomy in 194

(39%) patients, segmentectomy in 16 patients, and a single wedge resection in 161 patients. Multiple wedge resections were performed in 97 patients: 2 wedge resections were performed in 65 patients, 3 in 11 patients, 4 in 11 patients, 5 in 6 patients, and 6 in 4 patients. Of the 194 lobectomies performed, 10 were bronchoplastic sleeve resections, and 4 were concomitant pulmonary artery sleeve resections. Wedge resections were performed for metastasectomy. Further analysis of the data per procedure is shown in Table 2.

Four hundred eighty-two (96%) patients were extubated in the operating room. Three hundred eighty (76%) patients were sent to their hospital rooms. Of the remaining 120 (24%) patients who went to the ICU, 95 (79%) stayed only 1 day. The median stay in the ICU was 1 day (range, 1-41 days). Complications occurred in 107 (21%) patients and are shown in Table 3. No patient required a thoracentesis or reinsertion of a chest tube.

Ten patients died (operative mortality of 2.0%). This included 2 patients who had lung biopsies that were performed electively. The causes of death are shown in Table 4. No complication or mortality could be attributed to the fast-tracking protocol. Median length of stay is shown in Table 5 and was 5 days (discharge on POD 4; range, 2-119 days). Table 5 also depicts the number of patients who went home on each POD.

Nine (1.8%) patients were readmitted to other hospitals within 2 weeks of discharge. The main reason for readmission was pneumonia (diagnosed by means of chest radiograph only) in 5 patients and weakness and pain control in 4 patients. Six of these 9 patients did not leave our hospital until POD 6 or later because of pain or weakness. Four hundred ninety (98%) patients performed a satisfaction survey at the time of discharge, and 97% reported excellent or good satisfaction with their care. At the 2-week follow-up contact, 77% of patients completed a satisfaction survey, and 91% were extremely happy or satisfied with their hospital care and date of discharge.

Discussion

Concerns about cost containment, third-party payers, and health maintenance organizations have changed how physicians have practiced over the past 10 years. Despite these external influences, our main goal as thoracic surgeons has remained the same. We still must perform safe operations, minimize morbidity and mortality, and not compromise the quality of our care or patient satisfaction. However, the reality is that we must achieve these goals in the context of a cost-conscious environment.

The cost of any operation can be divided into several categories. These include the preoperative evaluation, intraoperative costs (eg, equipment, personnel, and time spent in the operating room), and postoperative care. The latter is affected mainly by length of stay. Because it may be one of

TABLE 3. Complications

Complication	No. of patients
Atrial fibrillation	34
Air leak on POD 3	34
Discharged with Heimlich valve	13
Pneumonia	11
Readmission to ICU	10
Ventilatory support >3 d	6
Coagulopathy	5
Multiorgan system failure	5
Symptomatic pneumothorax	5
Bacteremia	4
Mucous plug, bronchoscopy	3
Myocardial infarction	3
ARDS	3
Bronchopleural fistula	2*
Chylothorax	2
Reoperation for bleeding	2
Herpes simplex esophagitis	2
Ileus	2
Renal failure	1
Deep venous thrombosis	1
Stroke	1
Postpneumonectomy pulmonary edema	1

One hundred seven (21%) patients had complications, and some patients had more than one complication. ARDS, Adult respiratory distress syndrome.

*Both patients had a right pneumonectomy.

the easiest parameters for the surgeon to unilaterally change, this became the main thrust of this study.

In a university setting there is a constant flux of medical students, residents, and fellows who comprise the thoracic team. It can be difficult to control postoperative cost. Zehr,⁴ Wright,⁵ and their colleagues have shown that patient care protocols help standardize care and avoid unnecessary cost. In these reports patients were sent to the ICU, and the median length of hospital stay was 6 to 7.5 days, respectively. We believe the ICU could be avoided for most patients who undergo elective pulmonary resection. Moreover, the ICU seemed to decrease patient and patient family satisfaction because of the limitation of visiting hours and the lack of control the families experience in caring for their loved ones. We believe the family provides an important type of extra care for the patient, especially when they sleep in the room with the patient. Patients also seem less confused with their family members around. We therefore developed a postoperative protocol that highlighted the selected use of the ICU and targeted a 4- to 5-day length of stay after thoracotomy.

Our study found that the ICU could be safely avoided. There seemed to be no added morbidity or mortality with its elimination. When a patient has an arrhythmia or falling

TABLE 4. Data for mortalities

Procedure/pathology	Did patient go initially to surgical ICU?	Complication	Can fast tracking be blamed?	Total No. of days in surgical ICU	Total No. of days in hospital	Eventual cause of death
Lobectomy (T2 N0 M, lung cancer)	No	Aspiration on POD 4, Herpes simplex esophagitis	Probably not, happened POD 4	9	12	Aspiration pneumonia, sepsis, MOS failure
Wedge (metastatic sarcoma)	Yes (1 d)	Respiratory arrest, mucous plug on POD 3	No (arrested floor immediately coded and intubated)	6 6	8	Pneumonia, brain injury. MOS failure, made DNR
Open lung biopsy (CMV + fibrosis)	Yes (never left)	Stroke POD 12 (vision change), progressive pulmonary failure	No (never left surgical ICU)	10	10	Respiratory failure, brain injury, made DNR
Lobectomy (inflammatory scarring)	Yes (never left)	MI POD 3	No (never left surgical ICU)	6	6	Cardiac and respiratory failure, MOS failure
Wedge (granuloma)	Yes (1 d)	Stroke on POD 3	Probably not	7	9	Atrial fibrillation, pneumonia, brain injury, made DNR
Wedge (T3 N1 M1, metastatic lung cancer)	Yes (never left)	Renal failure	No	9	9	Refused dialysis, made DNR
Open lung biopsy (interstitial fibrosis)	Yes (never left)	Worsening fibrosis	No	4	4	Respiratory failure, MOS failure
Open lung biopsy (diffuse alveolar damage)	Yes (never left)	Worsening pulmonary function	No	9	9	Respiratory failure, MOS failure, sepsis
Pneumonectomy (T3 N1 M0, lung cancer)	Yes (never left)	Postpneumonectomy ARDS, cholesterol emboli	No	4	4	ARDS
Lobectomy (T1 N1 M0, lung cancer)	Yes (never left)	Emboli kidneys, renal failure	No	25	25	Renal and cardiac failure, MOS failure

MOS, Multiple organ system failure; CMV, cytomegalovirus; DNR, do not resuscitate; ARDS, adult respiratory distress syndrome.

TABLE 5. Length of stay

Date of discharge	No. of patients
POD 1	2 (both died of ARDS)
POD 2	40
POD 3	153
POD 4	132
POD 5	51
POD 6	32
POD 7	30
POD 8	12
POD 9	8
POD 10	9
POD 11	5
POD 12	4
POD 13	4
POD 14	2

One patient each was released on POD 17, 18, 21, 21, 22, 28, 29, 30, 30, 32, 44, 45, 62, 66, 97, and 119. ARDS, Adult respiratory distress syndrome.

oxygen saturation levels, early recognition and treatment are crucial. This can only be accomplished in a non-ICU setting with proper monitoring. We believe the future employment of centralized pulse oximetry units (the ability to monitor each patient's saturation at the nursing station) will further help ensure quick response time. Although patients in this study only had portable pulse oximetry units, these seemed to afford enough protection. All patients in this study had one of these units and received 24-hour cardiac telemetry until discharge. In this series 10 patients required readmission to the ICU, mainly because of falling oxygen saturation levels. A quick response time seems to avoid injuries.

We found that early discharge and fast tracking were possible and well received by patients and their families for several reasons. Major postoperative complications, which are best prevented in the operating room, must be avoided. Meticulous operative technique is mandatory. Removal of

the epidural catheter on POD 2 allows one to obtain the advantage of the catheter and still fast-track patients. We found no higher incidence of pneumonia or mucous plugging in this series versus those in other series in which epidural catheters were left in for longer periods of time. Our protocol provided the patient 24 to 48 hours to fine-tune oral pain medicines after catheter removal. Although most patients could go home the day the last chest tube was removed (POD 3 for most), we found that many wanted 1 or even 2 days for further pain refinement.

High satisfaction and fast tracking were accomplished by continually reviewing the planned events of each day (Table 1) and the planned day of discharge. This allows patients' and families' expectations to be met and arrangements for discharge to be made in advance. Communication is crucial to maintain high patient satisfaction. Early management of minor complications helped prevent them from becoming major complications. The use of a water seal for chest tubes helped stop air leaks, as we have shown in other trials.^{6,7} Heimlich valves allowed patients to go home with air leaks on POD 4. Atrial fibrillation should be quickly managed.

Interestingly, we found that patients who had pneumonectomy had longer lengths of stay, higher complication rates, and longer median lengths of stay both in the hospital and in the surgical ICU (as shown in Table 2). Patients who have undergone pneumonectomy have no chest tubes and no air leaks. They probably could go home routinely on POD 3. However, our preconceived bias and fear of postpneumonectomy syndrome kept us from sending them directly to the floor and from discharging them sooner. It is this type of thinking that our study hopes to address and change. Examination of Table 2 also shows that patients who underwent wedge resection were more likely to be younger and to have had a metastasectomy. Because of these factors, their complication rates were statistically lower than those of patients who underwent lobectomy. Because lobectomy was mainly performed for lung cancer and wedge resection was performed for metastasectomy, having lung cancer was a predictor of having a complication.

In conclusion, we have shown that most patients who undergo elective pulmonary resection can go directly to their hospital rooms, be discharged on POD 3 or 4, and have high patient satisfaction at discharge and at 2 weeks of follow-up. The general thoracic surgeon needs to continue to question the preconceived notions of postoperative care that have been passed down from generation to generation. We must continue to strive for cost-saving measures that maximize safety, quality of care, and satisfaction.

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Discussion

Dr Eric Vallieres (Seattle, Wash). The length of stay of our patients after elective lung resection is determined by 3 main factors: air leaks, pain control, and complications. Over the years, we have concentrated our efforts on minimizing the latter and have in many ways succeeded. Despite all the technologic advances we have seen over the years, certain ways of doing things have remained because that was the way we were taught. Personally, I was instructed that suction needed to be applied on all patients with air leaks to promote pleural apposition and healing, allowing safer and faster recovery. It made sense, and this is the way I initially practiced because that is the way I was taught.

You have to be congratulated for successfully challenging the old way of doing things in pulmonary operations. You have shown that by streamlining the postoperative care of your patients, their lengths of stay were kept short compared with the old standards, and this was done without affecting the quality of their care and level of satisfaction. It appears that such results were achieved by adopting different rules in chest tube management and by aggressively moving from epidural to oral analgesia early after the operations. This was done without an apparent increase in expected morbidity and mortality rates.

I have 1 comment and 3 questions.

First, you have emphasized the importance of preparing the patients and their families for this fast tracking, and I could not agree with you more. Although it is difficult to measure the effect of such preparation, in my mind it is key to the success of such a program.

My first question relates to the removal of epidural catheters. Ninety percent of these catheters were removed on POD 2 and 9% on POD 3. How was such a decision made, and who is in charge of your epidural catheters? Is it a pain service or your own service?

Dr Cerfolio. The majority of epidurals are removed on POD 2. We have a pain service that monitors these patients, and I think there is good and bad with that. I do not like it because we lose a little control. When our patients have problems with pain, I would prefer if we were called, but now the pain service is called. Sometimes, 10 or 15 minutes go by, and we are not happy with that delay. Soon it will be in our control.

The reason some patients had their postoperative epidural catheters removed on POD 1 is that the catheters were not working. Some patients had them removed on POD 3 because they requested it this way. I believe we work for them, and if that is what they wanted, we left them in.

Dr Vallieres. You report removing chest tubes when drainage fell under 400 mL for 24 hours. How did you select this number? How many of your patients required thoracentesis or reinsertion of chest tubes for fluid reaccumulation?

Dr Cerfolio. We arbitrarily selected the number. We all have been trained to use a certain number. Many use 150 or 200 mL a day. It just did not seem to make any sense to me. Therefore, I started to clamp or remove the tube, and I selected a number of 400 mL. If it is not chyle (and we check a triglyceride level if the output is greater than 400 a day) or they do not have a subarachnoid pleural fistula or bleeding, I do not think it makes any difference how much drainage comes through the chest tubes. Importantly, in this series we had no patients that I am aware of who had reinsertion of a chest tube or required thoracentesis because of a recurrent or residual pleural effusion after the chest tube was removed.

Dr Vallieres. Finally, you report on a very acceptable 1.8% readmission rate. Causes for readmission were pneumonia in 5 patients and weakness and poor pain control in 4 patients. How long did these patients remain in the hospital? Did this readmission or this complication have an effect on their long-term outcome? In retrospect, were there any factors that could have helped you predict this need for readmission?

Dr Cerfolio. We tried to look at pulmonary function test and other factors, but nothing predicted these readmissions. Most of these readmissions, 7 of the 9, were at other hospitals, almost all of which were in other states. As a surgeon who gets referrals from other pulmonologists in different states, I find it embarrassing to send a patient home and then, 2 days later, find out he or she is back in the home hospital on that referring pulmonologist's service. However, most patients were in the hospital for only a few days, getting intravenous fluids or antibiotics for supposed pneumonia. All were diagnosed by means of radiography, and I think they were looking at normal postoperative changes. We have no data showing that early discharge had a negative effect on the long-term survival.

Dr Thomas Rice (Cleveland, Ohio). I agree that preoperative education of both the patient and the family is crucial in timely discharge. Patients and families can have unreasonable expectations. However, your experience is a little atypical because you treat a lot of people with pulmonary metastases and you do wedge resections. Did you analyze patients with bronchogenic carcinomas and patients undergoing pneumonectomies and lobectomies? Were there any differences in the groups? Can you provide any hints about fast tracking those patients?

Dr Cerfolio. There were differences, and I left that information out of the presentation because of time limitations. In the article we looked at the length of stay per procedure, and the median length of stay in the pneumonectomy population was the longest. The reason for this is exactly because of the thinking that I am trying to change. I was afraid of sending a patient with a pneumonectomy home on POD 3 or 4. These patients have no tubes. They look great and could go home, but I worry about postpneumonectomy pulmonary edema, which often happens on the third or fourth day. Therefore, I had no patients go home on the target day of POD 3 or 4 who had a pneumonectomy. Their median length of stay was higher than that of patients undergoing the other procedures. I still am a slave to that preconceived thinking.

Patients on whom we did wedge resections had the same median length of stay, but the mean length of stay was longer. I believe this is because they are much sicker, and it is often a much more complicated procedure. A great percentage of these patients had multiple pneumonotomies (ie, many cuts into the lung with removal of 4 or 5 nodules). They had a lot of infiltrate in the lung postoperatively. A lot of these patients are amputees as a result of sarcomas. They have a long history of carcinoma, chemotherapy, and radiation therapy. They are a sick group of patients, and can be the toughest patients to care for. I think to stratify the data for bronchogenic malignancies versus others makes sense.

Dr Rice. Completing the satisfaction form was mandatory on discharge from the hospital. Does this invalidate your data? There is a decrease in patient satisfaction at 2 weeks of follow-up. Did you look at these data and compare them to find out why that dissatisfaction arose in the couple of weeks after discharge?

Dr Cerfolio. We did. The patients fill out the form anonymously and drop it off at the desk. Therefore, I think we try our best to get an honest satisfaction survey. There was an 8% drop, as you mentioned. The biggest complaint was the checkout process. The patients were delayed in leaving. I do not know why, but that seemed to be the thing over which they were the most upset. Because of this, we have changed our discharge format. This was the main reason for reduced satisfaction at 2 weeks.

Dr Charles Brantigan (Denver, Colo). Tell us about the ward that you put these patients on. With the volume of patients that you have and your ability to provide continuous echocardiography and pulse oximetry monitoring, it sounds like his ward must be a specialized unit. If you have such a unit, then the distinctions between intensive care and your unit tend to blur, and that undoubtedly contributes to your good results.

Dr Cerfolio. I agree with your statement up to the last point. It may blur the results but not the cost. The cost is different because it is not an ICU. It is not specialized care. It is actually a cardiology ward. It was a big jump for us to take surgical patients and move them to a medical ward, but I really wanted 24-hour telemetry and attempts for centralized pulse oximetry. We are still working on the latter. We spent a great deal of time educating the nurses. We have a good relationship with them. We do everything we can do to try to keep them happy and to keep them educated, especially about chest tubes. As you know, chest tubes are a black hole for most medical nurses. But it is not a specialized floor, except for the telemetry and the upcoming central pulse oximetry feature.

Dr Vallieres. You point out that education is essential. Did you have to add any staff or cost to accomplish that education?

Dr Cerfolio. I have added a nurse who is going to help me in the clinic, but that is because of my volume. She actually has not started yet. She starts in a few weeks.

Dr Vallieres. In tracking patients after the operation, were you able to identify what it is that causes an increase in their lengths of stay? You have your listed complications. Do you have a ranking of what is the most frequent cause of increased length of stay?

Dr Cerfolio. The most frequent cause of increased length of stay is the patient not wanting to go home. Either they could not get a ride that day or they had other problems at home or they just did not want to leave. Therefore, I let them stay. If you look at the patients who left after POD 7, it was because of complications, but until then, it is just a lack of desire to go home.