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## Treatment of Sleep Apnea : Unmet Needs

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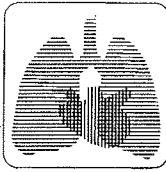
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### **CHEST at the New Millennium**

As we enter the 21st century, some reflection is warranted on the condition of the journal. Although *CHEST* has never suffered from any serious maladies, on reflection it does appear to me that the journal is now healthier than ever. I will enumerate the areas of fitness and let you calculate the Karnofsky score.

We now receive an average of 170 manuscripts per month, about 2,000 per year. This rate is as high as in any year in the history of the journal. What has changed is the nature of the manuscripts. In the past, the large number of case reports and letters inflated the total number of received manuscripts. This is no longer the case. The vast majority of submitted manuscripts are now clinical investigations. My interpretation of this change is that the submitted science has improved.

In addition, we have a healthy backlog of accepted manuscripts in all departments. Reviews, critical care, surgery, cardiology, etc, are all well represented. Despite this plethora of submitted manuscripts and the healthy backlogs, the time to publication after the manuscript is accepted has steadily fallen and now averages 5 months. This solid list of manuscripts reflects the efforts of an active and vigorous editorial board.

Before 1998, *CHEST* had never received more than one million dollars in advertising revenue. In both 1998 and 1999, such revenue will top one million dollars. The result is that the journal has been consistently profitable for the past 9 years. This profitability has allowed us to publish without page charges or fees for reviewing manuscripts. Neither charge to authors is contemplated in the near future.

Finally, the journal will be online with full text by the first of the year 2000. Not only will you be able to read, reproduce, import, and download material from the journal, but we will have an Interactive Letters section also. You may submit your letter, and it will be read by a member of the editorial board. If warranted, it will be immediately posted on the journal website. If anyone, including the author of

the mentioned manuscript, wishes to reply, a similar sequence will occur and the reply will be posted also.

The only area of concern that I can find at the moment is the unchanging circulation of the journal. Although we have had no significant declines in subscribers, the number has not risen either. Whether this reflects a constant level of membership in the American College of Chest Physicians, the availability of partial publication of the journal online, or the reduction in the rates of training new chest physicians is not clear to me now. In any case, the circulation of *CHEST* is now greater than any other currently published respiratory journal.

In most areas, the journal is quite healthy. Some preventive medicine may be warranted in the area of circulation, but mainly *CHEST* is fit and trim. We are definitely prepared for the new millennium, as are our Macintosh computers.

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### **Treatment of Sleep Apnea**

#### **Unmet Needs**

Judging by the number of publications and amount of media exposure allocated to sleep apnea syndrome, it is obvious that the awareness of sleep apnea as a major public health problem is no longer restricted to a small group of sleep specialists. Cognizance of the syndrome and its consequences has diffused to larger and larger circles of the medical community. The wide prevalence of the syndrome, its strong association with cardiovascular morbidity and mortality, and the relative ease by which diagnosis can be made have greatly influenced this process. In view of the fact that only 7 to 18% of the estimated 12 to 15 million persons having sleep apnea in the United States have had their conditions

diagnosed so far,<sup>1</sup> it can be safely predicted that the number of cases of sleep apnea diagnosed annually will be greatly accelerated in the coming years. Suitable diagnosis and treatment of such a large number of patients is not an easy task. In recent years, continuous positive airway pressure (CPAP) has become the main treatment modality in sleep apnea. There is convincing evidence that effective CPAP treatment can alleviate daytime and nighttime symptoms of the syndrome, such as sleepiness and fatigue, intellectual deterioration, and restless sleep.<sup>2-5</sup> Furthermore, studies have been carried out demonstrating that CPAP treatment can reduce diurnal and nocturnal BP values, as well as waking levels of sympathetic nerve activity,<sup>6,7</sup> and can acutely reduce plasma noradrenalin levels.<sup>8</sup> Recently, this treatment was shown to be more effective in lowering BP than a sham CPAP treatment.<sup>9</sup>

There is, however, a major drawback in CPAP treatment and that is its relatively low compliance. In spite of its proven efficacy, different studies showed that compliance with CPAP treatment is no more than 60 to 70%; in most cases, nightly use is only approximately 5 h.<sup>10,11</sup> In general, the lesser the severity of the syndrome, the lower the compliance. This emphasizes the need for alternative methods of treating sleep apnea patients. In this issue of *CHEST* (see page 1511), Pancer et al evaluate the efficacy of an adjustable mandibular positioning appliance for the treatment of snoring and sleep apnea. Although there have been several previous publications on the role of oral appliances in treating sleep apnea patients,<sup>12-16</sup> this is the largest study conducted so far. Seventy-five of the 134 patients who were fitted with the dental appliance were restudied by polysomnographic (PSG) recordings after an average of 85 days. Clinical assessment was made in 121 of these patients after an average of 350 days. Overall, there was a significant reduction in the apnea/hypopnea index (AHI) from  $44 \pm 28$  to  $12 \pm 15$  and a reduction in the arousal index from  $37 \pm 27$  to  $16 \pm 13$ . Epworth scores and bedpartners' assessment of snoring also revealed a significant improvement. In 38 of the 75 patients, sleep apnea was abolished. In these patients, the AHI decreased from a pretreatment level of  $39 \pm 21$  to  $5 \pm 3$ . In an additional 32 patients, there was a significant reduction in the AHI from  $55 \pm 31$  to  $22 \pm 18$ . Although the definition of a responder may be somewhat arbitrary (eg, a 50% reduction in AHI, a decrease in AHI to  $< 5$ , to  $< 10$ , etc.), and the efficacy of the appliance is still inferior to that of CPAP, it is evident that the large majority of patients in this study showed impressive improvement in nocturnal breathing with treatment. While previous studies<sup>15,16</sup> have suggested that the chances of success of oral appliances may be higher in

patients with mild to moderate sleep apnea, the results of Pancer et al demonstrated that patients with severe sleep apnea, as well as those with mild to moderate cases, benefited from the device.

While the study provides convincing evidence to support the efficacy of the adjustable appliance in treating sleep apnea, more information is needed on the importance of side effects with this kind of treatment. As in other studies using oral appliances, side effects occurred in 30% of the patients and mostly consisted of nonspecific teeth and jaw discomfort, and excessive salivation. Since the patients in this study could adjust the degree of protrusion themselves, it is not known how many of these side effects were caused by "aggressive" adjustment of the device, and how many were independent of the degree of protrusion. Unfortunately, information about the degree of protrusion was not available for these patients. If, indeed, side effects are caused by an aggressive adjustment, then control of the device should not be left in the hands of the patients. Furthermore, some patients could have set the appliance to be more comfortable and thus remained untreated. Obviously, more information is needed to resolve this question, particularly in long-term treatment.

Another lesson that can be learned from the present study is that the chances of successful treatment of sleep apnea, both with respect to efficacy and with respect to compliance, may be augmented if there is collaboration between sleep specialists and dentists. Too often the diagnosis of sleep apnea syndrome is made independently of treatment; the sleep specialist who diagnosed the syndrome is not involved in its treatment, and he or she has no information about treatment success or failure. Thus, sending a sleep apnea patient to have a dental appliance fitted without monitoring his or her response to treatment and adjusting the treatment accordingly is a recipe for low compliance. Likewise, a CPAP treatment regimen may require adjustments and further titrations in order to ensure the patient's compliance. Regardless of the treatment modality, due to the associated expenses, follow-up PSG recordings or any other form of follow-up studies, are rarely done in sleep apnea patients unless treatment is evaluated as part of a research protocol. In many cases, there are not even follow-up clinical interviews to ensure that patients comply with treatment and continue to be satisfied with it. Given the size of the patient population in need of suitable treatment, sleep specialists should play a more active role in the treatment and follow-up of sleep apnea patients. Reports of increased compliance with CPAP treatment after using simple interventions such as weekly phone calls and educational programs,<sup>17-19</sup> and de-

creased compliance in patients with sleep apnea that is diagnosed at home by ambulatory monitoring as compared to patients whose conditions are diagnosed at the sleep laboratory,<sup>20</sup> further stressed the centrality of the sleep specialists in the treatment procedure of sleep apnea patients. Using a low-cost monitoring methodology for follow-up evaluation by sleep specialists may serve both to encourage patient compliance and to help make decisions regarding the need for treatment readjustment. Thus, it is essential that a close cooperation takes place between sleep specialists and dentists in the case of oral appliances; between sleep specialists and respiratory therapists in case of treatment with nCPAP; and between sleep specialists and ear, nose, and throat surgeons in the case of upper airway surgery for the improvement of treatment in sleep apnea syndrome.

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#### REFERENCES

- 1 Young T, Evans L, Finn L, et al. Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle-aged men and women. *Sleep* 1997; 20:705-706
- 2 Ballester E, Badia JR, Hernandez L, et al. Evidence of the effectiveness of continuous positive airway pressure in the treatment of sleep apnea/hypopnea syndrome. *Am J Respir Crit Care Med* 1999; 159:495-501
- 3 Kiely JL, Murphy M, McNicholas WT. Subjective efficacy of nasal CPAP therapy in obstructive sleep apnoea syndrome: a prospective controlled study. *Eur Respir J* 1999; 13:1086-1090
- 4 Engleman HM, Asgrai-Jirhandeh N, McLeod AL, et al. Self-reported use of CPAP and benefits of CPAP therapy: a patient survey. *Chest* 1996; 109:1470-1476
- 5 Naegele B, Pepin JL, Levy P, et al. Cognitive executive dysfunction in patients with obstructive sleep apnea syndrome (OSAS) after CPAP treatment. *Sleep* 1998; 21:392-397
- 6 Akashiba T, Kurashina K, Minemura H, et al. Daytime hypertension and the effects of short-term nasal continuous positive airway pressure treatment in obstructive sleep apnea syndrome. *Intern Med* 1995; 34:528-532
- 7 Hedner J, Darpo B, Ejnell H, et al. Reduction in sympathetic activity after long-term CPAP treatment in sleep apnoea: cardiovascular implications. *Eur Respir J* 1995; 8:222-229
- 8 Minemura H, Akashiba T, Yamamoto H, et al. Acute effects of nasal continuous positive airway pressure on 24-hour blood pressure and catecholamines in patients with obstructive sleep apnea. *Intern Med* 1998; 37:1009-1013
- 9 Jenkinson C, Davies RJ, Mullins R, et al. Comparison of therapeutic and subtherapeutic nasal continuous positive airway pressure for obstructive sleep apnoea: a randomized prospective parallel trial. *Lancet* 1999; 353:2100-2105
- 10 Kribbs NB, Pack AL, Kline LR, et al. Objective measurement of patterns of nasal CPAP use by patients with obstructive sleep apnea. *Am Rev Respir Dis* 1993; 147:887-895
- 11 Rauscher H, Formanek D, Popp W, et al. Self-reported vs. measured compliance with nasal CPAP for obstructive sleep apnea. *Chest* 1993; 103:1675-1680
- 12 Schmidt-Nowar W, Lowe A, Wiegand L, et al. Oral appliances for the treatment of snoring and obstructive sleep apnea: a review. *Sleep* 1995; 18:501-510
- 13 Ferguson KA, Ono T, Lowe AA, et al. A short-term controlled trial of an adjustable oral appliance for the treatment of mild to moderate obstructive sleep apnoea. *Thorax* 1997; 52:362-368
- 14 Bennett LS, Davies RJ, Stradling JR. Oral appliances for the management of snoring and obstructive sleep apnoea. *Thorax* 1998; 53(Suppl 2):S58-S64
- 15 Ferguson KA, Ono T, Lowe AA, et al. A randomized crossover study of an oral appliance vs nasal-continuous obstructive sleep apnea. *Chest* 1996; 109:1269-1275
- 16 Clark GT, Blumenfeld I, Yoffe N, et al. A crossover study comparing the efficacy of continuous positive airway pressure with anterior mandibular positioning devices on patients with obstructive sleep apnea. *Chest* 1996; 109:1477-1483
- 17 Chervin RD, Theut S, Bassetti C, et al. Compliance with nasal CPAP can be improved by simple interventions. *Sleep* 1997; 20:284-289
- 18 Likar LL, Panciera TM, Erickson AD, et al. Group education sessions and compliance with nasal CPAP therapy. *Chest* 1997; 111:1273-1277
- 19 Hoy CJ, Vennelle M, Kingshott RN, et al. Can intensive support improve continuous positive airway pressure use in patients with the sleep apnea/hypopnea syndrome? *Am J Respir Crit Care Med* 1999; 159:1096-1100
- 20 Krieger J, Sforza E, Petiau C, et al. Simplified diagnostic procedure for obstructive sleep apnoea syndrome: lower subsequent compliance with CPAP. *Eur Respir J* 1998; 12:776-779

## Why the Upper Airway Is Not Like a Gall Bladder

A patient has complaints of right-sided abdominal discomfort, fatty-food intolerance, bloating, and nonspecific physical findings. Gallstones are noted on ultrasonography, and the gall bladder is not visualized on a technically adequate cholecystogram. After there has been no response to medical therapy directed toward dyspepsia, the patient's physician has reasonably localized the problem to the gall bladder. This site has obviously well-defined "margins" (when it is out, *it is out*), and following cholecystectomy, the surgeon is secure in the knowledge that he/she has addressed problems that are specifically related to this organ. If symptoms persist, one can definitively eliminate the gall bladder as the source, with the patient having undergone an effective operation that was directed at the wrong diagnosis. Unfortunately, the same cannot be said of the upper airway as it relates to patients with obstructive

sleep apnea/hypopnea (OSA/H). As has been frequently noted in these pages as well as elsewhere, the upper airway serves many physiologic and functional masters, accommodating to the demands of speech, deglutition, and breathing. We are aware that each of these charges requires unique and potentially competing properties. Inappropriate synchronization of these services may have disastrous outcome (eg, choking), requiring rescue by built-in protective mechanisms.

The gall bladder is an obviously well-defined anatomic structure, the removal of which is well tolerated and resolves the consequences of dysfunction. Obviously unlike caring for a patient with gall bladder disease, a surgeon attending an OSA/H patient cannot excise the upper airway in its entirety. Unless the specific location of the upper airway dysfunction is identified, the problematic region may not be addressed, an issue that will only come to light following recovery from surgery. As a result, there is an advocacy for "site-specific" upper airway surgery for OSA/H patients, which is prompted by the imperative to treat only the dysfunctional aspects of airway control and to minimize the adverse impact that anatomic restructuring may have on the myriad of its other mandates.<sup>1-6</sup> It is intuitively sensible that if the obstructing region can be identified in any given patient, the surgery should be designed accordingly and the problem solved after a single procedure, much like a cholecystectomy. However, instituting this scenario presupposes that we, as physiologists and clinicians, understand the normal mechanisms of upper airway function and dysfunctional sleep. Although there has been considerable progress over the last 2 decades, we challenge the contention that such knowledge is available. Efforts to identify the site, much less the mechanism of upper airway obstruction in a manner that assists surgeons, have lead to disappointing results. The Mueller maneuver performed during wakefulness with nasopharyngeal endoscopic observation, assessment of the level of obstruction using a multilevel pressure-sensor catheter, and fiberoptic evaluation of regional upper airway collapsibility during pharmacologically induced sleep have arguably not proven to be either useful or practical predictors of surgical outcome.<sup>7-10</sup>

There are many unique challenges to designing and evaluating optimal surgical paradigms for OSA/H. First, one may ask if, unlike gall bladder surgery, it is unrealistic to conceive of truly site-specific procedures on the upper airway. It may be naïve to think that surgical manipulation of one part of the airway has no impact on function in other locations. In the current issue of *CHEST* (see page 1519), Dr. Prinsell presents his approach to site-

specific intervention. However, although maxillo-mandibular advancement (MMA) was performed in patients believed to have hypopharyngeal obstruction, postoperative cephalometric imaging revealed shortening of the soft palate. Additionally, a number of Dr. Prinsell's patients had undergone concomitant surgery on structures that might be interactive in the pathogenesis of upper airway dysfunction, even though these structures may not have been located in the hypopharynx. In this light and in view of the likelihood that function and dysfunction across regions of the upper airway are interrelated, it may be prudent to conceive of "procedure-specific" outcomes instead of site-specific surgery.

Our current level of ignorance regarding the pathophysiology of OSA/H obfuscates assessment of treatment outcome and provides a unique challenge to those of us in the field of sleep medicine. Comparing the efficacy of different techniques for gall bladder surgery is relatively straightforward, with traditional and well-defined outcome measures. There are few critics who would find fault with assessment of hard end points such as postoperative vital signs, pulmonary mechanics, oxygenation, and radiographic abnormalities in comparing laparoscopic and open cholecystectomy.<sup>11</sup> In contrast, the concept of hard measures of therapeutic outcome following OSA/H treatment (medical and surgical) is confounded by uncertainties regarding the physiologic and clinical significance of currently employed parameters of breathing during sleep (eg, what parameter is the appropriate measure of disease?). Even if there was agreement regarding the proper metric(s) of outcome, there remain important unresolved technical issues including variability in recording techniques and criteria used to define an abnormality for any given variable across studies.<sup>12,13</sup> Attempts are underway to address these issues,<sup>14,15</sup> but currently it remains difficult to determine if disparate results across investigations, even those examining what is putatively the same intervention, are biological or methodologic in nature. No solution is currently operational, and clinicians and researchers must continue to work around these shortcomings. It is nonetheless essential to consider the potential impact of these deficits in critically assessing the literature. In this context, interpreting the results of the current paper in *CHEST* is complicated by assessments utilizing data collected across a number of different laboratories. Dr. Prinsell appropriately points out that this must be considered when interpreting his results, despite the fact that all of these facilities used "conventional criteria." Other confounding elements such as weight change (Dr. Prinsell's patients lost an average of 2 kg/m<sup>2</sup> from the pre- to postoperative polysomnogram) must be con-

sidered and the data adjusted accordingly. Particularly in view of the limitations that we are currently unable to address, research studies must be designed to minimize methodologic variability and to adjust for confounding factors.

In addition to the above issues, which globally influence assessment of both surgical and medical treatment outcomes, some considerations uniquely challenge the surgeons in designing efficacy studies. It is clear that the highest level of evidence comes from prospective, randomized controlled trials. This may be relatively easy in assessing medical therapy (*eg*, positive pressure vs a “pill”) that does not entail irreversible interventions. Randomizing OSA/H patients to one or another surgical procedure may be more technically and perhaps ethically vexing, but it has been done in other areas of surgery.<sup>11</sup> Future patients benefit from optimally designed research. There also remains the even-more-difficult-to-resolve potential for subtle or not-so-subtle differences across surgeons with regard to technique in performing what is termed the “same procedure.” This factor could conceivably complicate multicenter trials. Although technical differences could be a consideration in assessing the literature on gall bladder surgery outcome, it is doubtful that these would be as significant as are the potential variations in the degree to which the mandible is advanced, the volume of soft palate that might be resected, or the location from which the hyoid bone is resuspended. Finally, persistent symptoms after cholecystectomy indicates that the cause of the problem was not identified. On the other hand, if a patient fails to improve following upper airway surgery, it may be due to an otherwise effective procedure directed to the wrong location in the airway, an ineffective procedure directed toward the correct location, an ineffective procedure directed to the wrong location, or the presence of comorbid disease. Resolution of this dilemma depends on greater pathophysiologic insight to provide better matching of the patient and the procedure. We are not there yet.

In summary, we must conclude that the upper airway is not like the gall bladder, and in light of the above discussion (as well as for a variety of other reasons), it probably never will be. We admit to stretching our point. However, if surgery for OSA/H is going to evolve into a routinely successful treatment alternative, as it has for gall bladder disorders, rigorous attention to the Scientific Method must be applied in its development. If site-specific surgery is possible, and even if it is not, we must first have

more “specific insight” into the mechanisms of upper airway function and dysfunction during sleep.

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## REFERENCES

- 1 Hochban W, Brandenburg U, Peter JH. Surgical treatment of obstructive sleep apnea by maxillomandibular advancement. *Sleep* 1994; 17:624–629
- 2 Riley RW, Powell NB, Guilleminault C. Obstructive sleep apnea syndrome: a review of 306 consecutively treated surgical patients. *Otolaryngol Head Neck Surg* 1993; 108:117–125
- 3 Powell NB, Riley RW, Robinson A. Surgical management of obstructive sleep apnea syndrome. In: Strollo PJ Jr., Sanders MH, eds. *Clinical Chest Medicine*. Philadelphia, PA: WB Saunders, 1998; 77–86
- 4 Waite PD, Wooten V, Lachner J, et al. Maxillomandibular advancement surgery in 23 patients with obstructive sleep apnea syndrome. *J Oral Maxillofac Surg* 1989; 47:1256–1261
- 5 Johnson NT, Chinn J. Uvulopalatopharyngoplasty and inferior sagittal mandibular osteotomy with genioglossus advancement for treatment of obstructive sleep apnea. *Chest* 1994; 105:278–283
- 6 Feng L, Pogrel A, Ajayi M. Pharyngeal airway changes associated with mandibular advancement. *J Oral Maxillofac Surg* 1994; 52:40–43
- 7 Launois S, Feroah TR, Campbell WN, et al. Site of pharyngeal narrowing predicts outcome of surgery for obstructive sleep apnea. *Am Rev Respir Dis* 1993; 147:182–189
- 8 Katsantonis GP, Miyazaki S, Walsh JK. The predictive efficacy of the Muller maneuver in uvulopalatopharyngoplasty. *Laryngoscope* 1989; 99:677–680
- 9 Shepard JW, Olsen KD. Uvulopalatopharyngoplasty for treatment of obstructive sleep apnea. *Mayo Clin Proc* 1990; 65:1260–1267
- 10 Hudgel DW, Harasick T, Katz RL, et al. Uvulopalatopharyngoplasty in obstructive sleep apnea: value of preoperative localization of site of upper airway narrowing during sleep. *Am Rev Respir Dis* 1991; 143:942–946
- 11 Schauer PR, Luna J, Ghiatas AA, et al. Pulmonary function after laparoscopic cholecystectomy. *Surgery* 1993; 114:389–399
- 12 Redline S, Sanders M. Hypopnea, a floating metric: implications for prevalence, morbidity estimates, and case finding. *Sleep* 1997; 20:1209–1217

- 13 Redline S, KapurVK, Sanders MH, et al. Effects of varying approaches for identifying respiratory disturbances on sleep apnea assessment. *Am J Respir Crit Care Med* (in press)
- 14 Quan SF, Howard BV, Iber C, et al. The sleep heart health study: design, rationale, and methods. *Sleep* 1997; 20:1077-1085
- 15 American Academy of Sleep Medicine Task Force Sleep-Related Breathing Disorders in Adults. Recommendations for syndrome definition and measurement techniques in clinical research. *Sleep* 1999; 5:667-6891

## Bloody Pericardial Effusion

### Clinically Significant Without Intrinsic Diagnostic Specificity

**B**leeding in any tissue is always concerning and potentially serious, either as a marker of disease or of potential blood loss. Hemopericardium (Table 1) comprises sanguineous pericardial effusions (which do not clot), frank blood due to wounds, and rupture into the pericardium of cardiovascular structures. The latter usually overwhelms the fibrinolytic and anticlotting activities of the pericardial mesothelium<sup>1</sup> and therefore usually clots. In cases of frank bleeding, the cause is frequently manifest or rapidly becomes so. Bloody pericardial effusion, on the other hand, is diagnostically more challenging because of the wide variety of conditions that simultaneously produce fluid (mostly exudates) and various degrees of bleeding into it, presumably from irritated capillaries. Contemporary experience indicates the very broad range of effusions, including common viral pericarditides, that may exhibit sanguineous pericardial effusion,<sup>2</sup> in contrast to the time-dishonored teachings about the frequency of life-threatening underlying lesions, notably tuberculosis. With the exception of AIDS patients, tuberculosis has been disappearing, at least in the industrialized Western world. Of course, diagnostic specificity is heavily related to the prevalence of any disorder in a given population, and the skewed populations of referral centers and institutions, which have developed populations of particular kinds of patients, will reflect this.

In this issue of *CHEST* (see page 1564), Atar and colleagues render a signal service in their analysis of serosanguineous pericardial effusions in a hospital with a patient population paralleling that of most community hospitals that have catheterization laboratories and cardiopericardial surgery. They have amplified the value of their article by defining their terms and classifying the etiologies of bloody pericardial effusions (their Table 1); they specifically confined their study to nonclotting

**Table 1—Hemopericardium\***

|  |
|--|
| Hemopericardium                              |
| Frank blood                                  |
| Wounds                                       |
| Penetrating                                  |
| Catheters                                    |
| Pacemaker wires                              |
| Ablation of arrhythmogenic tissue            |
| Chest (cardiac) wounds                       |
| Esophageal wounds/erosion                    |
| Intracardiac injections during resuscitation |
| Cardiac laceration                           |
| Pericardiocentesis                           |
| Removal of epicardial wires                  |
| Amniocentesis (fetal tamponade)              |
| Blunt chest trauma                           |
| Impacts/deceleration                         |
| Resuscitation                                |
| Cardiac abnormalities                        |
| Chamber rupture                              |
| Hemorrhagic infarct                          |
| Neoplasms—malignant/benign                   |
| Erosion of pericardial vessels               |
| Pericardial irritant coagulation disorders   |
| Vascular tumors                              |
| Aortic disease                               |
| Dissecting hematoma ("aneurysm")             |
| Intramural hemorrhage                        |
| Hemorrhagic diatheses                        |
| Reperfusion/thrombolysis                     |
| + Pericarditis                               |
| + Hemorrhagic infarct                        |
| Primary coagulation disorders                |
| Scurvy                                       |
| Bloody pericardial effusion                  |
| All from frank blood section above           |
| Idiopathic pericarditis                      |
| Infection (all forms)                        |
| Parasitoses                                  |
| Noninfective inflammation                    |
| Uremic pericarditis                          |
| Vasculitis—connective tissue disease group   |

\*From Spodick DH. Acquired pericardial disease: pathogenesis and overview. In: *The pericardium: a comprehensive textbook*. New York, NY: Marcel Dekker, 1997; 83. Used with permission.

effusions, *ie*, excluding pure hemopericardium, in 150 patients, all with cardiac tamponade. Clearly their state-of-the-art and state-of-the-science presentation demonstrates the nonspecificity of merely finding a significant amount of blood in a pericardial effusion, with three fourths of their group classified among iatrogenic (due to invasive procedures), malignant, idiopathic, and complications of atherosclerotic heart disease. Their Table 3 lists and directly cites five "most referenced" United States textbooks (from 1994 to 1998 editions) that perpetuate the notion that tuberculosis is a common cause of bloody pericardial fluid. This should alert readers that textbooks frequently perpetuate the notions and ideas of previous edi-

tions, often because some contributing authors are less interested in making serious efforts to write precisely or to rewrite chapters than they are in doing original work. This is also a symptom of medicine's glacial movement in fields like pericardiology, in which there are only a few dedicated specialists.

Atar and colleagues present a picture of symptoms, signs (including pulsus paradoxus), ECG abnormalities, and imaging abnormalities that reflect contemporary experience, as do their mortality statistics: patients with malignancy-related effusions died within months, excepting those with lymphomata, while patients with iatrogenic and idiopathic bloody effusions survived quite nicely. Moreover, the authors point out the overall poor results of effusion cytology studies and cultures (laboratory results changed the prepericardiocentesis diagnosis in only 3 of 96 patients). Indeed, only 12 patients had any positive findings in their pericardial fluid. Pericardial biopsy was performed at the discretion of the patient's physician and is not reported. This is probably because there were either too few biopsies or those that were obtained were not helpful. This would reflect a common experience that the results of pericardial biopsies are either negative or nonspecific, probably because both normal and abnormal pericardial fluids exude via the *visceral* pericardium, containing combinations of substances from the cardiac interstitium and the visceral pericardial mesothelium. Yet, a biopsy of the visceral pericardium is almost never performed. A potentially productive investigation would be to perform a biopsy of the visceral pericardium at surgery or by pericardiocopy (taking care to avoid the coronary vessels) in patients for whom determining etiology could provide targets for specific therapy.

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#### REFERENCES

- 1 Spodick DH. Microphysiology of the normal pericardium. In: The pericardium: a comprehensive textbook. New York, NY: Marcel Dekker, 1997; 23-24
- 2 Spodick DH. Hemopericardium. In: The pericardium: a comprehensive textbook. New York, NY: Marcel Dekker, 1997; 82-84

## Improvements in Lung and Respiratory Muscle Function Following Lung Volume Reduction Surgery

### Smaller May Be Better, But How Long Does It Last?

Since lung volume reduction surgery (LVRS) was introduced in 1992, considerable controversy has revolved around this procedure that improves dyspnea and quality of life in patients with COPD. Measurements of physiologic variables of airway obstruction, elastic recoil pressure, gas exchange, and exercise capacity all improve within the first year after LVRS. These findings occur more dramatically with bilateral rather than with unilateral resection. In addition to these changes in conventional lung volumes and mechanics, there are at least short-term improvements in respiratory muscle function or control of ventilation in patients with severe emphysema who have undergone LVRS. In this issue of *CHEST* (see page 1593), Lahrman and colleagues describe an elegant study in which they assessed the relationship between dyspnea and respiratory mechanics, muscle function, and central drive at 1, 6, and 12 months after LVRS. As expected, they found significant increases from preoperative values in FEV<sub>1</sub> and decreases in residual volume (RV) and total lung capacity (TLC) 1 month after LVRS. More intriguing were their findings that maximum exercise capacity, maximum oxygen uptake, respiratory muscle strength, endurance capacity, central diaphragmatic drive, and dyspnea during loaded breathing all reached statistical significance not less than 6 months after LVRS. Of some clinical importance is their additional finding that even as FEV<sub>1</sub>, TLC, and RV began to return to preoperative values 12 months after LVRS, respiratory muscle function continued to improve, while intrinsic positive end-expiratory pressure decreased further during this period. Since it has been shown that diaphragmatic activity decreases when muscle length decreases for a given neural drive,<sup>1</sup> factors other than changes in lung volume and a resumption of a more advantageous operational length of the respiratory muscles must account for the improvement in respiratory muscle function and dyspnea.

The hyperinflation of COPD takes many years to develop and may be accompanied by adaptive changes in the chest wall and respiratory muscles. Acute reductions in muscle fiber length, as occur in the diaphragm during acute hyperinflation, decrease the length of all the sarcomeres, leading to a reduction in muscle contraction force (length-tension re-

relationship). Several animal experiments have shown that limb muscles can be remodeled<sup>2</sup>: when muscles are immobilized for a few weeks in stretched position, they lose sarcomeres. Studies by others have demonstrated similar adaptive changes that occur in the diaphragm in experimental emphysema.<sup>3</sup> Prolonged hyperinflation results in loss of sarcomeres with a shift of the active length-tension relationship toward shorter lengths. In addition, loss of diaphragm weight, thickness, and surface area in many COPD patients also contribute to decreased force generation.<sup>4,5</sup> It is therefore reasonable to assume that such structural and functional changes revert towards a more normal state over a period of several weeks following LVRS. Adaptive responses would also explain the continued improvement in respiratory muscle function even as lung volumes began to deteriorate after 1 year.

In addition to respiratory muscle weakness, peripheral (limb) muscle weakness is commonly observed in patients with COPD and may contribute to exercise intolerance.<sup>6</sup> In a recent study, Bernard and colleagues<sup>7</sup> demonstrated that the quadriceps strength/muscle cross-sectional ratio in patients with COPD was similar to that of normal subjects, suggesting that weakness in COPD is due to muscle atrophy related to deconditioning, disuse atrophy, and possibly malnutrition. Thus, improved exercise performance and activities of daily living observed following LVRS<sup>8</sup> may also account for the phase lag between the observed changes in lung and respiratory muscle function.

The data of Lahrman and colleagues also show that while the intensity of dyspnea decreased by 37% 1 year after LVRS, the FEV<sub>1</sub> actually lost more than half of the amount it had gained immediately after surgery. Indeed, several authors have found, at best, a weak correlation between FEV<sub>1</sub> and chronic dyspnea.<sup>9,10</sup> By contrast, in COPD patients, there is a close association between chronic dyspnea (MRC scale) and expiratory flow limitation during tidal breathing at rest,<sup>9</sup> a common finding in patients with severe airway obstruction. Murciano and colleagues<sup>11</sup> showed that following single lung transplantation for end-stage COPD, expiratory flow limitation at rest became uncommon, contributing to a reduction in chronic dyspnea. Furthermore, a decrease in functional residual capacity following single lung transplantation, and likely LVRS, leads to a substantial improvement in inspiratory capacity, in turn leading to a marked improvement in tidal volume during muscular exercise, and hence to enhancement of exercise performance.

The important issue is how long these adaptive changes in remodeling last after LVRS and allow the patient to continue a reasonable degree of quality of

life. It is hoped that this question will be answered by the outcomes arising from the nationwide, multi-center, 7-year randomized controlled trial initiated by the National Institutes of Health. The study by Lahrman provides an early idea by showing that, at least during the first year after LVRS, a reduced ventilatory drive contributes to a reduction in dyspnea, even as certain measurements of lung and respiratory muscle function begin to return to pre-operative values. Gelb and colleagues<sup>10</sup> showed that while several variables of lung mechanics showed significant improvement 6 to 12 months following LVRS, there was also a variable tendency for many of these indices to drift back towards presurgical values after 2 years. Such changes are akin to the loss in

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elasticity of a stocking or fishnet after repeated sewing of holes in its torn fabric: the supporting fibers continue to deteriorate and stretch even as the rents are repaired. Over time the lung loses its elasticity, resulting in increased volume, dynamic airway collapse with increased intrinsic positive end-expiratory pressure, worsening dyspnea and disability, and ultimately, respiratory failure.

It remains to be seen whether surgical approaches (in conjunction with or without a rehabilitation program) offer a long-term advantage over a carefully planned and directed rehabilitation program alone.

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#### REFERENCES

- 1 McCully KK, Faulkner JA. Length-tension relationship of mammalian diaphragm muscles. *J Appl Physiol* 1983; 54: 1681-1686
- 2 Williams PE, Goldspink. Changes in sarcomere length and physiological properties of immobilized muscle. *J Anat* 1978; 127:459-468
- 3 Farkas GA, Roussos C. Diaphragm in emphysematous hamsters: sarcomere adaptability. *J Appl Physiol* 1983; 54:1635-1640
- 4 Butler C. Diaphragmatic changes in emphysema. *Am Rev Respir Dis* 1976; 114:155-159
- 5 Arora NS, Rochester DF. COPD and human diaphragm muscle dimensions. *Chest* 1987; 91:719-724
- 6 Gosselink RT, Troosters T, Decramer M. Peripheral muscle weakness contributes to exercise limitation in COPD. *Am J Respir Crit Care Med* 1996; 153:976-980

- 7 Bernard S, Le Blanc P, Whitton F, et al. Peripheral muscle weakness in patients with chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1998; 158:629–634
- 8 Ferguson GT, Fernandez E, Zamora MR, et al. Improved exercise performance following lung volume reduction surgery for emphysema. *Am J Respir Crit Care Med* 1998; 157:1195–1203
- 9 Eltayara L, Becklake MR, Volta CA, et al. Relationship between chronic dyspnea and expiratory flow-limitation in COPD patients. *Am J Respir Crit Care Med* 1996; 154:1726–1734
- 10 Gellb AF, Brenner M, McKenna RJ, et al. Serial lung function and elastic recoil 2 years after lung volume reduction surgery for emphysema. *Chest* 1998; 113:1497–1506
- 11 Murciano D, Pichot M-H, Boczkowski J, et al. Expiratory flow limitation in COPD patients after single lung transplantation. *Am J Respir Crit Care Med* 1997; 155:1036–1041

## Asthma

### We Need To Do Better!

Asthma is a very common chronic disease with a self-reported prevalence of 13.7 million persons (1993–94 survey).<sup>1</sup> In 1995, there were an estimated 1.8 million emergency department visits for treatment of acute asthma.<sup>1</sup> Office visits for asthma have more than doubled in the past 20 years.<sup>1</sup> Estimated costs of asthma management exceed \$5 billion per year, with half of all costs used for acute exacerbations that are managed in the hospital setting.<sup>2,3</sup> With this type of expenditure for asthma, why are so many of our patients not doing well?

To improve the overall management of asthma, the National Asthma Education Program expert panel published guidelines in 1991,<sup>4</sup> and an international consensus was published in 1992.<sup>5</sup> The statements stress the importance of asthma education, self-monitoring of asthma symptoms, and outlines a stepwise approach to asthma care including the use of inhaled corticosteroids for moderate and severe asthma. They also recommend providing the patient with a written “plan of action” that can be initiated at the onset of an acute attack. In discussions with colleagues and teaching of residents, we all refer to the consensus statement. But why has this not become actual practice?

There are many reasons that can be listed: psychosocial issues including the inability to afford medications, the lack of a primary care physician, and continued exposure to known irritants, especially cigarette smoking. In this issue of *CHEST* (see page 1638), McD Taylor et al surveyed their asthma population in a Pittsburgh emergency department and compared the patient’s knowledge and their outpatient treatment with the consensus guidelines.

Patients in this study and those using hospital emergency departments generally have a poor understanding of their disease and poor management techniques.

According to McD Taylor et al, approximately 60% of patients were undertreated with medications, and > 80% had no plan of action for acute exacerbations. Their patient population had a poor understanding of their disease and were unclear on the use of their medications. With regards to the recommendation of inhaled steroids for moderate to severe disease, only 50% of their patient population used some form of steroid therapy (but again, some did not understand its proper use).

Another recent study by Legorreta et al<sup>6</sup> demonstrated dismal results also. Of interest, this study was conducted by written survey of an asthma population enrolled in a large health maintenance organization (HMO) in California. Of those patients with severe asthma, 72% had a steroid inhaler, but only 54% of those patients used it daily. As for monitoring peak flow, only 26% of respondents had a peak flowmeter, but only 16% of those patients used it daily to monitor their disease. Remember, this was a population of patients with insurance who should have been able to obtain medication, peak flowmeters, and access to care.

Many patients seeking care in emergency departments may not have a primary care provider. According to McD Taylor et al, only 38% of the patients could name a primary physician as the person from whom they obtained asthma education. Therefore, a significant number of patients received information from other sources. Many did not see a physician on a regular basis, which is important for patient education and adjustment of medications. Perhaps if the patient had a primary care physician with regularly scheduled follow-up visits, they would be managed and educated more appropriately and not use the emergency department for care.

The article by Kolbe et al<sup>7</sup> should remind us that other factors influence the ability of our patients to manage their disease. Asthma knowledge was compared to actual behavior during an acute attack. It was found that a reasonable knowledge base alone does not translate into appropriate action. Factors that may influence the “gap” include non-European descent, feeling stigmatized by the disease, high anxiety, concerns over the cost of medical care, living on Social Security benefits alone, low education, and the recent loss of a partner. When seeing asthma patients, it is important to realize that there are other social and psychological issues influencing that particular individual. Asthma education should begin with dealing with some of these issues that affect the everyday life of our patients.

Education is a big principle of current asthma management. The patient should understand their disease process, understand their medication and how to use it, and be able to react to changes in their disease by symptoms and/or actual measured peak flow. In the above-mentioned studies, it is clearly demonstrated that these points are not being made to our patients. Peak flowmeters were not widely available or used by this patient population. Peak flow is a valuable tool to aide the patient and physician in the management of asthma. It provides an objective measurement of airflow obstruction. However, it is only valuable when used, and those who use the peak flowmeters are usually well-monitored, well-motivated patients.<sup>8</sup> Peak flow-based action plans have been shown to improve asthma control and reduce the number of emergency department visits.<sup>9</sup> However, this has been a short-term effect. The patients may benefit from continued support and reminders from their primary care provider or asthma specialist concerning peak flow measurement and the use of inhalers. Education and good follow-up with a provider seems to influence the use of an inhaled steroid, at least over a short-term period.<sup>9</sup>

The guidelines suggest that all asthmatic patients measure their peak flow and symptoms daily. Some patients can only follow their symptoms, and those patients should be educated to do so. While it would be beneficial to the patient to have a peak flowmeter and to use it daily, the reality is that only well-motivated patients will do so. Certainly knowing the patient's best peak flow is a valuable tool to guide emergency management. Perhaps measuring the peak flow in the office when the patient is feeling well is the best we can do for some patients!

The article by McD Taylor et al, along with the study by Legorreta et al<sup>6</sup> should be a wake-up call for all who see asthma patients, whether it is in the primary care setting, the asthma specialty setting, or in the emergency department. All of us need to work harder at educating our patients and helping them deal with all aspects of their disease. Yes, the medications can be expensive, but this seems to be an excuse. The study by Legorreta et al<sup>6</sup> was conducted with people enrolled at an HMO; all patients should have had their medicines provided through their health plans. There are programs available to patients who cannot afford medication such as state insurance plans, or even through some of the pharmaceutical companies.

We may not be able to motivate our patients to do everything suggested in the guidelines, but we can strive for a few of the basics. All of us, including

those practicing in the emergency department setting, can make an effort to do better. At each patient encounter, we can readdress the basic issues and educate our patients about their disease. The most important aspect of education is inhaler technique and a review of the medications. Inhaler technique is generally suboptimal, and many may benefit from the addition of a spacer. Explain the need for daily use of an inhaled steroid, and explain the use of a "quick reliever" medicine. Give them a specific plan of action when they leave the emergency department or urgent-care clinic. This plan can be symptom or peak-flow based and should be adequate until they see their primary care provider in a few days. Stress the importance of follow-up in 2 to 3 days. Finally, stress the importance of avoiding known irritants, especially cigarettes. If we as physicians do basic education at every visit, we will eventually do better!

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#### REFERENCES

- 1 Mannino DM, Homa DM, Pertowski CA, et al. Surveillance for asthma—United States, 1960–1995. *MMWR* 1998; 47: 1–27
- 2 Smith DH, Malone DC, Lawson KA, et al. A national estimate of the economic costs of asthma. *Am J Respir Crit Care Med* 1997; 156:787–793
- 3 Stanford R, McLaughlin T, Okamoto LJ. The cost of asthma in the emergency department and hospital. *Am J Respir Crit Care Med* 1999; 160:211–215
- 4 National Asthma Education Program. Expert Panel Report: guidelines for the diagnosis and management of asthma. Bethesda, MD: National Institutes of Health, August 1991; Publication No. 91–3042
- 5 International Asthma Management Project. International consensus report on the diagnosis and management of asthma. *Clin Exp Allergy* 1992; 22(suppl1):1–52
- 6 Legorreta AP, Christian-Hernan J, O'Connor RD, et al. Compliance with national asthma management guidelines and specialty care. *Arch Intern Med* 1998; 58:457–464
- 7 Kolbe J, Vamos M, Fergusson W, et al. Differential influences on asthma self-management knowledge and self-management behavior in acute severe asthma. *Chest* 1996; 110:1463–1468
- 8 Cowie RL, Revitt SG, Underwood MF, et al. The effect of a peak flow-based action plan in the prevention of exacerbations of asthma. *Chest* 1997; 112:1534–1538
- 9 Cote J, Cartier A, Robichaud P, et al. Influence on asthma morbidity of asthma education programs based on self-management plans following treatment optimization. *Am J Respir Crit Care Med* 1997; 155:1509–1514

## Treatment of Sleep Apnea : Unmet Needs

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