infusion of fluid, in our experience, even 5 to 10 mg/kg cannot always be administered due to the development of hypotension and cardiovascular depression during the infusion. This could be explained by the fact that the typical neurosurgical patient requiring pentobarbital coma is significantly dehydrated by fluid restriction, mannitol administration, and diuretic therapy in an attempt to reduce intracranial pressure. In addition, these patients are frequently old, may have some septic process, and may have some degree of myocardial impairment.

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REFERENCES

To the Editor:

The concerns expressed by Drs Teba and Weber regarding loading doses of pentobarbital in the 36-mg/kg range are well founded. Administering high-dose barbiturate therapy carries all the risks of emergency anesthetic administration to a patient near death. This is probably the reason why most textbooks of neurosurgery and critical care recommend smaller loading doses. Lower loading doses optimize patient safety but may not provide rapid reduction of cerebral oxygen consumption, cerebral electrical activity, and intracranial pressure. Recent reports advocate the use of high loading doses because of the concern for a timely therapeutic response for the selected patient indicators discussed in our review. A loading dose of 28 to 34 mg/kg administered during a 4-h period has been shown to raise serum levels to 30 to 40 µg/mL quickly enough to reduce elevated intracranial pressure and minimize further neurologic injury. Although the relationship between drug concentration and pharmacologic response may be loosely defined in these patients, it is well established that these serum levels are associated with coma, isoelectric EEG, and effective adjunctive therapy for head injury. While we readily acknowledge the difficulty in inducing and maintaining high-dose barbiturate therapy, it is beyond the scope of this report to discuss in detail such administration protocols, which have been discussed elsewhere.

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REFERENCES

Air Trapping following Coronary Artery Bypass Surgery

To the Editor:

In a recent report in your journal, Dries et al have presented a case of hemodynamic compromise associated with air trapping following coronary artery bypass surgery. This phenomenon was originally described by Weng et al, as cited by Dries et al. Over the past few years we have witnessed lung hyperinflation following coronary artery bypass surgery in at least five additional cases, four of which were in women with a significant history of smoking. The observed air trapping was never due to high ventilation rate or prolonged inspiratory time, but was rather due to severe bronchospasm, and resulted in high airway pressure once attempts to close the chest were made. This bronchospasm is very resistant to conventional bronchodilator therapy; therefore, the use of the expiratory retard mode is indicated.

The differential diagnosis of hypotension occurring following chest closure (ie, whether it is due to pulmonary hyperinflation or to primary cardiac failure) can be greatly simplified by analyzing the effects of the mechanical breath on the arterial waveform. We have recently shown that a state of inadequate preload is characterized, and may actually be quantified, by the amount of the decrease in the systolic blood pressure following a mechanical breath relative to the systolic pressure during apnea (Δ down). On the other hand, a state of congestive heart failure is characterized by a near-total lack of a decrease in the systolic blood pressure following a mechanical breath, because the transient decrease in venous return does not affect left ventricular stroke output. Furthermore, an early inspiratory increase in the systolic pressure, denoting a positive cardiovascular effect of the increase in intrathoracic pressure, may appear in congestive heart failure.

Thus, if hypotension occurs following chest closure, a Δ down of more than 10 percent of the systolic pressure during a short apnea is indicative of inadequate preload due to either absolute hypovolemia or lung hyperinflation, the latter case being usually associated with a high peak inspiratory pressure. If such hypotension is accompanied by a lack of a Δ down, and the systolic pressure is unchanged or somewhat elevated following a mechanical breath, the diagnosis is congestive heart failure.

This is another example of the usefulness of arterial pressure waveform analysis in the hemodynamic assessment of ventilated patients.

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REFERENCES
2 Weng JT, Smith DE, Graybar GB, Kirby RR. Hypotension

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secondary to airtrapping treated with expiratory flow retard. Anesthesiology 1984; 60:350-53
3 Perel A, Pizov R, Cotov S. The systolic blood pressure variation is a sensitive indicator of hypovolemia in ventilated dogs subjected to graded hemorrhage. Anesthesiology 1987; 67:498-502

To the Editor:

We thank Drs Perel and Koman for reporting additional cases of air trapping following coronary artery bypass grafting. The technique of arterial waveform analysis described by this group may demonstrate relative hypovolemia or mechanical compromise secondary to hyperinflation or more mundane problems, such as residual pneumothorax or hemothorax. While comparable information can be obtained with use of a pulmonary artery catheter, which is routine in our practice with high-risk patients, arterial waveform analysis may provide useful information where data from a pulmonary artery catheter are not immediately available.

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Bronchoscopy for Hemoptysis

To the Editor:

We read with great interest the letter by Drs Schraufnagel and Margolis1 concerning the paper by Dr Lederle and co-workers2 on the issue of whether diagnostic fiberoptic bronchoscopy is indicated for patients with hemoptysis and a negative chest radiograph.

We suggest that disagreement on whether bronchoscopy should be done "routinely" in this setting is often based on two common misunderstandings: considering data from dissimilar patients to be comparable and assuming that showing any difference is the same as proving that such a difference is clinically relevant. Thus, the accuracy of the proposed 16 percent diagnostic yield for bronchogenic carcinoma in this setting4 depends on exactly which types of patients are included in the analysis (eg, young vs old, first vs recurrent episode of hemoptysis, smoker vs nonsmoker, hemoptysis in the setting of acute bronchitis vs "spontaneous" hemoptysis, and truly negative chest radiograph vs one with borderline or nonspecific abnormalities).

In addition, even if one accepts that immediate bronchoscopy can be used to diagnose some occult bronchogenic carcinomas in patients with truly normal chest radiographs, the value of doing so is by no means automatically proved. Given the high proportion of negative bronchoscopic examinations that would have to be done in this scenario (at least 84 percent1), the cost-effectiveness and risk-benefit ratio of such an approach should be considered acceptable only if the following statements are proved to be true:
1. Unless bronchoscopy is performed at once, occult bronchogenic carcinomas will be missed for a long time and will not be diagnosed before it is "too late."
2. Alternatively, even if occult bronchogenic carcinomas are not missed for long, diagnosing them at the time of the first episode of hemoptysis significantly improves prognosis. In other words, even a short delay (days/weeks/months) in making the diagnosis has a definite negative impact on final outcome.
3. Because of the two previous points, the benefits of immediate bronchoscopy clearly outweigh the morbidity/mortality (albeit low) associated with at least 84 percent of "unnecessary" bronchoscopic examinations and justify the definitely not-insignificant added cost.

To our knowledge, no study has ever been published proving any of the above statements to be true. Thus, over the past few years we often have elected to defer bronchoscopy, even in smokers over the age of 40, if all of the following criteria were met:
1. First episode of hemoptysis during a one-year period.
2. Duration of hemoptysis of less than ten days.
3. The hemoptysis developed in the context of a clinically apparent episode of acute bronchitis, or a specific cause of hemoptysis (eg, pulmonary embolism or trauma) is overwhelmingly evident.
4. If hemoptysis is associated with bronchitis, the chest radiograph is completely negative (not suspicious, nonspecific, or unsatisfactory4).
5. There are no historical or clinical data suggestive of a possible occult malignancy (eg, unexplained weight loss, anemia, hypercalcemia, or evidence of distant metastasis).
6. Rapid (within seven days) and complete resolution of hemoptysis with medical therapy. If any amount of hemoptysis recurs within 12 months, or if it persists, bronchoscopy is performed at once.

In all cases, close follow-up is provided, and patients are clearly instructed to contact us at once if any amount of hemoptysis (however slight) recurs or if any new symptom develops.

We selected the above criteria based on a review of our clinical experience since 1982 and previously published data,3 both of which suggested that these criteria may be accurate predictors of underlying bronchogenic carcinoma in this setting. Since 1988, of 17 patients we have seen at our institution who met all of the above criteria, only one was later found to have a bronchogenic carcinoma. In this case, the diagnosis was made within six weeks of the initial episode of hemoptysis due to recurrent blood-tinged sputum. Of course, no conclusions can yet be drawn from our data, since the number of cases is small and many patients have not completed a sufficiently long period of follow-up.

Although routinely performing bronchoscopy in all patients presenting with acute first-time hemoptysis and a negative chest radiograph will eventually result in the diagnosis of a few occult bronchogenic carcinomas, whether this is cost-effective, or even necessary, is far from being definitely established. Consequently, we believe that, until a proper prospective study answers these questions, clinical judgment and close clinical observation, rather than a routine and possibly overaggressive approach, can and should dictate when and if diagnostic fiberoptic bronchoscopy is indicated for a specific patient with hemoptysis.

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REFERENCES
1 Schraufnagel D, Margolis B. Bronchoscopy for hemoptysis, letter. Chest 1990; 97:1502
3 Weaver LJ, Solliday N, Cugell DW. Selection of patients with hemoptysis for fiberoptic bronchoscopy. Chest 1979; 76:7-10
5 Jackson CV, Savage PJ, Quinn DL. Role of fiberoptic bronchoscopy...