23.0 percent and 8/56 or 14.2 percent respectively. It would be of great interest to further subclassify these four groups (UAT and NUAT, with and without complications) according to their preoperative FEF25-75%. Important information with predictive value, might emerge.

The authors chose not to include the forced expiratory volume for one second (FEV1) in their analysis. This index, expressed in liters or as percent predicted, is related to the MVV and I believe is in much wider use than the MVV in clinical pulmonary function laboratories. It would be helpful if some indication could be given of the predictive value of this index for the development of postoperative pulmonary complications.

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REFERENCES

To the Editor:

We appreciate Dr. Snider's comments regarding our article "Preoperative Pulmonary Preparation of Patients with Chronic Obstructive Pulmonary Disease." We agree with his point that it would have been preferable if we had had an "unprepared" group to compare to our prepared group as a control. Unfortunately, as we noted in the article, all the patients were felt to need pulmonary preparation because of the serious nature of their obstructive lung disease and the potential complications of anesthesia and major surgery. We did not feel that we could in good conscience withhold a potentially beneficial preoperative procedure from these patients. We were, therefore, forced to use a similar group of patients previously studied for pulmonary complications of surgery who had not received preoperative pulmonary preparation at our institution, published by Tarhan and associates.

We appreciate Dr. Snider's comments regarding alternative ways of analyzing our data. We analyzed this material in just about every conceivable combination. We will certainly accept Dr. Snider's recommendation, however, and look at these data in the manner he suggests.

We again wish to thank Dr. Snider for his interest in our article and appreciate his excellent comments.

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Pulmonary Artery Stenosis and Renal Artery Stenosis

To the Editor:

I should like to comment on the very interesting article by Carambas et al in Chest 75:402, 1979. The association of pulmonary artery stenosis and renal artery stenosis should raise the question of generalized nonspecific arteritis as a possible differential diagnosis.

In Mexico, this association is not exceptional. Different degrees and types of narrowing and/or obstruction of renal, pulmonary and other arteries have been reported in several series in children.1-3 Obviously, the patient of Carambas and coauthors had a murmur since birth and this might eliminate any possibility of an acquired condition. Still, it may be worthwhile to perform tests which point in the direction of an inflammatory condition such as a positive PPD, Mantoux test, gamma globulins, etc which we often have found in a large percentage of children with arteritis.

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Persisting Pneumothorax as a Complication of Chest Suction

To the Editor:

While pneumothorax is generally well treated with only a chest tube and chest bottle, most surgeons apply suction if a significant air leak is present.1,2 Usually, one of the common "bubbling" type or vacuum regulation devices is used, but sometimes these devices can actually block the removal of air from the chest. Two examples are presented.

CASE 1

A 21-year-old student had a chest tube in place for right pneumothorax. There was a moderately large air leak, so a wall-mounted "bubbling" suction device (NCG) was used at 27 mm Hg (20 cm water). The flow through the bubble chamber was kept low to minimize noise. Pneumothorax persisted. It was finally noted that whenever she coughed, the bubbling of air ceased. When she coughed hard, water was pushed out of the air intake tube. The suction device was discontinued, and the pneumothorax resolved in a few hours.

CASE 2

A 20-year-old asthmatic student presented with left tension pneumothorax. A tube was placed, and suction (27 cm H2O) was applied with a wall-mounted "bubbling" suction device (NCG). After 36 hours, she still had 30 percent pneumothorax. When she coughed, the bubbling of air stopped, and water was pushed up the air intake tube. She was switched to a fan-operated suction device (Emerson) at 40 cm H2O. The lung expanded completely. Her air leak persisted. Six days later, the fan-operated device was replaced by the "bubbling." The pneumothorax recurred. The fan-operated suction device was reconnected, and the lung promptly re-expanded. The air leak stopped five days later.

DISCUSSION

Wall suction (600-700 cm H2O) cannot be applied directly to a chest tube. The bubble-chamber type of vacuum regulator is commonly used to reduce it to a 20-40 cm H2O
Figure 1. Diagram of the bubble-chamber type of vacuum regulation system used for chest suction. This shows the classic "three bottle system." The same principles apply to most wall-mounted suction regulation units and to the disposable plastic molded units. A high resistance, adjustable needle valve is used to drop the wall suction pressure down to the range needed for chest suction. This results in a relatively low flow of air through the entire system, which severely limits the response of this type of suction device to transient high flow situations such as coughing.

(Fig 1). Negative pressure in the chamber, which exceeds the height of water in the air inlet tube, causes air to be pulled in through the tube, regulating the pressure.

The total flow through the system is controlled by the needle valve, because it is the highest resistance element in the system. For a given setting of the needle valve, $Q_R$ is fixed. This means that if $Q_T$ rises to equal $Q_R$, then $Q_B$ stops. This destroys the pressure regulation.

$Q_T = Q_B + Q_P$

$Q_B$ is rarely a steady flow of air. This is typically low with brief transients (30-50 L/min) on coughing or forced expiration. But the system works best when $Q_B$ is limited to around 5-10 L/min. If $Q_T$ is allowed to become larger than this, then the bubbling of water through the chamber ($Q_B$) becomes excessive and the negative pressure in the chamber rises.

The net effect of these relationships is that the system cannot remove high flow transients in $Q_T$. During transients, intrapleural pressure rises and often becomes positive. If the air leak is large and persistent, the peaks of positive intrapleural pressure may keep the lung partially collapsed, as in the two cases presented.

Fan-operated units can take much larger air flows. In the Emerson unit, a flow of 50 L/min will drop the negative pressure from 27 to 24 cm H$_2$O. In a bubblor unit, 5 L/min drops the pressure from 27 cm H$_2$O to zero. The fan-operated unit, besides providing superior pressure regulation, has enough capacity to deal with the transients produced by coughing or forced expiration.

Three precautions can be used: 1) the flow through the bubble chamber should be relatively high; 2) all bubble chamber units should be equipped with a blow-off valve so that, at worst, they will function as well as an underwater seal bottle; and 3) patients with a significant air leak should be managed with fan-operated suction units or other equivalent high-volume systems.

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