To the Editor:—I read with considerable interest the article by Benavides et al.1 describing experiments of air bubble growth in water during exposure to 100% nitrous oxide, 100% xenon, or 50% xenon-50% oxygen. Although the experiments were nicely conducted, they explore a physics of gas flux in an unconstrained bubble permitted to grow spherically. Importantly, this geometry has limited biologic relevance for bubbles occluding vessels in the size range they have studied. The authors have referenced our previous work on xenon transport,2 but they have mistakenly interpreted the findings presented therein to indicate the growth of bubbles as spheres. Rather, that study presents some simulations for bubbles that are initially spherical and just fill the vessel lumen. Such bubbles cannot grow radially because they are constrained by the vessel wall and therefore elongate during growth while maintaining a fixed curvature on the interface. This results in a much different force balance across the gas-liquid interface and, hence, a different pressure condition on the interior of the bubble from that which occurs in the case of a time-varying interfacial shape, which the authors have studied. We have described these differences in our previous theoretical and experimental studies of intravascular gas embolism.2–5

In addition, the initial internal gas content they have studied includes nitrogen, equilibrated with test solution A, but test solution B is nitrogen free. Hence, there are large gradients for nitrogen flux when the solutions are switched. We purposely avoided nitrogen as a component of either the bubble or perfusate in our predictions and considered only oxygen and xenon as the transportable species.2 Whereas others have studied growth of similarly unconstrained air bubbles during cardiopulmonary bypass,6 our work has not provided any data for direct comparisons such as the authors have made, based on the different gas constituents and the governing physics dictated by the shape constraint.

I find it fascinating, however, that they have couched their results in terms of bubble diameter growth. When transferred to the volume domain, one readily sees that the spherical bubbles exposed to 100% xenon or 100% nitrous oxide had grown to more than twice their initial volume in 25 min (figs. 2 and 3) and continued growing when the solutions were switched (downward arrow). The time required for this is surprisingly similar to the volume doubling times we reported for many of the cases we explored, despite the differences in our model and these experiments.

The curve fitting by a double exponential suggests that there will be continuous exponential growth of bubble diameter. So although the physics and gas transport are different from what we studied, the indication of the studies are the same.

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increase in the number of observed emboli, which would have occurred had the bubble size of gas emboli increased significantly.5

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To the Editor:—I read with interest the report by Campos et al.1 This article reported 39% and 36% incidences of failure of proper placement of lung isolation devices by faculty and senior residents, respectively. All participating anesthesiologists did not regularly practice thoracic anesthesia. The authors stated that one-lung ventilation is primarily provided by either a double-lumen tube, the Univent® torque control blocker (Vitaaid Ltd., Lewiston, NY), or the Arndt® blocker (Cook Critical Care, Bloomington, IN). However, an additional blocker that was not mentioned is the Cohen blocker (Cook Critical Care). This commonly used blocker has a wheel at the operator end that, when turned, flexes the tip and gives the anesthesiologist the ability to direct the blocker to the appropriate bronchus.

This is an important article that highlights the difficulties for anesthesiologists who need to provide one-lung ventilation on an occasional basis. There is a learning curve with all of these techniques. I agree with the authors that the successful practice of thoracic anesthesia requires familiarity with the devices, skill in fiberoptic bronchoscopy, and knowledge of the tracheobronchial anatomy. Residents learning thoracic anesthesia should learn all three of these types of skills before graduation, and these should be specific goals in residency programs.

The authors stated that the preoperative instruction included the fiberoptic views that constituted correct positioning of the device. When checking the position of the lung isolating device, it is also important to identify the right upper lobe, the characteristic D-shaped opening to the middle lobe, and the basilar and superior segments of the lower lobe. The left mainstem bronchus is identified, as well as the left upper and lower lobes. The views of just the double-lumen tube or blocker balloon are not adequate for establishing correct positioning, which could account for some of the malpositions reported in the study. If a simplified instruction is given, it is most important to identify the right upper lobe. It would be helpful to know exactly which views were included in the tutorial.

It would be interesting to repeat the study, with more training, to achieve a higher success rate. Anesthesiologists who may have to provide one-lung ventilation on occasion should become familiar with the devices, learn the tracheobronchial anatomy, and practice fiberoptic bronchoscopy. There are hands-on workshops that are given at the annual meetings of the American Society of Anesthesiologists and the International Anesthesia Research Society and at the PostGraduate Assembly in Anesthesiology.

When choosing a lung isolation technique, there are other issues to consider besides the initial placement. Blockers, especially when used on the right side, are more easily dislodged than double-lumen tubes. It is also easier to suction and apply oxygen via a double-lumen tube, compared with a blocker. The main advantage of the blocker is in the patient with the difficult airway, which was excluded in the study. It is essential to be knowledgeable of possible complications. For example, a blocker may become dislodged into the trachea and block ventilation completely. Techniques for prevention and treatment of hypoxemia must be understood.

There is more to practicing thoracic anesthesia than just the initial placement of the lung isolation device.

The most important teaching message from this study is that practitioners who may have to provide one-lung ventilation on an occasional basis need to do continuing medical education. Development of a tutorial and/or attending a hands-on workshop might be beneficial.

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Reference


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To the Editor:—The study by Campos et al.1 presented some interesting findings. It was surprising that the lung isolation device used to achieve one-lung isolation did not provide an advantage to the anesthesiologist with limited experience. There was no difference in frequency of failure or time to successful tube positioning among the three devices. A difference might have been anticipated, especially between the Arndt® blocker and the left-sided double-lumen endotracheal tube (DLT), because the DLT is the most commonly used device for lung isolation,2 and bronchial blocking devices gener-

Results of the Study Comparing Devices Used for Lung Isolation Are Rather Concerning

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ally require longer time for placement compared with the left-sided DLT. The results of the study are rather concerning, because training and exposure for residents largely consist of the use of the DLT, which is used more often and has been in clinical practice for a longer period of time. Because a combination of unfamiliarity with tracheobronchial anatomy and skill in fiberoptic bronchoscopy was responsible for most of the malpositions, perhaps training for residents should concentrate on building a stronger foundation in basic knowledge and skill. Personal experience with the routine use of video-bronchoscopy for confirmation of DLT position has shown that it greatly facilitates the learning process. Anatomy can be demonstrated clearly, and due to simultaneous viewing by the attending and resident, there is better appreciation of the steps involved in the identification and correction of any misposition problems. The use of a virtual bronchoscopy simulator may also be useful in skill acquisition in flexible bronchoscopy.

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In Reply.—We thank Drs. Ng and Neustein for their interest in our research. Addressing Dr. Ng’s letter, we fully agree with his comments that more attention should be given while training residents or staff anesthesiologists in lung isolation techniques, with particular emphasis on tracheobronchial anatomy and skills in fiberoptic bronchoscopy. In fact, after we published our study, we designed a second study based on the lessons that we learned previously. Because the previous study did not demonstrate any advantage between the left-sided double-lumen endotracheal tubes and bronchial blockers (Univent®, Vital Ltd., Lewiston, NY) and Arndt® (Cook Critical Care, Bloomington, IN) blocker) and because the most common device used for lung isolation is the left-sided double-lumen endotracheal tube, we are currently conducting a new study, involving the use of left-sided double-lumen endotracheal tubes among anesthesiologists with limited experience in thoracic anesthesia (i.e., less than two lung isolation device cases per month). In this randomized study, one group of anesthesiologists has been assigned to a tutorial in the simulator facility at The University of Iowa (Iowa City, Iowa), providing a tutorial demonstration and hands-on practice in proper placement of a double-lumen endotracheal tube with the aid of flexible fiberoptic bronchoscopy techniques on a mannequin model. The second group has been assigned to self-training using a DVD that was made by one of the authors (J.H.C.) that includes placement of left-sided double-lumen endotracheal tubes along with a detailed description of fiberoptic bronchoscopy techniques. It is our hope to have a definitive answer to determine which method (simulator training vs. DVD self-training) facilitates placement of double-lumen endotracheal tubes for anesthesiologists with limited thoracic anesthesia experience.

Our study has shown that one of the limitations of anesthesiologists with limited experience in thoracic anesthesia is unfamiliarity with bronchial anatomy. In principle, every anesthesiologist resident or staff member should know the anatomical distances pertaining to the airway; for example, in an average subject, the distance from the incisors to the vocal cords is 15 cm, and the distance from the vocal cords to the tracheal carina is approximately 12 cm. The distance from the tracheal carina to the takeoff of the right upper lobe bronchus is an average of 1.5 cm in females and 2 cm in males. The distances from the carina to the takeoff of the left upper and lower bronchi are an average of 4.5 and 5.0 cm, respectively.

Furthermore, when looking through the fiberoptic bronchoscope, the only early structure in the right mainstem bronchus that has three orifices is the right upper lobe bronchus: These are the apical, the anterior and the posterior bronchi. If every anesthesiologist recognized this anatomical structure, fewer problems would be encountered when inserting lung isolation devices. Adding a shared demonstration through a video-bronchoscopy might enhance training. Unfortunately, it has not been scientifically tested.

In response to Dr. Neustein’s comments regarding the Cohen endobronchial blocker, when the original manuscript was submitted, this blocker was mentioned as one of the lung isolation devices. However, one of the reviewers stated that this blocker should be deleted from the manuscript because this device was not tested in our study, and we complied. We have used the Cohen endobronchial blocker when lung isolation is required for either a left- or a right-sided surgical procedure with excellent results but have not identified an advantage over the Arndt® wire-guided endobronchial blocker.

As we previously stated, every trainee must be familiar with (1) the devices for lung isolation, (2) fiberoptic bronchoscopy techniques, and (3) the complete knowledge of tracheobronchial anatomy to be able to properly position and use these devices. This should be a high priority in resident training during thoracic anesthesia rotations and should be the case with every anesthesiologist who is involved on an occasional basis with lung isolation cases.

Regarding the question of which views were included in the tutorial, a graphic display of fiberoptic bronchoscopy images was shown in color in real time, showing step-by-step the correct fiberoptic bronchoscopy findings of the right or left bronchus and its secondary bronchi with special attention to the takeoff of the right upper bronchus, including a view of the apical, anterior, and posterior bronchi. Also, as we stated in our study, a pictorial review of the fiberoptic views that constituted proper positioning of the three devices was shown to each participant before the study.

Regarding the workshops given in major meetings, there is no study available to demonstrate the efficacy of this method. Personally, we do not believe it is the solution to the problem. Perhaps a simulator or self-teaching instruction with a professional DVD made by an expert in the field could make a difference. Our next study should provide an answer to this question.

Regarding the choice of lung isolation techniques, Dr. Neustein stated in his letter that bronchial blockers placed on the right side are more easily dislodged than a double-lumen endotracheal tube. We absolutely disagree with his statement. In a previous report by our group, when we compared right-sided double-lumen endotracheal tubes with bronchial blockers (Univent® bronchial blocker), there were three malpositions in the right-sided double-lumen endotracheal tube group versus five malpositions in the right-sided Univent® bronchial blocker group. In both groups, there was only one instance in which a right-sided double-lumen endotracheal tube and a bronchial blocker dislodged; the other malpositions were related to the cuff needing more air or the tube being too far in. Overall in that study, the

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number of malpositions was quite low for both tube types and did not differ between the groups. Therefore, the choice of device for lung isolation in the right mainstem bronchus does not matter when a cardiothoracic anesthesiologist places these devices. This concept might not apply to anesthesiologists with limited experience in thoracic anesthesia, but to our knowledge, this has not been tested scientifically.

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Edison’s Anesthetic

To the Editor.—American inventor and businessman Thomas Alva Edison is legendary for his contributions to such technologies as the lightbulb, the telephone, the phonograph, and motion pictures, among many others. In his lifetime, Edison obtained 1,093 US patents and some 1,239 patents in other countries. Little known among these efforts was his “improved anesthetic compound.”

In the summer of 1882, George F. Sh Brady (Founder and Editor, Medical Record 1866–1904) (1837–1907), reported that Thomas Edison invented a new anesthetic made of chloroform, ether, alcohol, and camphor and had applied for British and German patents. The witty but misinformed editor added, “Edison may wish to use it on his stockholders until electric light was in successful operation.”

In fact, the “anesthetic” actually was an analgesic liniment that Edison had prepared in early 1878. He named it Polyform and advertised it for “neurologic pain.” Polyform was a mixture of chloroform, ether, camphor gum, alcohol, chloral hydrate, morphine, and oils of peppermint and clove. Edison believed that his compound’s various analgesics would potentiate each other and that the mixture would attack pain in a “shotgun manner.”

In 1879, Edison applied for a US patent but, for unknown reasons, withdrew his application shortly thereafter. In February 1880, the British patent No. 599 was granted to his London agents for a slightly modified compound. The editor of the Medical Record was misinformed: Edison did not apply for a German patent (written personal communication, Hubert Rothe, Director, Information Department, German Patent and Trademark Office, Munich, Germany, May 2004).

Topical ether and, especially, chloroform had been widely used for musculoskeletal and neurologic pains since their discovery. At the time of Edison’s invention, not only were liniments of chloroform and of camphor used in the United States, but there also existed lotions made of chloroform, camphor, ether, alcohol, morphine, and chloral hydrate. One, Sankt Jakob Oel, had been popular in Germany since 1866–1904. At the time of Edison’s invention, not only were liniments of chloroform and of camphor used in the United States, but there also existed lotions made of chloroform, camphor, ether, alcohol, morphine, and chloral hydrate. One, Sankt Jakob Oel, had been popular in Germany since 1866–1904. It was marketed in the United States during the 1880s under the name of St. Jacob’s Oil by the firms of C.A. Voegeler in Baltimore and Kroeger Ltd. of Cincinnati. Its formula is given in several US formularies.

Whether Edison knew of St. Jacob’s Oil when he invented his Polyform or whether he learned of its existence later on is unknown. The latter may explain why he did not apply for a German patent and withdrew his US application.

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A Rare Iatrogenic Cause of Upper Gastrointestinal Bleeding

To the Editor.—An 85-yr-old man was transferred to our institution for evacuation of a subdural hematoma. His course was complicated by deep venous thromboembolism necessitating intravenous heparin. He ultimately required intubation and was ventilated for several minutes before the recognition of an inadvertent esophageal intubation. The endotracheal tube was correctly repositioned, and a nasogastric tube was inserted with the return of approximately 500 ml of fresh blood.

After the heparin was discontinued, his partial thromboplastin time normalized, and the platelet count and international normalized ratio were also normal. On upper endoscopy, the esophagus and duodenum were completely normal. In the gastric fundus, there were linear mucosal tears (fig. 1). There was no surrounding inflammation, and the appearance was not consistent with trauma from the nasogastric tube. There was minimal oozeing of blood and small adherent clots, but there was nothing necessitating endoscopic treatment.

Tears in the gastric mucosa from overdistension during endoscopy for percutaneous endoscopic gastrostomy tube placement in the set-
We report a case of acute upper gastrointestinal bleeding from mucosal tears resulting from gastric overdistention after inadvertent esophageal intubation. To our knowledge, this complication has not been previously described and should be included in the differential diagnosis of upper gastrointestinal bleeding in critically ill patients who have had inadvertent esophageal intubation or cardiopulmonary resuscitation. The combination of history of esophageal intubation, involvement of the lesser curvature, and similarity to the mucosal tears seen by Green and Tendler⁴ during percutaneous endoscopic gastrostomy tube placement support this diagnosis. In addition, in cases of upper gastrointestinal bleeding when a history of inadvertent esophageal intubation is obtained, gastric perforation should be ruled out with abdominal imaging before performing upper endoscopy.

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To the Editor.—We would like to report our recent experience with a patient with a rare disorder known as Gitelman syndrome.

Gitelman syndrome, a variant of Bartter syndrome, is a congenital autosomal recessive disorder characterized by hypokalemia, hypomagnesemia, and hypocalcinuria associated with metabolic alkalosis.¹ ² Unlike Bartter syndrome, which presents in the neonatal period and childhood up to 5 yr of age, Gitelman syndrome presents in early adulthood. The two syndromes may also be distinguished from each other because Gitelman syndrome presents with hypomagnesemia and hypocalcinuria, whereas Bartter syndrome presents with normal serum magnesium and high urinary calcium.¹ ² Patients with Gitelman syndrome usually present with cramps, fatigue, muscle weakness, and carpopedal spams.

A 47-yr-old woman recently presented to us for repair of nasolacrimal duct stenosis during general anesthesia. Her medical history was significant for diabetes, gastrointestinal reflux disease, and thyroid disease. Her surgical history included a hysterectomy, an appendectomy, a thyroidectomy, a breast biopsy, and an exploratory laparotomy for ovarian cancer. She described her symptoms as cramps in her legs. She related that 2 yr ago during the surgery for her thyroid, she had a cardiac arrest. The patient stated that her cardiac arrest had occurred because of unrecognized hypokalemia and hypomagnesiam.

Her medications included potassium chloride, magnesium, spironolactone, levothyroxine, glyburide, and lensoprazole. Her vital signs included a blood pressure of 111/77 mmHg, pulse of 98 beats/min, respiration of 18 breaths/min, and temperature of 97.9°F. Her laboratory studies showed the following: white blood cells, 10.6 (4.1–11.2); hemoglobin, 15.3 g/dl (11.5–15.1); hematocrit, 45.0% (35–46); platelets, 503 × 10³ (400–900); Na, 137 mEq/l (136–145); K, 4.2 mEq/l (3.5–5.1); Cl, 96 mEq/l (98–107); HCO₃⁻, 27 (20–27); blood urea nitrogen, 20 mg/dl (6–20); creatinine, 0.8 (0.5–1.2); glucose, 68 mg/dl (65–115); Ca, 10.9 mEq/l (8.8–10.5); Mg, 1.9 mEq/l (1.3–2.1); and urine creatinine, 181 mEq/l. She was 4 ft 11 in tall and weighed 70 kg.

In the operating room after placement of an electrocardiograph, noninvasive blood pressure cuff, and pulse oximetry, general anesthesia was induced using propofol and fentanyl for muscle relaxation and for tracheal intubation. Desflurane was used...
for maintenance of anesthesia. At the end of the case, the muscle relaxant was reversed using glycopyrrolate and neostigmine. When the patient was awake and responding to commands, her trachea was extubated in the operating room without any complications.

Although the patient’s current magnesium level was only slightly decreased, we decided not to replace it. Her current potassium level was also normal. She was aware of her diagnosis of Gitelman syndrome and was taking potassium and magnesium replacement. Review of the literature reveals that ventricular tachycardia has occurred in patients with Gitelman syndrome when potassium and magnesium levels are low. This potentially fatal arrhythmia must be recognized and treated early.

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