Once with each strip, and the free ends were applied to the pig's snout. This resulted in contact areas of approximately 7.5 cm² (adhesive tape—tracheal tube) and 60 cm² (adhesive tape—skin).

Using standard equipment, mean axial traction forces resulting in extubation were >20 N. With the disconnecter in place, extubation by traction was impossible. Disconnection took place at a mean force of 15, 5, and 3 N with traction applied axially (180°), and at angles of 45° and 90°, respectively.

We conclude that the "disconnecter" reliably prevents unintentional extubation, resulting from traction, accidentally applied to the breathing system. In contrast to accidental extubation, facilitated disconnection is unlikely to result in a serious hazard, because specific alarm features that are part of standard anesthesia machines (ISO 5358) will alert the anesthesiologist to take appropriate action.

A device such as described here may contribute to patient safety during procedures that are associated with an increased risk of accidental traction application to the breathing system, such as frequent repositioning of the patient, neuroradiology (angiography, computed axial tomography, or nuclear magnetic resonance imaging), or immersion lithotripsy.

JOSEF ECK
Department of Biomedical Engineering
JAN-PETER A. H. JANTZEN, M.D., D.E.A.A.
Department of Anaesthesiology
Johannes Gutenberg—University Medical School
Klinik für Anästhesiologie
Langenbeckstrasse 1
D-6500 Mainz
Germany

REFERENCE
(Accepted for publication December 8, 1991.)

Beyond Transesophageal Echocardiography: Ultrasound Imaging in the Operating Room

To the Editor—The availability of ultrasound in the operating room has been increasing rapidly because of the demand for transesophageal echocardiography (TEE). With the TEE probe, anesthesiologists have the opportunity to assess not only cardiac function but also the thoracic aorta, pleural effusions, intracranial balloon pump placement, mediastinal masses, and upper abdominal structures. The natural extension of this experience has been the use of high-frequency external probes to localize vascular structures for cannulation. At our institution, we use the external probes occasionally for assistance with catheter insertion and for imaging the heart preinduction. Recently we had the opportunity to put the technology to a new intraoperative use.

Case: A 66-yr-old man underwent coronary artery bypass grafting.
uneventfully. However, on the second postoperative day, attempts to remove the Foley catheter were unsuccessful. The cuff on the catheter could not be deflated. The urology service was consulted. They recommended either instrumentation of the catheter to try to puncture the cuff from the lumen, ultrasound-guided suprapubic needle puncture by radiology, or ether injection of the port to try to dissolve the cuff. Instrumenting the catheter was tried without success, and while waiting for an opening on the radiology schedule, the patient had an episode of coughing that resulted in dehiscence of his sternal wound with instability of his sternum. He was brought to the operating room for emergency exploration and sternal rewiring. His main concern at that time was the seemingly permanent catheter. Sternal closure was performed, and after the dressing was placed and while the patient was still under anesthesia, a 2.5-MHz Hewlett-Packard external transducer was placed over the suprapubic area to image the bladder. Normal saline was infused into the catheter to expand the bladder. An excellent image of the catheter cuff was obtained with the proximal surface measured to be at a depth of 6 cm (fig. 1). The surgeon passed a 22-G spinal needle suprapublicly, proximal and parallel to the probe. The needle was seen on the ultrasound monitor to puncture the cuff on the first pass. The cuff was seen to deflate, and the catheter was then removed easily. A new catheter was placed for the immediate postoperative period. The urine was blood-tinged but cleared in 30 min. The patient recovered uneventfully and was discharged.

The purchase of ultrasound technology by an anesthesiology department is a significant investment especially when one considers the difficulty obtaining reimbursement for the service. We have the good fortune to possess the equipment and have an aggressive service that looks for opportunities to contribute to better patient care. Further benefits in the operating room can be attained if one keeps in mind the utility of noninvasive soft tissue imaging for localization. This tool can be used instead of palpation, percussion, or auscultation. The procedure presented has been described previously in the urology literature. This patient benefited by having the procedure done under anesthesia.

The ultrasound was used again during a suprapubic cystostomy when the first deep pass with the large trocar yielded only venous bleeding. The ultrasound was used to demonstrate a slightly displaced bladder, which was then easily punctured.

The increasing use of TEE in cardiac and noncardiac surgery is providing more anesthesiologists with significant knowledge and experience in ultrasound technology. Documentation of experience and intradepartmental credentialing is necessary to demonstrate responsible use of the tool and has been in place at our institution for two years. As with any new tool or technique, the clinician should always seek more expert assistance if available.

Non-TEE uses would never justify acquisition of the technology by an anesthesiology department. However, the added benefits of its immediate availability especially in a teaching institution are limited only by one's imagination.

RICHARD J. Bjerke, M.D.
Assistant Professor of Anesthesiology and Critical Care Medicine
University of Pittsburgh
Chief of Anesthesia Service
Veterans Affairs Medical Center
University Drive C
Pittsburgh, Pennsylvania 15240

REFERENCES

(Accepted for publication December 9, 1991.)