Central Venous Catheterization

TO THE EDITOR: I have three concerns about the description of central venous catheterization in the video by Graham et al. (May 24 issue).[1] First, it is misleading to describe the risk of hemothorax as "not applicable" when the internal jugular approach is used, since hemothorax is a known complication.[2] Second, head rotation of 45 degrees increases the overlap of the carotid artery by the internal jugular vein,[3] increasing the risk of arterial puncture.[4] For this reason, most authors recommend a near-midline position of the head. Third, the manometer technique that is shown is inadequate. Blood rising more than 30 cm in the vertical tube indicates arterial catheterization; however, the absence of this increase does not exclude the possibility of arterial puncture if the needle tip abuts the artery wall. Arterial puncture can be excluded only by filling the horizontal catheter with more than 30 cm of blood and then holding it upright and observing a fall in the column. Finally, in light of the potential for serious or fatal complications, it is difficult to justify an attempt at central venous catheterization without an experienced operator present.

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1. Graham AS, Ozment C, Tegtmeyer K, Lai S, Braner DAV. Central venous catheterization. N Engl J Med 2007;356:e21 (Web only). (Available at http://content.nejm.org/cgi/content/short/356/21/e21/.)
2. Eisen LA, Narasimhan M, Berger JS, Mayo PH, Rosen MJ, Schneider RF. Mechanical complications of central venous catheters. J Intensive Care Med 2006;21:40-6.
3. Wang R, Snoey ER, Clements RC, Hern HG, Price D. Effect of head rotation on vascular anatomy of the neck: an ultrasound study. J Emerg Med 2006;31:283-6.
4. Sulek CA, Gravenstein N, Blackshear RH, Weiss L. Head rotation during internal jugular vein cannulation and the risk of carotid artery puncture. Anesth Analg 1996;82:125-8.

TO THE EDITOR: We welcome the emphasis on sterility in the instructional video by Graham et al., given the association of central venous catheterization with bacteremia,[1] including infection with methicillin-resistant *Staphylococcus aureus*.[2] However, we wish to emphasize the significant variation in position of the jugular veins.

We undertook an audit of 100 patients who were awaiting coronary angiography and found that 11% of right internal jugular veins and 24% of left internal jugular veins were anterior and medial to the carotid artery (Fig. 1). With the use of the landmark technique described in the video, safe catheterization of these veins will probably be difficult, if not impossible. Therefore, it is not surprising that the landmark technique carries a 9% risk of arterial puncture.[3] Furthermore, the degree of head rotation recommended can have a significant effect on the position of the vein.[4]

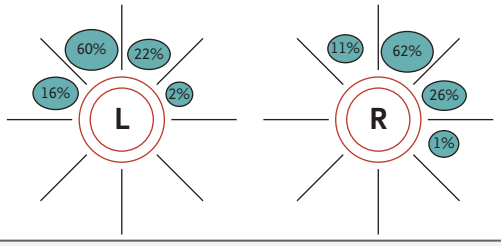

Figure 1. Distribution of Internal Jugular Vein According to Quadrant.
The view is from the head of the bed, with the patient's head turned to the contralateral side. L denotes left carotid artery, and R right carotid artery.

Ultrasonography accurately locates the target vein and also provides information about venous pressure and the presence of intravascular thrombus. Its use should therefore be an integral part of central venous catheterization.

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1. Coello R, Charlett A, Ward V, et al. Device-related sources of bacteraemia in English hospitals — opportunities for the prevention of hospital-acquired bacteraemia. J Hosp Infect 2003;53:46-57.
2. Carnicer-Pont D, Bailey KA, Mason BW, Walker AM, Evans MR, Salmon RL. Risk factors for hospital-acquired methicillin-resistant Staphylococcus aureus bacteraemia: a case-control study. Epidemiol Infect 2006;134:1167-73.
3. McGee DC, Gould MK. Preventing complications of central venous catheterization. N Engl J Med 2003;348:1123-33.
4. Sulek CA, Gravenstein N, Blackshear RH, Weiss L. Head rotation during internal jugular vein cannulation and the risk of carotid artery puncture. Anesth Analg 1996;82:125-8.

TO THE EDITOR: The video by Graham et al. shows a guidewire inducing premature ventricu-

lar contractions, illustrating a common problem during insertion of central venous catheters: overinsertion of guidewires. Intravenous guidewires, commercially available in kits, are generally twice as long as the catheters they guide, a length that easily allows entry into cardiac chambers and results in arrhythmias.[1] We have observed transient right bundle-branch block and ventricular fibrillation when overinserted guidewires entered the right ventricle.

Overinsertion of guidewires occurs during the initial placement of the wire and during advancement of the catheter over the guidewire. We teach that the distal end of the guidewire should never be inserted past the top of the patient's head during catheterization of the right internal jugular vein and that the wire should be kept at this position during advancement of the catheter. If a guidewire requires withdrawal through the catheter for control of the distal end, the guidewire was inserted into the patient farther than necessary. Avoidance of guidewire overinsertion can be lifesaving in some patients.

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1. Royster RL, Johnston WE, Gravlee GP, Brauer S, Richards D. Arrhythmias during venous cannulation prior to pulmonary artery catheter insertion. Anesth Analg 1985;64:1214-6.

TO THE EDITOR: Sometimes ultrasonographic guidance is not available for central venous catheterization, so the operator must rely on surface landmarks alone. In this situation it may be safer if the patient's head is in the neutral position. Head rotation can cause the internal jugular vein to move laterally in relation to surface landmarks and become more difficult to locate.[1] Furthermore, the vein can lie directly above the carotid artery,[2] increasing the risk of arterial puncture. Using a 22-gauge needle to find and anchor the vein is also useful.[3] This needle can be left in the vein to guide the insertion of the introducer needle.

Another recognized complication is damage to the guidewire.[4] This is avoided by nicking the skin while the needle is in place and by retracting the skin while inserting the dilator.

Finally, use of an introducer cannula rather than the introducer needle minimizes the risk of laceration of the vein if the needle moves. This is particularly useful if pressure transduction is required to check location before insertion of the catheter.

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1. Khatri VP, Wagner-Sevy S, Espinosa MH, Fisher JB. The internal jugular vein maintains its regional anatomy and patency after carotid endarterectomy: a prospective study. Ann Surg 2001;233:282-6.
2. Sulek CA, Gravenstein N, Blackshear RH, Weiss L. Head rotation during internal jugular vein cannulation and the risk of carotid artery puncture. Anesth Analg 1996;82:125-8.
3. Tripathi M, Pandey M. Anchoring of the internal jugular vein with a pilot needle to facilitate its puncture with a wide bore needle: a randomised, prospective, clinical study. Anaesthesia 2006;61:15-9.
4. Monaca E, Trojan S, Lynch J, Doehn M, Wappler F. Broken guide wire — a fault of design? Can J Anaesth 2005;52:801-4.

THE AUTHORS REPLY: We regret that although our video stresses not over-rotating the head, our text refers to the classic teaching of positioning the patient with the head rotated away from neutral.[1] It has become clear that as the head rotates away from neutral, there is an increase in both the overlap and proximity of the internal jugular vein and carotid artery,[2] which increases the risk of carotid puncture.

We agree that ultrasonography enhances the rate of success of internal jugular venous catheterization, speeds the process, demonstrates important anatomical variations, demonstrates vessel thromboses, and decreases complications, including catheter-related bloodstream infections.[3] We appreciate Reade's comment that hemothorax is a rare but potentially serious complication of internal jugular venous catheterization. Ultrasonographic guidance may reduce the risk of hemothorax from 1.7% to zero.[3] Unfortunately, ultrasonography is not universally available and ultrasound devices may fail to operate; therefore, knowledge of the landmark technique remains essential.

We agree with Newsome et al. that guidewire overinsertion can be dangerous. The wire needs to be advanced only far enough to maintain reliable control of the tract from the skin surface to the intravascular space.

Adhya and Laha suggest nicking the skin while the needle remains in place, which may prove useful as long as the operator takes care not to cause damage by inadvertent movement of the indwelling needle during the process. They also refer to an interesting study that describes the use of a small-gauge pilot needle to locate the internal jugular vein and an innovative technique to then stabilize it.[4] This small-gauge pilot needle may be particularly useful when patients have coagulopathy or when ultrasonography is not available.

We agree that, ideally, an experienced operator should be present for all central venous catheterization procedures. This is especially important for patients with known risk factors for difficult catheterization.

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1. McGee DC, Gould MK. Preventing complications of central venous catheterization. N Engl J Med 2003;348:1123-33.
2. Wang R, Snoey ER, Clements RC, Hern HG, Price D. Effect of head rotation on vascular anatomy of the neck: an ultrasound study. J Emerg Med 2006;31:283-6.
3. Karakitsos D, Labropoulos N, De Groot E, et al. Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients. Crit Care 2006;10:R162.
4. Tripathi M, Pandey M. Anchoring of the internal jugular vein with a pilot needle to facilitate its puncture with a wide bore needle: a randomised, prospective, clinical study. Anaesthesia 2006;61:15-9.

Long-Term Follow-up after Treatment of Rabies by Induction of Coma

TO THE EDITOR: In 2005, Willoughby and colleagues[1] reported on a 15-year-old girl's survival from rabies encephalitis — the sixth such case that had been reported in humans — after treatment with a novel therapeutic regimen that included ketamine, ribavirin, and amantadine. Five months after exposure, she still had dysarthria, weakness in the left hand and foot, bilateral extensor plantar response, generalized choreoathetosis, intermittent dystonia, and a lurching gait. Here we report on the functional outcomes 18 months and 27 months after her initial exposure to a rabid bat.

Her generalized choreoathetosis completely resolved by 2006. A trial of therapy with carbidopa–levodopa caused worsening of abnormalities in her gait. A cerebrospinal fluid analysis in September 2005 showed normalization of the protein level and the white-cell count, with decreased levels of biopterin. Eighteen months after her exposure to rabies, her dysarthria and gait abnormalities had significantly improved, but she could not return to her previous level of participation in sports. She resumed classes full time in high school without having difficulties with either learning or memory.

On neurologic examination, the patient showed no choreoathetoid movements during four separate visits with three neurologists and two rehabilitation specialists. She had normal affect and cognition, ataxic dysarthria (see video, available with the full text of this letter at www.nejm.org), and normal cranial-nerve functions. Also evident in the video are both mild weakness in the left foot dorsiflexor and mild dystonia in the left hand, without weakness on surface electromyography. She also had slowed alternating movements in the left hand and fingers and paresthesia in the region of the bat bite. Her deep-tendon reflexes were symmetric throughout, and her plantar responses were flexor. She had mild ataxia, especially during running (see video). Analysis of the cerebrospinal fluid showed six unique oligoclonal bands. A mildly elevated level of neopterin and decreased levels of 5-hydroxyindoleacetic acid and homovanillic acid suggested decreased turnover of dopamine and serotonin. Magnetic resonance imaging of the brain showed resolution of the hyperintensities in the basal ganglia that had been seen on T_2-weighted images in November 2004.

Twenty-seven months after exposure, the patient continued to have fluctuating dysarthria and gait difficulties, plus an intermittent sensation of cold in the feet. She had no difficulties with her instrumental activities of daily living, including driving. In high school, she took college-level courses in English, physics, and calculus. She scored above average on a national college achievement test, graduated from high school in 2007,