

---

## Brief Clinical Report

---

# Detection of subdural placement of epidural catheter using nerve stimulation

---

Ban C.H. Tsui MSc MD,  
Sunil Gupta MD FRCP,  
Derek Emery MD FRCP,\*  
Brendan Finucane MBBCH FRCP

**Purpose:** To report the detection of a subdural catheter placement using nerve stimulation through an epidural catheter.

**Clinical features:** An 85-yr-old gentleman was scheduled for radical cystectomy and creation of an ileal conduit. Combined general anesthesia and regional technique was selected. An epidural catheter (19 G Arrow Flextip Plus) was inserted prior to induction of general anesthesia. Intra-operatively, the patient received 5 mg morphine and 10 ml bupivacaine 0.5% via the epidural catheter. The patient remained hemodynamically stable throughout the operation and did not require intravenous opioids. The patient was discharged to the ward with an order for epidural morphine for pain control. The next day, the patient remained comfortable. As an ongoing quality assessment to survey the success rate of epidural catheters at our institution, all patients are invited to have their catheter assessed using an electrical epidural stimulation test. Electrical stimulation (1-10mA) with a segmental motor response (truncal or extremities movement) indicates that the catheter is in the epidural space. No motor response indicates that it is not. In this case, subdural catheter placement was suspected because a diffuse motor response including right anterior chest wall, back muscle, and bilateral lower extremities was observed using only 0.3 mA. Subdural catheter placement was subsequently confirmed by a radiograph showing a very thin film of dye spreading cephalad and caudad over many segments.

**Conclusion:** This new electrical test helps to detect subdural placement objectively.

**Objectif :** Rappporter la détection du positionnement d'un cathéter sous-dural à l'aide de la neurostimulation au travers d'un cathéter péridural.

**Éléments cliniques :** Une cystectomie radicale avec création d'un canal iléal a été prévue chez un homme de 85 ans. On a choisi une anesthésie générale combinée à une technique régionale. Un cathéter péridural (19 G Arrow Flextip Plus) a été inséré avant l'induction de l'anesthésie générale. Pendant l'opération, le patient a reçu 5 mg de morphine et 10 ml de bupivacaine à 0,5 % au travers du cathéter péridural. La stabilité hémodynamique s'est maintenue pendant l'intervention et le patient n'a pas eu besoin d'opioïdes intraveineux. Le patient a quitté le service avec une prescription de morphine péridurale contre la douleur. Le jour suivant, il se portait toujours bien. Afin d'étudier le taux de réussite de l'usage de cathéters périduraux à notre institution, nous procédons à une analyse permanente de la qualité, invitant les patients à faire évaluer leur cathéter au moyen de test de neurostimulation. La stimulation électrique (1-10 mA), par une réponse motrice segmentaire (mouvement du tronc ou des extrémités), indique si le cathéter est dans l'espace péridural. L'absence de réponse motrice indique qu'il ne l'est pas. Dans le cas présent, un positionnement sous-dural du cathéter est envisagé parce qu'une réponse motrice diffuse, incluant la paroi thoracique antérieure droite, les muscles du dos et les extrémités inférieures bilatérales, a été observée en utilisant un courant de seulement 0,3 mA. La position sous-durale a été confirmée par une radiographie ultérieure montrant une très mince couche de colorant qui s'étendait en direction céphalique et caudale sur de nombreux segments.

**Conclusion :** Ce nouveau test électrique aide à détecter objectivement le placement sous-dural d'un cathéter.

From the Department of Anesthesiology and Pain Medicine, and the Department of Diagnostic Imaging,\* University of Alberta Hospitals, Walter Mackenzie Health Sciences Centre, 8440-112 Street, Edmonton, Alberta, T6G 2B7 Canada.

*Address correspondence to:* Dr. Ban C.H. Tsui. Phone: 780-407-8861; Fax: 780-407-3200; E-mail: btsui@ualberta.ca  
Presented in part at the International Anesthesia Research Society, 74th Clinical and Scientific Congress, March, 2000.

*Accepted for publication January 22, 2000.*

**S**UBDURAL injection of local anesthetic drugs is a potentially serious complications of epidural anesthesia that occurs in up to 1% of cases.<sup>1-3</sup> Clinical manifestations of subdural block can vary and it is suggested that diagnosis of a subdural catheter placement is made radiologically using contrast media.<sup>4</sup> Only a handful of case reports show clear radiographic documentation of subdural catheter placement.<sup>5</sup> Thus, many epidural catheters may be placed subdurally unbeknownst to the clinicians.<sup>3</sup>

Recently, electrical stimulation (1-10mA) has been used to confirm the location of epidural catheters<sup>6-8</sup> and the technique may be used to confirm epidural catheter placement and to detect subarachnoid and intravascular placement. This report describes the use of this new electrical test to detect a case of subdural catheter placement in a patient without clinical evidence of subdural placement.

#### *Stimulation test*

A nerve stimulator (Dakmed model 750 digital, C.R. Bard, Inc., Tewksbury, USA) was connected to the epidural catheter via an adapter (Johans ECG Adapter, Arrow International, Inc., Reading, USA). The epidural catheter (19 G Arrow Flextip Plus, Arrow International, Inc., Reading, USA) and ECG adapter were primed with sterile normal saline. The anode lead of the nerve stimulator was connected to an electrode over the upper or lower extremities as a grounding site. The cathode lead of the stimulator was connected to the metal hub of the adapter. The nerve stimulator was set at a frequency of 1 Hz with a pulse width of 200 msec.<sup>6-8</sup> Electrical stimulation (1-10mA) with a segmental motor response (truncal or extremities movement) indicates that the catheter is in the epidural space. No motor response indicates that it is not. Since it is possible to obtain vigorous and uncomfortable twitches with an excessive current, the current output must be carefully increased from zero and stopped once motor activity is visible. Thus, the stimulator used in the test must be sensitive enough to allow a gradual increase of current output from zero up to at least 10 mA. Because a motor response will be elicited at a very low current (<1mA) in the case of subarachnoid or subdural placement, the current output must be carefully increased in small increments (0.1mA) between zero and 2 mA.

#### *Case report*

An 85-yr-old gentleman was scheduled for radical cystectomy and creation of an ileal conduit. An epidural catheter (19 G Arrow Flextip Plus) was easily inserted at the L<sub>3-4</sub> interspace by an experienced anesthesiolo-

gist. An epidural test dose was not administered. After negative aspiration for blood and cerebrospinal fluid, general anesthesia was induced and maintained. Intraoperatively, the patient received 5 mg morphine and 10ml bupivacaine 0.5% via the epidural catheter. The patient remained hemodynamically stable throughout the procedure and did not require intravenous opioids. The patient awoke pain free and remained so whilst receiving intermittent boluses of epidural morphine. The following day, the new test was performed with the patient's written consent. Subdural catheter placement was suspected because a diffuse and vigorous motor response (including right anterior chest wall, back muscles, and bilateral motor response in the legs) was observed using only 0.3 mA. Subdural catheter placement was confirmed radiologically using contrast (Figure). The catheter was immediately removed and the patient was monitored overnight with continuous pulse oximetry. The patient's subsequent course was uneventful and his pain was controlled using patient controlled analgesia (morphine).

#### *Discussion*

We have described successful detection of a case of subdural catheter placement using electrical stimulation test. Subdural catheter placement was suspected during a quality assurance project checking all epidur-

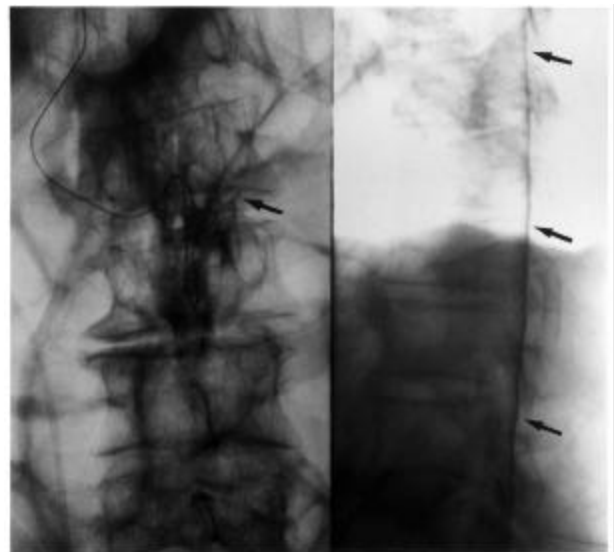


FIGURE Radiographs after the injection of 3 ml contrast medium via the epidural catheter.

(Left) Antero-posterior view; arrow shows the tip of the catheter at L<sub>2-3</sub> level.

(Right) lateral view; arrows show a very thin film of contrast medium spreading cephalad over many segments along the dorsal part of the spinal canal.

al catheter postoperatively. The suspicion was verified radiologically using contrast fluoroscopy.

The characteristic of subdural catheter placement is that fluid injection into this space can spread a considerable distance.<sup>3,5</sup> The injected fluid will only be separated from the spinal nerves by the relatively thin arachnoid and pia mater. In the test described, an electrical impulse is conducted through the injectate into the subdural space. We hypothesized that a diffuse motor response involving multiple segments would be exhibited at a low current (<1mA) when a catheter was in the subdural space. This response is caused by diffuse spread of injectate in the subdural space which conducts electricity to multiple nerve roots. The observations in this case are consistent with the hypothesis. A diffuse positive motor response involving the right chest, back and both lower extremities was observed at a low current (0.3mA). This unusual response had never been observed before in over 100 cases. The clinical signs of subdural local anesthetic injection are not consistent but are sometimes characterized by an extensive spread of sensory anesthesia and sometimes Horner's syndrome. However, clinical signs of subdural placement were not observed in this case because local anesthetic drugs were not used postoperatively. Indeed, the patient had been comfortable with adequate analgesia from morphine via the catheter which did not suggest abnormal placement. The only evidence suggesting subdural catheter placement was provided by the new stimulation test. The figure demonstrates a typical subdural catheter placement radiograph,<sup>9,10</sup> characterized by a very thin film of dye, spreading in both cephalad and caudal directions over many segments.

This is the only observation we have made of subdural catheter placement using this new stimulation test. We do not have sufficient data to make statements about the sensitivity or specificity of the test in detecting subdural catheter placement. Since the incidence of subdural catheter placement is uncommon, the probability of detection of subdural placement with this new test by random chance is small. This new test is the first simple method of detecting subdural catheter placement objectively.

The frequently employed test dose is intended to detect intravascular and subarachnoid catheter misplacement, but it may not detect subdural placement.<sup>2</sup> There are many examples of false positive and negative results associated with the standard test dose. Thus, the test dose is not used routinely in clinical practice. In this case, the test was omitted. However, we believe that the use of a test dose and careful aspiration in conjunction with this new test may improve safety and success rates of epidural anesthesia.

#### Acknowledgment

The authors would like to thank Ms. Betty Wong, Department of Radiological Imaging, University of Alberta Hospitals, for her assistance.

#### References

- 1 Lubenow T, Keh-Wong E, Kristof K, Ivankovich O, Ivankovich AD. Inadvertent subdural injection: a complication of an epidural block. *Anesth Analg* 1988; 67: 175-9.
- 2 Crosby ET, Halpern S. Failure of a lidocaine test dose to identify subdural placement of an epidural catheter. *Can J Anaesth* 1989; 36: 445-7.
- 3 Gershon RT. Surgical anaesthesia for Caesarean section with a subdural catheter. *Can J Anaesth* 1996; 43: 1068-71.
- 4 Bromage PR. Continuous epidural analgesia. *In: Bromage PR. Epidural Analgesia. Philadelphia: W.B. Saunders, 1978: 215-57.*
- 5 Collier CB. Accidental subdural block: four more cases and a radiographic review. *Anaesth Intensive Care* 1992; 20: 215-32.
- 6 Tsui BCH, Gupta S, Finucane B. Confirmation of epidural catheter placement using nerve stimulation. *Can J Anaesth* 1998; 45: 640-4.
- 7 Tsui BCH, Gupta S, Finucane B. Confirmation of epidural catheter placement using nerve stimulation in obstetric patients: the Tsui test. (Abstract) *Reg Anesth* 1998; 23(Suppl): 35.
- 8 Tsui BCH, Gupta S, Finucane B. Determination of epidural catheter location using nerve stimulation in obstetric patients. *Reg Anesth Pain Med* 1999; 24: 17-23.
- 9 Covino BG, Scott DB. Complications of epidural anaesthesia. *In: Covino BC, Scott DB, Handbook of Epidural Anaesthesia and Analgesia. Orlando: Grune & Stratton, Inc, 1985: 131-69.*
- 10 Shapiro R. Anatomy. *In: Shapiro R. Myelography, 3rd ed. Chicago: Year Book Medical Publishers Inc, 1975: 77-92.*