Brief Reports

Decreased incidence of complications in parturients with the Arrow (FlexTip Plus™) epidural catheter

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Purpose: To compare the incidence of complications during placement of Arrow (FlexTip Plus™) and Concord/Portex™ epidural catheters in parturients receiving continuous epidural analgesia.

Methods: Two hundred parturients requesting continuous epidural analgesia were prospectively and randomly assigned to receive either the Arrow (FlexTip Plus™) or the Portex epidural catheter. The incidences of paresthesiae, inadvertent venous cannulation and inability to thread the catheter into the epidural space were recorded.

Results: A total of 222 attempts at epidural placement occurred in the parturients enrolled. The Arrow catheter displayed a lower incidence of paresthesiae (3/112 vs 39/110, $P < 0.0001$) and venous cannulation (0/112 vs 11/110, $P = 0.0007$) than did the Portex catheter. The Portex catheter demonstrated a tendency towards increased inability to be advanced into the epidural space (5/110 vs 0/112, $P = 0.057$) in comparison to the Arrow catheter. When a Portex catheter would not advance into the epidural space ($n = 5$), an Arrow catheter was threaded successfully in all five cases without the need to reposition the Tuohy needle.

Conclusion: Compared with a less flexible catheter, the Arrow decreases the incidence of transient paresthesiae and inadvertent venous cannulation, while improving the ability to thread the catheter into the epidural space. Intravascular injection, transarachnoid migration, and the rare occurrence of epidural haematoma may be further reduced with the use of flexible, soft-tip catheters.

Objectif : Évaluer l'incidence des complications durant l'introduction de deux cathéters périduraux, le FlexTip Plus® d'Arrow et le cathéter de Concord/Portex®, chez des parturientes nécessitant une analgésie épidurale.

Méthodes : Deux cents parturientes demandant une analgésie péridurale ont été assignées aléatoirement et de façon prospective à deux groupes quant au cathéter utilisé, le FlexTip Plus® d'Arrow ou le cathéter Portex. On a colligé l'incidence des paresthésies, des canulations veineuses accidentelles et des incapacités à monter le cathéter dans l'espace.

Résultats : Un total de 222 essais d'introduction de cathéter ont été réalisés chez les parturientes de l'étude. Le cathéter Arrow a présenté une incidence plus faible de paresthésies (3/112 vs 39/110, $P < 0,0001$), de canulations veineuses (0/112 vs 11/110, $P = 0,0007$) ainsi que d'incapacité à monter le cathéter (0/112 vs 5/110, $P = 0,057$) que le cathéter Portex. En outre, dans les cinq cas où le cathéter Portex n'a pas voulu monter dans l'espace, le cathéter Arrow a été introduit avec succès sans besoin de repositionner l'aiguille de Tuohy.

Conclusion : Par comparaison avec un cathéter moins flexible, le cathéter d'Arrow diminue l'incidence de paresthésies transitoires et de canulations veineuses accidentelles, tout en améliorant la capacité de monter le cathéter dans l'espace péridural. L'injection intravasculaire, la migration sous arachnoïdienne et la survenue très rare d'un hématome épidural pourraient voir leur incidence encore réduite par l'utilisation de cathéters souples à bout mousse.

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Accepted for publication January 15, 1998.

SEVERAL complications can occur with epidural catheter placement, including transient paraesthesia and inadvertent venous cannulation. While causing no permanent neurological deficit, paraesthesia are unpleasant.¹ The reported incidence is as high as 44%² and is correlated to catheter type.^{3,4} Venous cannulation during epidural catheter placement occurs with a frequency of 1 to 12%.² Several authors have suggested that a less rigid catheter may lower the incidence of trauma to blood vessels.⁵

The Arrow Flextip Plus™ is an open-tip, single-orifice catheter constructed of a circumferential stainless steel coil impregnated in soft polyurethane. It is a more flexible design than our institution's standard catheter, the Concord/Portex™ blunt-tip nylon catheter with three lateral holes.

The purpose of this prospective, randomised, unblinded clinical trial was to compare the incidences of venous cannulation and transient paraesthesia in parturients receiving CEA with either the Arrow or the Portex epidural catheters.

Methods

Our Institutional Review Board decided that informed consent was unnecessary as both types of catheters were marketed medical appliances. During the authors' on-call periods from November, 1995 to March, 1996, all women in active labour were enrolled if requesting and having no contraindications to CEA. Prior to physician-patient contact, parturients were assigned by a computer-generated random number sequence to receive either the Arrow (#EC-05500) or Portex (#4910-16/17) catheter. Age, weight, height, gravidity, gestational age, platelet count, type of CEA maintenance, previous CEA, and complications were noted.

The patient was placed in the lateral decubitus or sitting position, depending on the anaesthetist's preference. After sterile preparation and subcutaneous infiltration with local anaesthetic, the L₂₋₃ or L₃₋₄ epidural space was located via a midline approach with a #17 gauge Tuohy needle using loss-of-resistance to air. The patient was warned about possible paraesthesia. After administering one millilitre CO₂ lidocaine through the needle, the assigned catheter was advanced five centimetres into the epidural space.

Paraesthesia were reported only if described by the patient during catheter placement as a "shock," or other transient sensation that radiated into the buttock(s) or leg(s). If the patient did not volunteer any sensation, she was questioned as to its occurrence. Venous cannulation was reported if blood was aspirated through the catheter. If cannulation occurred, then both catheter and needle were withdrawn together,

the epidural space resited, and a catheter inserted of the same type as that originally assigned.

After a test dose of 3 ml CO₂ lidocaine, analgesia was established with incremental doses of CO₂ lidocaine to a total of 8 to 12 ml. The CEA was maintained with either intermittent boluses of bupivacaine 0.25% 8–10 ml q1h prn or by an infusion protocol administering 8–14 ml·hr⁻¹ bupivacaine 0.125% and 2 µg·ml⁻¹ fentanyl.

Failed CEA and additional local anaesthetic bolus administration were also recorded to ascertain whether the difference in catheter design would affect success of the block.

Continuous data were analysed by Student's *t* test; categorical data were analysed by the Pearson Chi-Square test with the Fischer's exact test when appropriate.

Results

Ninety-seven parturients were enrolled in the Portex group and 103 in the Arrow group. The groups were similar in all demographic characteristics (see Table I).

Portex

Of the 97 parturients initially assigned to the Portex group, 82 catheters (85%) were inserted without difficulty. Two "failed" blocks required reinsertion and there were 11 instances (10%) of venous cannulation resulting in 110 attempts at Portex placement. There were 39 instances (35.5%) of paraesthesia and, in five cases, the Portex catheter would not thread into the epidural space. (5/110 *vs* 0/112, *P* = 0.057) (see Table II). When this occurred, the Tuohy needle was left in position and an Arrow catheter insertion was attempted. In all five cases, the Arrow passed easily into the epidural space. There was one inadvertent subarachnoid Portex placement.

Arrow

Of the 103 parturients initially assigned to the Arrow group, all were inserted easily into the epidural space. Four "failed" blocks required reinsertion, and five "inability to thread" Portex parturients changed group assignment resulting in 112 attempts at Arrow placement. The Arrow catheter displayed a lower incidence of paraesthesia (3/112 *vs* 39/110, *P* < 0.0001) and venous cannulation (0/112 *vs* 11/110, *P* = 0.0007) than did the Portex catheter. Five Arrow catheters were associated with a failed block including one subdural Arrow placement (5/112 *vs* 2/110, *P*: NS).

Discussion

The most important finding in this study was the zero incidence of venous cannulation in the Arrow group. Such a low incidence of venous cannulation has not been previously achieved in trials of other catheters.

TABLE I Demographic characteristics

Characteristic	Portex n = 97	Arrow n = 103
Age (yr)	28 ± 5	29 ± 6
Weight (kg)	79 ± 14	80 ± 15
Height (cm)	162 ± 7	163 ± 7
Gravidity	2.1 ± 1.3	2.0 ± 1.2
Gestational Age (wk.)	38.9 ± 2.7	38.9 ± 3.0
Platelet Count (n × 10 ³)	233 ± 54	226 ± 85
Previous CEA	41 (42.6)	47 (45.6)
Infusion	14 (14.4)	10 (9.7)
Premedication	3 (3.1)	5 (4.9)

Mean ± SD (%). There were no significant differences between the two groups.

TABLE II Complications at catheter placement

Characteristic	Portex n = 110	Arrow n = 112	P
Paraesthesia	39 (35.5)	3 (2.7)	0.0007
Venous cannulation	11 (10.0)	0 (0.0)	0.0001
Inability to thread	5 (4.5)	0 (0.0)	0.057
Other	1 (0.9)*	1 (0.9)†	

*clinical subarachnoid catheter placement and PDPH.

†clinical subdural catheter placement, no PDPH.

The values in parentheses refer to percent. The incidences of paraesthesia and venous cannulation as lower in the Arrow group.

The 2.7% incidence of paraesthesia in the Arrow group is similar to the 2.2% incidence noted by Junega *et al.*³ In the Portex group, the incidence of 35.5% paraesthesia and 10% venous cannulation are both consistent with previous reports.²

Factors which independently increase catheter stiffness include increased outside diameter, wall thickness, and the elastic property of the catheter material(s).^{6,7} As these factors are independent, a comparably flexible catheter can be constructed of a stiffer material, for example, by decreasing either the outside diameter or the wall thickness. The Arrow's design utilises a soft polyurethane polymer which has greater elasticity than the nylon in the Portex. Reinforcement with a circumferential steel coil allows a reduction in catheter wall diameter further increasing flexibility, yet providing comparable tensile strength.⁸

Five of the Portex catheters could not be advanced into the epidural space despite correct placement of the Tuohy needle. Rather than relocate the epidural space, an Arrow was threaded successfully in all five cases. The flexibility of the catheter may afford it an advantage in exiting the Tuohy needle in the presence of obstructing epidural structures.

Hardy has shown that epidural catheters cannot penetrate the dura mater, but can easily penetrate the arachnoid and acknowledges the potential for transarachnoid

migration of catheters in the subdural space.¹¹ Flexible catheters, such as the Arrow, should decrease the incidence of arachnoid penetration secondary to reduced tip forces during catheter placement, as well as decreasing the incidence of transarachnoid migration while *in situ*.

In summary, the Arrow catheter reduces the incidence of transient paraesthesia and inadvertent venous cannulation compared with a nylon catheter. When the risk-benefit ratio dictates, the Arrow catheter may be useful in patients with borderline coagulopathies. The inability to advance the catheter into the epidural space, as well as the incidence of transvascular migration, transarachnoid migration, and the rare occurrence of epidural haematoma may be decreased with this flexible catheter.

Acknowledgments

The authors would like to thank the labour and delivery room nursing staff involved in the care of the study patients, as well as M. Louis Lauzon for his translation of the Japanese articles in Masui.

References

- 1 Hetherington R, Stevens RA, White JL, Spitzer L, Koppel S. Subjective experiences of anesthesiologists undergoing epidural anesthesia. *Reg Anesth* 1994; 19: 284-8.
- 2 Rolbin SH, Hew E, Ogilvie G. A comparison of two types of epidural catheters. *Can J Anaesth* 1987; 34: 459-61.
- 3 Juneja M, Kargas GA, Miller DL, *et al.* Comparison of epidural catheters induced paresthesia in parturients. *Reg Anesth* 1995; 20(Suppl): 152.
- 4 Kobayashi KN. A comparison of 7 types of epidural catheters. *Masui* 1990; 39: 335-42.
- 5 Verniquet AJW. Vessel puncture with epidural catheters. Experience in obstetric patients. *Anaesthesia* 1980; 35: 660-2.
- 6 Hardy PAJ. Force exerted by epidural catheters. *Anaesthesia* 1986; 41: 306-8.
- 7 Stenquist O, Curelaru I, Linder L-E, Gustavsson B. Stiffness of central venous catheters. *Acta Anaesthesiol Scand* 1983; 27: 153-7.
- 8 Blum S, Sosis M. An investigation of the comparative strengths of 19 gauge epidural catheters. *Reg Anesth* 1995; 20(Suppl): 157.
- 9 Michael S, Richmond MN, Birks RJS. A comparison between open-end (single hole) and closed-end (three lateral holes) epidural catheters. *Anaesthesia* 1989; 44: 578-80.
- 10 Spriggs LE, Vasdev GM, Leicht CH. Clinical evaluation of wire impregnated epidural catheter with standard epidural catheter for labor analgesia. *Reg Anesth* 1995; 20(Suppl): 154.
- 11 Hardy PAJ. Can epidural catheters penetrate dura mater? An anatomical study. *Anaesthesia* 1986; 41: 1146-7.