

Single-dose intrathecal analgesia to control labour pain

Is it a useful alternative to epidural analgesia?

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ABSTRACT

OBJECTIVE To examine the safety and efficacy of single-dose spinal analgesia (intrathecal narcotics [ITN]) during labour.

QUALITY OF EVIDENCE MEDLINE was searched and the references of 2 systematic reviews and a meta-analysis were reviewed to find articles on obstetric analgesia and pain measurement. The 33 articles selected included 14 studies, 1 meta-analysis, and 2 systematic reviews, all providing level I evidence.

MAIN MESSAGE The literature supports use of ITN as a safe and effective alternative to epidural anesthesia. The recent decrease in rates of episiotomies and use of forceps during deliveries means patients require less dense perineal anesthesia. The advantage of single-dose ITN is that fewer physicians and nurses are needed to administer it even though its safety and effectiveness are comparable with other analgesics. Use of ITN is associated with a shorter first stage of labour and more rapid cervical dilation. A combination of 2.5 mg of bupivacaine, 25 µg of fentanyl, and 250 µg of morphine intrathecally usually provides a 4-hour window of acceptable analgesia for patients without complications not anticipating protracted labour. The evolution in dosing of ITN warrants a re-examination of its usefulness in modern obstetric practice.

CONCLUSION Physicians practising modern obstetrics in rural and small urban centres might find single-dose ITN a useful alternative to parenteral or epidural analgesia for appropriately selected patients.

RÉSUMÉ

OBJECTIF Examiner l'innocuité et l'efficacité d'une dose unique d'analgésie rachidienne (injection intrathécale de narcotiques [ITN]) durant le travail.

QUALITÉ DES PREUVES On a consulté MEDLINE et les bibliographies de 2 revues systématiques et d'une méta-analyse, à la recherche d'articles sur l'analgésie obstétricale et sur la mesure de la douleur. Les 33 articles retenus comprenaient 14 études, une méta-analyse et 2 revues systématiques, toutes basées sur des preuves de niveau I.

PRINCIPAL MESSAGE La littérature montre que l'ITN représente une alternative sécuritaire et efficace à l'anesthésie épidurale. La récente diminution du recours à l'épisiotomie et aux forceps durant l'accouchement signifie que les patientes requièrent moins d'anesthésie périnéale. L'avantage de l'ITN en dose unique est que son administration requiert moins de médecins et d'infirmières, tout en étant aussi sécuritaire et efficace que les autres analgésiques. Avec l'ITN, le premier stade du travail est plus court et la dilatation cervicale plus rapide. Une combinaison de 2,5 mg de bupivacaine, de 25 µg de fentanyl et de 250 µg de morphine intrathécaux procure habituellement une analgésie suffisante pendant 4 heures chez les patientes sans complications pour lesquelles on ne prévoit pas de travail prolongé. Il faudra réévaluer l'utilité des doses d'ITN utilisées dans le cadre de la pratique obstétricale moderne.

CONCLUSION Les médecins qui pratiquent une obstétrique moderne dans les petits centres urbains ou en milieu rural pourraient trouver que l'ITN en dose unique est une alternative intéressante à l'analgésie parentérale ou épidurale pour certaines patientes.

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Providing high-quality analgesia for Canadian women in labour in small community hospitals is a challenge. In rural areas and smaller urban centres, epidural services are often unavailable.^{1,2} Parenteral narcotics, nitrous oxide, regional anesthesia, and other analgesics are commonly used.

The literature indicates that intrathecal narcotics (ITN) can be used effectively and economically for intrapartum care when pain control is required. Intrathecal narcotics have the potential to play a much larger role in managing obstetric anesthesia. Our rural obstetric and anesthesia programs (300 deliveries annually) have integrated it successfully into practice during the past 3 years. Any discussion of medication during labour should recall the comments of Lurie and Priscu in their 1993 review of the topic: "...effective pain relief does not ensure a satisfactory birth experience ... attention, sympathy, reassurance and support are superior. ..."³

Quality of evidence

MEDLINE was searched using the MeSH terms spinal anesthesia, spinal injections, labour, obstetrical anesthesia, obstetrical delivery, obstetrical analgesia, opioid analgesia, epidural analgesia, pain measurement, pregnancy, fentanyl, morphine. The references of 2 systematic reviews were considered. Thirty-three articles were selected as relevant for content focused on ITN and for appropriate rigorous methodology. Level I studies included 2 systematic reviews, 1 meta-analysis, and 14 randomized blinded studies. Four observational studies without control groups provided level II evidence. Other articles were opinion pieces or government or organizational reports providing level III evidence.

Levels of evidence

Level I: At least one properly conducted randomized controlled trial, systematic review, or meta-analysis

Level II: Other comparison trials, non-randomized, cohort, case-control, or epidemiologic studies, and preferably more than one study

Level III: Expert opinion or consensus statements

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Main message

Changing obstetric practice. Opioids have been used intermittently for centuries to alleviate pain during labour. By 1915, the Ottawa Maternity Hospital was using chloroform in 75% of deliveries,⁴ but by the end of the century, epidurals were chosen for 45% of women in labour.⁴ No statistics on use of ITN, patient-controlled analgesia using narcotics, nitrous oxide, or pudendal blocks exist in Canada.

The last 20 years have seen a dramatic change in obstetric practice. Assisted outlet deliveries are now routinely done with the less traumatic vacuum extraction.⁴ In the 1990s, forceps use fell from 11% to 6% and episiotomies fell from 49% to 24%.⁵ This resulted in a substantial reduction in somatic discomfort during the second stage of labour for many women. Studies of ITN in the 1980s, which concluded that ITN delivered inadequate anesthesia, often had 100% rates of routine use of both episiotomies and forceps.⁶ Since our delivery methods have become more "perineal friendly," simple spinal anesthesia can be effective for many deliveries.⁷

Physiology. Pain associated with the first stage of labour is considered visceral in origin. Narcotics delivered by spinal or epidural methods function at the same site in the spinal cord. Interestingly, the analgesic properties of ITN are not affected by narcotic antagonists given by other routes.^{8,9} Pain during the second stage of labour is a combination of visceral and somatic pain from distention and tearing of the perineal tissues. Intrathecal narcotics are not particularly effective for this pain, but local anesthetic agents, such as bupivacaine, are beneficial and can be added to spinal "cocktails."

Effectiveness. Results of studies on ITN are shown in **Table 1**¹⁻²⁹. Intrathecal sufentanil (10 µg) appears to have a faster onset and longer duration of action than bupivacaine (30 mg), but otherwise the 2 drugs provide comparable levels of analgesia (level I evidence).¹⁰ In a study of 133 patients, Bucklin et al concluded that, 15 to 20 minutes after the injection, there was no significant difference in the pain experiences of patients who received ITN and those who received epidural local anesthesia (level I evidence).²⁴

When Leighton et al used intrathecal fentanyl and morphine, all the participating nulliparous women said they were "satisfied with their analgesia and would like to receive intrathecal analgesia during future labour."⁸ Some multiparous patients said they preferred ITN analgesia to the epidural anesthesia they had received during previous labours. This finding is similar to those of several other studies that also reported a high level of patient satisfaction with ITN (level I evidence).⁷⁻⁹ The American Society of Anesthesiologists' guidelines suggest that analgesia provided by ITN is equivalent to epidural local anesthesia.³⁰

Table 1. Studies on analgesia for managing labour pain

AUTHORS	LEVEL OF EVIDENCE	N	STUDY OBJECTIVE	FINDINGS
Leighton and Halpern ¹² (2002)	I	4324	Epidural analgesia vs parenteral opioids (systematic review)	Epidural analgesia was associated with hypotension, maternal fever, longer second-stage labour, more use of oxytocin, and more satisfied mothers
Mardirosoff et al ²⁷ (2002)	I	3513	Intrathecal opioids (fetal bradycardia) (systematic review)	Increase in risk of fetal bradycardia, but no increase in rate of cesarean sections
Howell ²³ (2005)	I	3157	Epidural vs nonepidural analgesia (Cochrane systematic review)	Epidural relieves pain better, but labour lasts longer, and there is more fetal malpositioning, oxytocin use, and instrument deliveries
Wong et al ²¹ (2005)	I	728	Intrathecal fentanyl vs intravenous hydromorphone	Time from analgesia initiation to complete dilation was 90 min shorter with ITN. There was less pain and better Apgar scores
Bucklin et al ²⁴ (2002)	I	333	Intrathecal opioids vs epidural local anesthetics (meta-analysis)	ITN increased pruritus. No difference in nausea or method of delivery
Wong et al (2000)	I	170	Intrathecal bupivacaine plus sufentanil (various doses)	Similar analgesia with all doses; fewer side effects with less sufentanil. Bupivacaine prolongs analgesia
Pace et al ¹⁹ (2004)	I	111	Intrathecal bupivacaine plus fentanyl vs pudendal block (mepivacaine)	ITN patients much more satisfied with pain relief
Yeh et al ²⁹ (2001)	I	95	Intrathecal fentanyl plus bupivacaine with or without morphine	Morphine increases duration of analgesia
Hess et al ¹³ (2003)	I	60	Intrathecal fentanyl (12.5 µg) plus bupivacaine (2 mg) with or without morphine (125 µg)	Morphine did not prolong analgesia, but after delivery, morphine patients had less pain
Harsten et al ²⁰ (1997)	I	58	Intrathecal sufentanil vs epidural bupivacaine	ITN gave more rapid onset and good analgesia and was often advantageous
D'Angelo et al ¹⁰ (1994)	I	50	Intrathecal sufentanil vs epidural bupivacaine	Rapid onset and lack of motor block with ITN; side effects should be monitored
Campbell et al ¹⁵ (1995)	I	43	Intrathecal bupivacaine vs intrathecal sufentanil vs combination	Adding bupivacaine to sufentanil prolonged analgesia. Fast onset
Grieco et al ¹⁷ (1993)	I	41	Sufentanil with or without epinephrine or morphine	Morphine prolongs analgesia better than epinephrine
Viscomi et al ¹¹ (1997)	I	41	Early vs advanced labour at time of intrathecal sufentanil plus bupivacaine	Longer duration of action when given early in labour
Abboud et al ²⁶ (1984)	I	30	Intrathecal morphine (various doses)	More side effects with higher dose. Delayed onset, but long duration of action
Cascio et al ¹⁴ (1997)	I	24	Intrathecal fentanyl vs epidural lidocaine	Both give similar pain relief
Baraka et al ⁶ (1981)	I	20	Intrathecal morphine (various doses) plus lidocaine	Slow onset, long duration of action, no motor block, little effect on fetus
Lieberman and O'Donoghue ²² (2002)	I	NA	Epidural (unintended effects) (systematic review)	Fewer spontaneous and more instrumental vaginal deliveries, longer labours, higher rates of intrapartum fever and septic infants
Herpolsheimer and Schretenthaler ⁷ (1994)	II	150	Intrathecal fentanyl plus morphine	ITN gives good pain relief with rapid onset lasting 4–5 hours without disrupting labour
Zapp and Thorne ⁹ (1995)	II	150	Intrathecal morphine plus fentanyl plus naltraxone	ITN well accepted, cost-saving, and very effective for labour analgesia

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AUTHORS	LEVEL OF EVIDENCE	N	STUDY OBJECTIVE	FINDINGS
Fontaine et al ²⁵ (2002)	II	82	Intrathecal morphine plus fentanyl vs epidural bupivacaine plus fentanyl	ITN patients had higher pain and lower satisfaction scores, but ITN was good for women who delivered within 2-3 hours
Carton et al ¹⁶ (1987)	II	24	Intrathecal morphine	ITN provides effective analgesia during labour
Leighton et al ⁸ (1989)	II	15	Intrathecal fentanyl plus morphine	Simple ITN technique was often advantageous
CIHI ⁵ (2004)	III	NA	Giving Birth in Canada: Providers of Maternity and Infant Care	Demographics
CIHI ⁴ (2004)	III	NA	Giving Birth in Canada: A Regional Profile	Demographics
Leslie ² (2000)	III	NA	ITN (review)	ITN improves pain control in rural maternity centres with no full-time epidural services
Lurie and Priscu ³ (1993)	III	NA	Epidurals (review)	Supplementing with opioids (fentanyl) and patient-controlled epidural anesthesia are recommended
SRPC, CFPC, CAS ¹ (2001)	III	NA	Joint Position Paper on Training for Rural Family Physicians in Anesthesia	Anesthesia close to home. Family physician anesthesiologists require support
Vasdev and Keegan ²⁸ (1998)	III	NA	Sufentanil (review)	Good analgesia, no motor block

CAS—Canadian anesthesiologists' Society, CIHI—Canadian Institute for Health Information, CFPC—College of Family Physicians of Canada, ITN—intrathecal narcotics, NA—not applicable, SRPC—Society of Rural Physicians of Canada.

Onset and duration of action. Lipid-soluble ITN (fentanyl, sufentanil) take effect in only 5 minutes.¹³⁻¹⁵ Morphine, a water-soluble agent, takes effect in 20 to 30 minutes when administered intrathecally.^{6,16}

Duration of action is a considerable limiting factor of ITN. A 25-µg dose of fentanyl lasts 60 to 90 minutes.¹⁷ A 10-µg dose of sufentanil lasts about 2 hours.¹⁰ Synergy has been noted between 10 µg of intrathecal sufentanil¹⁸ or 25 µg of fentanyl¹⁹ and 2.5 mg of bupivacaine, with analgesia lasting about 3 hours (level I evidence).¹⁸

Due to its water solubility, morphine has a much longer duration of action when administered intrathecally. Early studies with high doses (2 mg) showed good analgesia that lasted 8 hours, but there were many side effects.⁸ Current doses around 0.2 mg give good analgesia that lasts more than 4 hours, especially when combined with 25 µg of fentanyl.⁷ There are fewer side effects at this much lower dose,⁸ which can also relieve lesser postpartum pain for more than 8 hours (level I evidence).¹³

Unfortunately, patients develop substantial tachyphylaxis to ITN. Repeat doses of narcotics result in little ongoing benefit.²⁰ For cesarean sections, repeat intrathecal injection of the local anesthetic without the narcotic component is still effective.⁹ A 1995 cohort study of 150 patients given ITN (morphine and fentanyl) noted that none of the 13 patients who successfully went on to have cesarean sections with repeat spinal injections got spinal headaches (level II evidence).⁸

Effects on labour. An exciting development in obstetric analgesia in the last year has been the observation that fentanyl injected into the intrathecal space seems to cause more rapid cervical dilation and to shorten the first stage of labour by as much as 100 minutes (level I evidence).²¹ In contrast, epidurals have long been associated with increased oxytocin use, increased fetal malposition, lower rates of spontaneous vaginal delivery, higher rates of instrumental delivery, longer labours, more intrapartum maternal fever, and more neonatal treatment for sepsis (level I evidence).^{22,23}

Intrathecal narcotics do not affect ambulation (level I evidence).⁶ When compared with intravenous analgesia, they seem to cause less nausea and to be associated with high Apgar scores and good neonatal outcomes (level I evidence).²¹

Side effects. Intrathecal narcotics commonly cause pruritus that can be treated with oral, intramuscular, or intravenous narcotic antagonists that do not affect analgesia levels (level I evidence).^{10,11,17} Nausea has often been attributed to ITN, but the meta-analysis by Bucklin et al²⁴ and the systematic review of epidural and intrathecal analgesia by Leighton and Halpern¹² found no difference in the incidence of nausea (level I evidence). Nausea associated with intrathecal morphine has been effectively prevented with a single dose of oral naltrexone (12.5 to 25 mg), a long-acting narcotic antagonist (level

I evidence).^{8,9,25} Studies of urinary retention have conflicting results, but do not cause concern.^{12,26} Respiratory depression has been reported occasionally, usually in the context of concurrent parenteral narcotic administration or use of water-soluble intrathecal morphine, or in otherwise compromised patients (level II evidence).^{9,16} Respiratory depression can be managed with routine narcotic antagonists.^{7,16} These side effects were described when narcotic doses were approximately 10 times higher than those we currently use. Lowering the dose of morphine from 2.0 mg to 0.2 mg has reduced or eliminated many of these side effects and has not lessened the effect of the analgesia (level I evidence).^{6,26}

A systematic review in 2002 by Mardirosoff et al confirmed an association between ITN and fetal bradycardia with a number-needed-to-harm of 28.²⁷ This did not lead to any changes in instrumental deliveries, number of cesarean sections, or neonatal Apgar abnormalities (level I evidence).²⁷

Substantial risk of postprocedure puncture headaches was described when larger needles were used.^{17,30,31} Current use of 25-gauge cone-tipped needles has reduced the incidence of headaches to about 1%.³²

How to use intrathecal analgesia. An excellent approach has been described by Leslie.² Intrathecal analgesia should be characterized as a single treatment that attempts to achieve a 4-hour window of ambulatory pain control for labouring women. Patients can be either primiparous or multiparous. Repeat ITN injections are ineffective due to narcotic tachyphylaxis.

If later in labour patients require subsequent spinal or epidural anesthesia for cesarean sections, there are no contraindications. We use the classic lumbar puncture technique, generally with patients seated and bent forward, using a 25-gauge cone-tipped needle. Once the dura has been punctured and backflow is evident, the injection syringe should be attached to the needle, the mixture injected, and the needle withdrawn.

Fentanyl is chosen because of its rapid onset of action of 5 minutes (level I evidence).¹³⁻¹⁵ Bupivacaine is added to help with the somatic pain of second-stage labour (level I evidence).¹⁹ Morphine prolongs the analgesia²⁹ more effectively than epinephrine (level I evidence).¹⁷ We have found that this low-dose combination (fentanyl 25 µg, bupivacaine 2.5 mg, and morphine 250 µg) in one injection provides up to 4 hours of ambulatory pain control. Pruritus and nausea can be treated with oral, intramuscular, or intravenous naltrexone (or naloxone); nausea can also be treated with metoclopramide.

Conclusion

Since obstetric delivery has become less invasive, the challenge is to develop appropriate corresponding changes in analgesia practices. Single-dose ITN have been shown to relieve pain safely in most labouring

EDITOR'S KEY POINTS

- In many small rural communities, epidural anesthesia is unavailable to labouring women. An alternative, intrathecal narcotics (ITN) using traditional lumbar puncture technique, has been shown to provide good anesthesia with few side effects for about 4 hours.
- A cocktail of several drugs permits rapid and prolonged action: fentanyl works within 5 minutes; a local anesthetic, such as bupivacaine, lasts for up to 3 hours; and morphine, even in low doses, lasts up to 4 hours.
- Use of ITN has the benefits of not interfering with ambulation and of bringing on a more rapid first stage of labour. Common side effects are pruritus and nausea that can be managed with narcotic antagonists (eg, naltrexone). About 1% of patients have postprocedure headaches when 25-g cone-tipped needles are used.
- A repeat dose of ITN (narcotics are not effective after the first dose) can be given later if patients subsequently require cesarean section or an instrumental delivery.

POINTS DE REPÈRE DU RÉDACTEUR

- Dans plusieurs petites collectivités rurales, les femmes n'ont pas accès à l'anesthésie épidurale au cours du travail. L'injection intrathécale de narcotiques (ITN) par ponction lombaire traditionnelle est une alternative qui s'est révélée efficace pour procurer une anesthésie d'environ 4 heures avec peu d'effets indésirables.
- Un cocktail de plusieurs médicaments permet une action rapide et prolongée: le fentanyl agit en moins de 5 minutes; l'effet de la bupivacaine dure jusqu'à 3 heures; et celui de la morphine, jusqu'à 4 heures, même en dose faible.
- L'utilisation de l'ITN a l'avantage de ne pas interférer avec la mobilité et de raccourcir le premier stade du travail. Les effets indésirables fréquents sont le prurit et les nausées, qu'on peut traiter avec des antagonistes des narcotiques (par ex. le naltrexone). Environ 1% des patientes présentent des céphalées post-ponction lorsqu'on utilise des aiguilles 25 à bout conique.
- Lorsqu'une césarienne ou le recours à des instruments devient nécessaire, on peut administrer une nouvelle dose d'ITN (une deuxième dose de narcotique n'est toutefois pas efficace).

women, who report they are highly satisfied with this method of pain control. Intrathecal narcotics are limited by their duration of action, so are unsuitable for patients with complications who anticipate protracted labours.

In resource-challenged settings, single-dose ITN might make the best use of limited physician and nursing

resources. The spinal anesthetic technique is identical to a lumbar puncture; both lie within the scope of experienced general practitioners. We are developing a program to encourage family physicians to provide this service.



Competing interests

None declared

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