

Case Series

Effect of oral 25% dextrose on early post-procedural pain following lumbar puncture in neonates assessed using the neonatal infant pain scale: a prospective case series

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ABSTRACT

Lumbar puncture is a painful but essential diagnostic procedure in neonates. Although oral sweet solutions are established non-pharmacological analgesics for neonatal procedural pain, evidence specifically addressing oral 25% dextrose during lumbar puncture is limited. This prospective case series included 15 term neonates undergoing diagnostic lumbar puncture. Each infant received 2 ml of oral 25% dextrose 2 minutes before the procedure, with facilitated tucking maintained throughout. Behavioural pain was assessed using the neonatal infant pain scale (NIPS) at baseline, 1 minute, and 2 minutes after completion of the procedure. The mean NIPS score was 0.40 ± 0.63 at baseline, increased to 2.73 ± 0.70 at 1 minute after lumbar puncture, and decreased to 1.33 ± 0.62 at 2 minutes. At 1 minute, 10 neonates (66.7%) had NIPS scores of 0–2 and 5 (33.3%) had scores of 3–4; no neonate had a score ≥ 5 . At 2 minutes, all 15 neonates (100%) had NIPS scores of 0–2. These findings indicate a transient early post-procedural behavioural pain response followed by a reduction in NIPS scores within 2 minutes among neonates who received oral 25% dextrose with facilitated tucking. Because there was no control group, the observed response cannot be attributed to dextrose alone. Nevertheless, the findings provide preliminary procedure-specific evidence supporting the feasibility of oral 25% dextrose as a simple adjunct to comfort measures during neonatal lumbar puncture and support further controlled evaluation.

Keywords: Neonate, Oral dextrose, Lumbar puncture, Procedural pain, Neonatal infant pain scale, Analgesia

INTRODUCTION

Pain management is an important component of neonatal care because newborn infants undergo numerous diagnostic and therapeutic procedures that can produce significant behavioural and physiological responses. Neonates possess functional nociceptive pathways and are capable of experiencing pain, while repeated untreated painful exposure has been associated with adverse short- and long-term effects.^{1,2} Therefore, appropriate assessment and management of neonatal procedural pain are essential components of quality neonatal care.

Lumbar puncture (LP) is commonly performed in neonates for the evaluation of suspected meningitis, sepsis, and other central nervous system infections. Although brief, LP is an invasive procedure that can produce pain and behavioural distress. Assessment is challenging because neonates cannot verbally communicate their experience. The neonatal infant pain scale (NIPS) is a behavioural pain assessment tool that evaluates facial expression, cry, breathing pattern, arm and leg movements, and state of arousal and has been used for assessment of acute neonatal procedural pain.³

Oral sweet solutions are widely used as non-pharmacological analgesics for neonatal procedural pain.

Evidence from heel lance, venepuncture, and other minor procedures has demonstrated reductions in behavioural pain responses following oral glucose or sucrose.^{4-6,10} However, evidence specifically addressing oral 25% dextrose during neonatal lumbar puncture remains limited. A recent randomized clinical trial evaluating 25% oral sucrose before lumbar puncture reported lower post-procedural pain responses compared with sterile water, providing procedure-specific evidence for sweet-solution analgesia.⁷

The present prospective case series was undertaken to describe the early post-procedural behavioural pain response in term neonates receiving 2 ml of oral 25% dextrose before lumbar puncture, assessed using NIPS.

CASE SERIES

This prospective case series was conducted in the Neonatal Intensive Care Unit after approval from the Institutional Ethics Committee. Written informed consent was obtained from the parents or legal guardians of all enrolled neonates. Fifteen consecutive term (≥ 37 weeks), appropriate-for-gestational-age, haemodynamically stable neonates requiring diagnostic lumbar puncture were included. Preterm neonates, critically ill infants, those with major congenital anomalies, prior analgesic or sedative exposure, or contraindications to lumbar puncture or oral dextrose were excluded.

Each neonate received 2 ml of oral 25% dextrose administered slowly 2 minutes before lumbar puncture. The procedure was performed under standard aseptic precautions by a paediatric resident while a trained neonatal care provider maintained facilitated tucking throughout. Behavioural pain was assessed using NIPS, a six-parameter scale with a total score ranging from 0 to 7, with higher scores indicating greater behavioural pain. For the purpose of this case series, NIPS scores of 0–2, 3–4, and ≥ 5 were categorized as no/minimal, mild–moderate, and significant behavioural pain, respectively. NIPS assessments were performed 1 minute before lumbar puncture, 1 minute after completion of the procedure (after withdrawal of the needle), and 2 minutes after needle withdrawal. Heart rate, respiratory rate, and oxygen saturation were monitored continuously during the procedure.

At baseline, the mean NIPS score was 0.40 ± 0.63 . One minute after lumbar puncture, the mean NIPS score increased to 2.73 ± 0.70 . Ten neonates (66.7%) had scores of 0–2, while five (33.3%) had scores of 3–4; no neonate had a score ≥ 5 . At 2 minutes after lumbar puncture, the mean NIPS score decreased to 1.33 ± 0.62 , and all 15 neonates (100%) had scores of 0–2.

Individual case-level observations are summarized in aggregate in Table 1 in accordance with the journal's requirement.

Table 1: Distribution of NIPS pain categories at each assessment time point.

Assessment time	NIPS 0–2 no/minimal pain, N (%)	NIPS 3–4 mild–moderate pain, N (%)	NIPS ≥ 5 significant pain, N (%)
Baseline (1 min before LP)	15 (100.0)	0 (0.0)	0 (0.0)
1 min after LP	10 (66.7)	5 (33.3)	0 (0.0)
2 min after LP	15 (100.0)	0 (0.0)	0 (0.0)

Mean $\pm$ SD NIPS score: 0.40 ± 0.63 at baseline; 2.73 ± 0.70 at 1 minute after LP; 1.33 ± 0.62 at 2 minutes after LP, denominator=15 neonates

DISCUSSION

The present case series observed a transient increase in behavioural pain scores after lumbar puncture, followed by a reduction in NIPS scores within 2 minutes among neonates who received oral 25% dextrose with facilitated tucking. The baseline mean NIPS score was low (0.40 ± 0.63), and all 15 neonates were in the predefined no/minimal pain category before the procedure. This establishes a low pre-procedural behavioural pain state against which the post-procedural response can be interpreted. The NIPS was developed as a behavioural measure for neonatal pain assessment and incorporates facial expression, cry, breathing pattern, limb movement, and arousal state.³

At 1 minute after lumbar puncture, the mean NIPS score increased to 2.73 ± 0.70 . Despite this increase, 10 of 15 neonates (66.7%) remained in the no/minimal pain category and 5 (33.3%) had mild–moderate behavioural pain; none had a score ≥ 5 . These findings are broadly

consistent with the recent randomized clinical trial by Motlagh et al which evaluated 2 ml of 25% oral sucrose administered 2 minutes before lumbar puncture and found a lower post-procedural pain response compared with sterile water.⁷ The intervention in that trial was sucrose rather than dextrose and the study had a control group; therefore, its numerical findings cannot be directly equated with the present results. Nevertheless, the similar timing, volume, concentration, procedure, and use of NIPS provide relevant procedure-specific comparison.

Evidence from other neonatal procedures also supports the analgesic potential of oral sweet solutions. Carbajal et al. demonstrated analgesic effects of both glucose and sucrose in term neonates, supporting the concept that the sweet stimulus itself contributes to reduction of procedural pain.⁴ Haouari et al and Skogsdal et al similarly reported beneficial effects of oral sucrose or glucose during heel lance and venepuncture.^{5,6}

The Cochrane review by Stevens et al concluded that sucrose reduces pain responses associated with single painful procedures in newborn infants.¹⁰ These studies involve different procedures and outcome measures and therefore are not direct numerical comparators for the present NIPS findings, but they provide supportive evidence for the broader use of oral sweet solutions in neonatal procedural pain management.

The choice of 25% dextrose in the present case series was pragmatic and supported by neonatal procedural analgesia literature. Jatana et al compared 10%, 25%, and 50% glucose during heel puncture and reported greater analgesic effects with 25% and 50% glucose than with 10%, with no clear additional benefit of 50% over 25%.⁸ Thus, 25% represents a practical concentration with established use in neonatal procedural analgesia without implying that it is universally superior to other concentrations. The mechanism of sweet-solution analgesia is thought to involve activation of oral sweet-taste pathways and endogenous pain-modulating mechanisms, although the precise contribution of systemic glucose effects remains incompletely defined.⁴⁻⁶

At 2 minutes after lumbar puncture, the mean NIPS score decreased to 1.33 ± 0.62 , and all 15 neonates (100%) had scores of 0–2. This indicates that the measurable behavioural response had diminished rapidly in the immediate post-procedural period. The randomized lumbar puncture study using 25% sucrose also demonstrated attenuation of post-procedural pain responses after the procedure, although its controlled design provides stronger evidence regarding treatment effect than the present uncontrolled case series.⁷

The present findings therefore provide preliminary procedure-specific observations regarding oral 25% dextrose during neonatal lumbar puncture rather than definitive evidence of efficacy.

Limitations

An important consideration is that facilitated tucking was maintained throughout the procedure. Therefore, the reduction in NIPS scores cannot be attributed to oral dextrose alone. The absence of a control group, small sample size, and use of a behavioural pain scale further limit causal interpretation. Heart rate, respiratory rate, and oxygen saturation were monitored, but numerical physiological outcomes were not presented in the available dataset; accordingly, no conclusion regarding physiological changes should be drawn from these variables.

These limitations should be considered when interpreting the findings and support the need for adequately powered randomized controlled studies comparing 25% dextrose with placebo, sucrose, or other established analgesic strategies during neonatal lumbar puncture.

CONCLUSION

In this prospective case series of 15 term neonates, administration of 2 ml of oral 25% dextrose 2 minutes before lumbar puncture was associated with a transient increase in NIPS scores followed by a reduction to the no/minimal pain category within 2 minutes. No neonate had a NIPS score ≥ 5 at 1 or 2 minutes after the procedure. Although the uncontrolled design and concurrent facilitated tucking prevent attribution of the observed response to dextrose alone, the study provides preliminary procedure-specific observations supporting the feasibility of oral 25% dextrose as an adjunct to non-pharmacological comfort measures during neonatal lumbar puncture. These findings add to the limited literature on sweet-solution use during lumbar puncture and provide a basis for controlled studies evaluating its independent analgesic efficacy.

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