

Pain Management in the NICU

References

- Aldrink, J. H., M. Ma, W. Wang, D. A. Caniano, J. Wispe and T. Puthoff (2011). "Safety of ketorolac in surgical neonates and infants 0 to 3 months old." J Pediatr Surg **46**(6): 1081–1085.
- Allegaert, K., G. Naulaers, S. Vanhaesebrouck and B. J. Anderson (2013). "The paracetamol concentration-effect relation in neonates." Paediatr Anaesth **23**(1): 45–50.
- Anand, K. J., B. A. Barton, N. McIntosh, H. Lagercrantz, E. Pelausa, T. E. Young and R. Vasa (1999). "Analgesia and sedation in preterm neonates who require ventilatory support: results from the NOPAIN trial. Neonatal Outcome and Prolonged Analgesia in Neonates." Arch Pediatr Adolesc Med **153**(4): 331–338.
- Anand, K. J. and D. B. Carr (1989). "The neuroanatomy, neurophysiology, and neurochemistry of pain, stress, and analgesia in newborns and children." Pediatr Clin North Am **36**(4): 795–822.
- Anand, K. J., R. W. Hall, N. Desai, B. Shephard, L. L. Bergqvist, T. E. Young, E. M. Boyle, R. Carbajal, V. K. Bhutani, M. B. Moore, S. S. Kronsberg and B. A. Barton (2004). "Effects of morphine analgesia in ventilated preterm neonates: primary outcomes from the NEOPAIN randomised trial." Lancet **363**(9422): 1673–1682.
- Baserga, M. C., T. M. Bahr, M. J. Yang, C. Rau, T. L. DuPont, B. Ostrander, E. B. Gerday, V. Yellepeddi and K. M. Watt (2026). "Dexmedetomidine use in Infants undergoing Cooling due to neonatal Encephalopathy (DICE trial): safety and pharmacokinetics." Pediatr Res.
- Bueno, M., L. Candido, J. Hu, M. Fiander, J. Cracknell, E. Xu, J. Kang and J. Yamada (2026). "Sucrose analgesia for venepuncture in neonates." Cochrane Database of Systematic Reviews(3).
- Burnsed, J. C., K. Heinan, L. Letzkus and S. Zanelli (2020). "Gabapentin for pain, movement disorders, and irritability in neonates and infants." Dev Med Child Neurol **62**(3): 386–389.
- Carbajal, R., A. Rousset, C. Danan, S. Coquery, P. Nolent, S. Ducrocq, C. Saizou, A. Lapillonne, M. Granier, P. Durand, R. Lenclen, A. Coursol, P. Hubert, L. de Saint Blanquat, P.-Y. Boëlle, D. Annequin, P. Cimerman, K. J. S. Anand and G. Bréart (2008). "Epidemiology and Treatment of Painful Procedures in Neonates in Intensive Care Units." JAMA **300**(1): 60–70.
- Ceelie, I., S. N. de Wildt, M. van Dijk, M. M. van den Berg, G. E. van den Bosch, H. J. Duivenvoorden, T. G. de Leeuw, R. Mathôt, C. A. Knibbe and D. Tibboel (2013). "Effect of intravenous paracetamol on postoperative morphine requirements in neonates and infants undergoing major noncardiac surgery: a randomized controlled trial." Jama **309**(2): 149–154.
- Colloca, L., T. Ludman, D. Bouhassira, R. Baron, A. H. Dickenson, D. Yarnitsky, R. Freeman, A. Truini, N. Attal, N. B. Finnerup, C. Eccleston, E. Kalso, D. L. Bennett, R. H. Dworkin and S. N. Raja (2017). "Neuropathic pain." Nat Rev Dis Primers **3**: 17002.

Cornette, L. (2012). "Therapeutic hypothermia in neonatal asphyxia." Facts Views Vis Obgyn **4**(2): 133–139.

Foster, J. P., C. Taylor and K. Spence (2017). "Topical anaesthesia for needle-related pain in newborn infants." Cochrane Database Syst Rev **2**(2): Cd010331.

Gautam, B., B. Piya and D. Karki (2020). "Study of Dexmedetomidine in Caudal Block for Children Undergoing Inguino-scrotal Surgery." Kathmandu Univ Med J (KUMJ) **18**(69): 68–73.

Gritz, E. C., A. M. Barr and D. E. Cortezzo (2025). "Sedation, Analgesia, and Delirium in Neonates: A Comprehensive Review." Neoreviews **26**(10): e679–e703.

Haslbeck, F. B., K. Mueller, T. Karen, J. Loewy, J. J. Meerpohl and D. Bassler (2023). "Musical and vocal interventions to improve neurodevelopmental outcomes for preterm infants." Cochrane Database of Systematic Reviews(9).

Herrington, C. J. and L. M. Chiodo (2014). "Human Touch Effectively and Safely Reduces Pain in the Newborn Intensive Care Unit." Pain Management Nursing **15**(1): 107–115.

Huang, G., W. Li, L. Ma, X. Lei, X. Lin, Y. Chen and B. Xu (2024). "Clinical application of middle descending colon-double lumen ostomy with distal stoma narrowing in the treatment of anorectal malformation." BMC Pediatrics **24**(1): 207.

Johnston, C., M. Campbell-Yeo, T. Disher, B. Benoit, A. Fernandes, D. Streiner, D. Inglis and R. Zee (2017). "Skin-to-skin care for procedural pain in neonates." Cochrane Database of Systematic Reviews(2).

Mantecón-Fernández, L., S. Lareu-Vidal, C. González-López, G. Solís-Sánchez and M. Suárez-Rodríguez (2023). "Dexmedetomidine: An Alternative to Pain Treatment in Neonatology." Children (Basel) **10**(3).

Mayock, D. E. and C. A. Gleason (2013). "Pain and Sedation in the NICU." NeoReviews **14**(1): e22–e31.

Midgett Y, Baquero M, Parupalli A, Richardson L, Sharp C, Vakani K, Campbell M, Greenberg RG, Benjamin DK, Tolia V, Stark S (2026). "Off-Label but On the Rise: National Trends in Clonidine Use in U.S. NICUs, 2008–2022." Poster presentation: Pediatric Academic Societies (PAS) Annual Meeting, Boston, MA.

Mills, K. P., R. E. Lean, C. D. Smyser, T. Inder, C. Rogers and C. C. McPherson (2022). "Fentanyl Exposure in Preterm Infants: Five-Year Neurodevelopmental and Socioemotional Assessment." Front Pain Res (Lausanne) **3**: 836705.

Morton, S. U., M. Labrecque, M. Moline, A. Hansen and K. Leeman (2021). "Reducing Benzodiazepine Exposure by Instituting a Guideline for Dexmedetomidine Usage in the NICU." Pediatrics **148**(5).

Ochsenreither, J. M., E. Z. Ramsey, C. G. Mest and T. DiMaggio (2017). "Effect of Rectal Acetaminophen with Intravenous Opioid on Comfort Levels And Opioid Use in Full-Term Infants Post-Open Heart Repair." Pediatric Nursing **43**(4).

Ojha, S., J. Abramson and J. Dorling (2022). "Sedation and analgesia from prolonged pain and stress during mechanical ventilation in preterm infants: is dexmedetomidine an alternative to current practice?" BMJ Paediatr Open **6**(1).

Ou, Y., L. Chen, X. Zhu, T. Zhang, Y. Zhou, L. Zou, Y. Gao, Z. Wang and X. Zheng (2024). "The effect of music on pain management in preterm infants during daily painful procedures: a systematic review and meta-analysis." Front Pediatr **12**: 1351401.

Pilkington, M., B. Pentz, K. Short, T. Marchand, S. Aziz, J. Y. Lam, A. Spencer, M. A. Brockel, S. Else, D. McLuckie, A. Franklin, D. de Beer, M. V. Raval, M. Scott and M. E. Brindle (2024). "Enhanced Recovery After Surgery (ERAS) consensus recommendations for opioid-minimising pharmacological neonatal pain management." BMJ Paediatr Open **8**(1).

Pillai Riddell, R. R., O. Bucsea, I. Shiff, C. Chow, H. G. Gennis, S. Badovinac, M. DiLorenzo-Klas, N. M. Racine, S. Ahola Kohut, D. Lisi, K. Turcotte, B. Stevens and L. S. Uman (2023). "Non-pharmacological management of infant and young child procedural pain." Cochrane Database Syst Rev **6**(6): Cd006275.

Roberts, A. G., R. Kilpatrick, L. D. Diaz, S. Benjamin, A. J. Espinoza Santiago, B. Jallow, M. F. Monteith, S. Rumsey, R. H. Clark, K. Zimmerman, D. K. Benjamin, Jr. and R. G. Greenberg (2025). "Trends in Gabapentin Use in Neonatal Intensive Care Units from 2005 to 2020." Am J Perinatol **42**(8): 1017–1023.

Shah, P. S., R. Torgalkar and V. S. Shah (2023). "Breastfeeding or breast milk for procedural pain in neonates." Cochrane Database of Systematic Reviews(8).

Walker, S. (2016) "Developmental Aspects of Nociception." Anesthesia Key.

Weeks MF, Peralta D, Greenberg RG, Zimmerman KO, Clark RH, Aleem S (2024). The Use of Sedatives and Analgesics in Critically Ill Infants at the End of Life. Poster presentation: Pediatric Academic Societies (PAS) Annual Meeting 2024, Toronto, Ontario, Canada, May 2024.