

Original Article

Nonnutritive Sucking and Oral Sucrose Relieve Neonatal Pain During Intramuscular Injection of Hepatitis Vaccine

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Abstract

Context. Newborns are subject to pain during routine invasive procedures. Pain caused by immunization injections is preventable, but remains untreated in neonates.

Objectives. The purpose of the study was to compare the effectiveness of three nonpharmacological pain relief strategies on newborns' pain, physiological parameters, and cry duration before, during, and after hepatitis B intramuscular (IM) injection.

Methods. In this prospective, randomized clinical trial, we enrolled 165 newborns (gestational age, ≥ 36 weeks). The infants received IM injections and were randomized to three treatment groups: nonnutritive sucking (NNS), 20% oral sucrose, or routine care. Pain was measured by the Neonatal Facial Coding System, physiological signals by electrocardiogram monitors, and cry duration using a stopwatch.

Results. Pain was significantly lower among infants in the NNS ($B = -11.27$, $P < 0.001$) and sucrose ($B = -11.75$, $P < 0.001$) groups than that in controls after adjusting for time effects, infant sleep/wake state, number of prior painful experiences, and baseline pain scores. Infants in the NNS and sucrose groups also had significantly lower mean heart and respiratory rates than the controls. Cry duration of infants receiving sucrose was significantly shorter than those in the NNS ($Z = -3.36$, $P < 0.001$) and control groups ($Z = -7.80$, $P < 0.001$).

Conclusion. NNS and oral sucrose can provide analgesic effects and need to be given before painful procedures as brief as a one-minute IM injection. Sucrose orally administered two minutes before injection more effectively reduced newborns' pain during injection than NNS. Both nonpharmacological methods

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more effectively relieved newborns' pain, stabilized physiological parameters, and shortened cry duration during IM hepatitis injection than routine care. *J Pain Symptom Manage* 2011;42:918–930. © 2011 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.

Key Words

Nonnutritive sucking, sucrose, newborn, pain, immunization, intramuscular injection

Introduction

From birth, normal newborns are subject to procedural pain from routine care, such as injection of vitamin K and vaccines, circumcision, and heel sticks.¹ Newborns can perceive pain, process pain sensation, and respond to pain through facial expressions, behavioral responses, and physiological signals.^{2,3} Early exposure of newborns to repeated procedural pain is considered a major factor contributing to negative physiological, cognitive, behavioral, and psychological consequences.^{4,5} To promote newborns' well-being and development, clinicians are obliged to offer them pain relief.

Pain can be managed by pharmacological and nonpharmacological interventions. Using analgesics to relieve short-term procedural pain in newborns is questionable because of these agents' poor effectiveness and potential side effects.^{6–8} Nonpharmacological pain relief strategies are not only convenient, inexpensive, and can be used without prescriptions, but also are well tolerated by infants. Procedural pain in newborns has been relieved by nonpharmacological interventions, such as nonnutritive sucking (NNS),^{9–11} swaddling,¹² facilitated tucking,^{7,13,14} oral sucrose,^{15–18} breast feeding,^{19,20} and skin-to-skin contact.^{21–23} Most of these studies examined effects on pain caused by heel sticks, venipuncture, eye examination, and circumcision. Only two studies have examined the effects of oral sucrose and kangaroo care on newborn pain during intramuscular (IM) injection.^{16,22}

However, all newborns require injections of hepatitis B vaccine around 48 hours after birth to prevent hepatitis B virus infection.²⁴ Thus, promoting infant health requires considering and treating the pain caused by injecting hepatitis B vaccine soon after birth. Neonatal clinicians also need to consider which strategies better relieve pain caused by routine injections.

Among nonpharmacological pain relief strategies for newborns, the most appropriate for use during thigh IM injections are NNS and oral sucrose because they do not impede the procedures. NNS is hypothesized to produce analgesia by stimulating orotactile and mechanoreceptors in the mouth, thus modulating transmission or processing of nociception by the endogenous nonopioid system.^{25,26} Sucrose is thought to activate endogenous opiates through tactile stimulation by the sweet fluid in the mouth, which releases endogenous opiates,^{27,28} and the presence of opioid receptors on the tongue.²⁹ The analgesic effect lasts approximately 10 minutes, peaking two minutes after administration.³⁰

Despite their different pain relief mechanisms, NNS and sucrose are both effective pain relief interventions. For example, NNS effectively reduced preterm infants' pain during heel sticks.⁹ Sucrose also was shown in 45 studies to be effective and safe in reducing newborns' procedural pain.³¹ However, sucrose was reported to be ineffective in reducing infants' pain during IM injection of vitamin K in the first hour after birth.¹⁶ Thus, it remains unknown whether NNS or sucrose can effectively relieve newborn pain caused by IM injection of hepatitis B vaccine around 48 hours after birth and which pain relief strategy better relieves pain.

To address these gaps in knowledge, this study offered newborns receiving their first IM injection for hepatitis B three nonpharmacological pain relief strategies: routine care measures, NNS, or sucrose. The purpose of the study was to compare the efficacy of these three strategies on newborns' pain, physiological parameters, and cry duration, before, during, and after their first IM injection of hepatitis B vaccine. We hypothesized that pain caused by IM injection would be better managed in infants receiving NNS and sucrose than in those

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