

Sedation protocols for Ponseti clubfoot Achilles tenotomy

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Abstract

Purpose Ponseti clubfoot management requires percutaneous tenotomy in 90% of cases, typically with local anesthesia. We report two light sedation protocols for outpatient tenotomy.

Methods Operating room protocol: 24 patients (36 club feet; mean age at tenotomy, 70 days) underwent mask induction with oxygen/nitrous oxide. Pediatric intensive care unit protocol: five patients (eight club feet; mean age at tenotomy, 119 days) underwent intravenous propofol infusion with supplemental oxygen.

Results All patients were discharged several hours after surgery with no complications. Anesthesia that is

administered intravenously might have less risk of bronchial reaction than anesthesia that is administered by inhalation.

Conclusions Our light sedation protocols offer safe alternatives to general anesthesia. Disadvantages include increased cost when compared with local anesthesia. Light sedation can be used effectively and has advantages when treating older infants who might struggle while under local anesthesia.

Keywords Achilles tenotomy · Clubfoot · Ponseti · Sedation

The subjects' legal guardians provided informed consent to participate. The study was approved by each institution's human research committee.

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Introduction

The Ponseti clubfoot treatment method has been shown to obtain satisfactory functional results in 89% of feet [1–4]. Success is related to strict adherence to Ponseti's protocol, including weekly manipulation and casting and long-term bracing with a derotational foot orthosis. Equinus is the most resistant component of the deformity. Therefore, in approximately 70–91% of the cases, percutaneous complete tenotomy of the Achilles tendon is required [1, 3–6]. Ponseti's recommendation is to perform the procedure with a minimal dose of lidocaine for local anesthesia [7]. Indeed, over zealous injection of lidocaine could obscure landmarks and make it more difficult to localize the tendon. Additionally, some infants (especially those older than 3 months) struggle during tenotomy, despite injection of local anesthesia. Our experience with applying a topical anesthetic cream (EMLA cream) before injection is not much better. The end result is that the procedure might be more stressful for the infant, the surgeon, and (if present) the parents and/or family members. We herein

report two alternative methods of light sedation, whereby the minor operative procedure can be performed under more optimal conditions with a reasonable degree of safety.

Materials and methods

Two groups of patients were included in this study: the Israeli group and the United States group. The preference of the Israeli surgeon is to perform all tenotomies in the operating room with the use of sedation. The preference of the United States surgeon is to perform most tenotomies in the clinic with the use of local anesthesia, with the sedation protocol being applied to older infants only in a pediatric intensive care unit. From 2001 to 2004, we used light sedation during Achilles tenotomy for 29 patients (24 Israelis and five Americans) with idiopathic clubfoot. All procedures were performed with the infant in a supine position.

Inhalation sedation (Israel)

The Israeli group consisted of 24 patients (36 club feet) with a mean age at time of tenotomy of 70 days (age range, 43–153 days) who underwent outpatient tenotomy in the operating room. Informed consent was obtained from the infants' parents in accordance with our institution's regulations. Each infant was kept NPO as follows: 4-h breast milk deprivation or 6-h formula deprivation and clear fluid deprivation of up to 2 h before the procedure. Midazolam syrup (0.5 mg kg^{-1}) was orally administered 30–40 min before surgery. Calm infants did not receive any premedication. Each infant was accompanied into the operating room by a parent. Once the infant was settled on the bed, a ventilation mask was gently applied to the infant's face and a mixture of oxygen/nitrous oxide (30:70) was administered at a rate of 6 L min^{-1} with the use of a Jackson-Rees apparatus. Halothane was administered at a low concentration if the infant reacted poorly to the oxygen/nitrous oxide mixture and eventually was switched to isoflurane, titrated to surgical stress, for maintenance of sedation. If the infant showed signs of surgical stress, the isoflurane concentration was raised accordingly. At the end of the operation, the surgical wound was infiltrated with 0.25% bupivacaine ($1.5\text{--}2.0 \text{ mg kg}^{-1}$) for postoperative pain relief. After recovery from sedation, patients were transferred to the post-anesthesia care unit for 1 h of observation. They were allowed water or breast milk and, if necessary, acetaminophen suppositories ($30\text{--}40 \text{ mg kg}^{-1}$) to treat agitation or pain.

Intravenously administered sedation (United States)

Five patients (eight club feet) with a mean age of 119 days (age range, 49–196 days) underwent outpatient tenotomy in the pediatric intensive care unit, with an intravenous sedation protocol administered by a pediatric anesthesiologist. Informed consent was obtained in accordance with our institutional regulations. The protocol included NPO for 6 h preoperatively (clear liquids, 2 h), rectal administration of 1 mg kg^{-1} midazolam 60 min preoperatively, placement of an intravenous line, and propofol infusion. The propofol was titrated to an appropriate level, and supplemental oxygen was administered. At the end of the procedure, acetaminophen rectal suppositories (25 mg kg^{-1}) were administered.

Results

All patients did well with the inhalation technique, except one in the Israeli group who required a laryngeal mask because of an inadequate respiratory pattern. This patient recovered quickly after surgery, and the postoperative course was uneventful. For most patients, a single acetaminophen suppository was sufficient for pain relief. Occasionally, patients required an additional dose of 15 mg kg^{-1} acetaminophen 4 h after surgery. All patients were discharged to home several hours postoperatively.

Discussion

In the Ponseti method, the initial casts correct the varus and rotational deformities. Equinus is the last deformity to be corrected. However, the equinus is very resistant to manipulation in most cases [6]. Forcible manipulation may result in a break through the midfoot and creation of a rockerbottom deformity.

Ponseti understood that this scenario can be avoided by simple subcutaneous tenotomy of the Achilles tendon. Achilles tenotomy is performed in 70–91% of cases, almost always with the patient under local anesthesia [1, 3–6]. General anesthesia, as used by Ponseti during the first years of treatment [6], was replaced by local anesthesia because local anesthesia was felt to be safer. The various risks associated with general anesthesia (such as fatality (less than three pediatric perioperative mortalities per 100,000 procedures) [8, 9], morbidity (pediatric perioperative morbidity rate of 7.5%) [8, 9], aspiration, cardiac arrhythmia, cardiac arrest, and laryngeal spasm or bronchospasm due to intubation) were thereby avoided. In the early years of his experience, Ponseti witnessed a severe adverse reaction to general anesthesia in an infant

undergoing tenotomy. This stimulated him to develop the local anesthesia protocol (I. V. Ponseti, personal communication, 2000).

Percutaneous tenotomy of the Achilles tendon is an important, usually necessary step in Ponseti clubfoot management. Therefore, it must be performed adequately. Use of deep general anesthesia should be avoided in infants because of its related risks. However, over-insufflation with local anesthesia could mask the Achilles tendon, making it less palpable to the surgeon before surgery. In addition, the infant often struggles, moving the foot and potentially interfering with the procedure. Therefore, the procedure becomes more difficult and incomplete cutting of the tendon can occur.

Recently, the Ponseti method has been applied to older infants [10]. In this population, sedation protocols have an even greater application than for newborns, as older infants tend to struggle more.

Our study shows that Achilles tenotomy can be performed without the use of general anesthesia, endotracheal intubation, and their associated risks. Postoperatively, the combination of field infiltration with a local anesthetic solution plus systemic administration of a non-steroidal analgesic provides a calm and pain-free period for the infant. The sedation and surgical approaches used in our study are safe and can be adopted by outpatient clinics in which pediatric surgical procedures are routinely performed. We recommend that sedation be induced by an experienced pediatric anesthesiologist. Requirements of different health-care systems and individual surgeon preference may dictate that tenotomy be performed in the clinic, intensive care unit, or operating room. The

important point is that when sedation is selected as the method of anesthesia, it should be administered with a safe, reliable, reproducible protocol, such as those presented herein.

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References

1. Cooper DM, Dietz FR (1995) Treatment of idiopathic clubfoot: a thirty-year follow-up note. *J Bone Joint Surg Am* 77:1477–1489
2. Laaveg SJ, Ponseti IV (1980) Long-term results of treatment of congenital club foot. *J Bone Joint Surg Am* 62:23–31
3. Ponseti IV (1992) Treatment of congenital clubfoot. *J Bone Joint Surg Am* 74:448–454
4. Herzenberg JE, Radler C, Bor N (2002) Ponseti versus traditional methods of casting for idiopathic clubfoot. *J Pediatr Orthop* 22:517–521
5. Goksan SB (2002) Treatment of congenital clubfoot with the Ponseti method [in Turkish]. *Acta Orthop Traumatol Turc* 36:281–287
6. Ponseti IV, Smoley EN (1963) Congenital clubfoot: the result of treatment. *J Bone Joint Surg Am* 45:261–275
7. Ponseti IV (1996) *Congenital clubfoot: fundamentals of treatment*. Oxford University Press, New York
8. Morray JP, Geiduschek JM, Ramamoorthy C, Haberkern CM, Hackel A, Caplan RA, Domino KB, Posner K, Cheney FW (2000) Anesthesia-related cardiac arrest in children: initial findings of the Pediatric Perioperative Cardiac Arrest (POCA) registry. *Anesthesiology* 93:6–14
9. Murat I, Constant I, Maud'huy H (2004) Perioperative anaesthetic morbidity in children: a database of 24,165 anaesthetics over a 30-month period. *Paediatr Anaesth* 14:158–166
10. Bor N, Herzenberg JE, Frick SL (2006) Ponseti management of clubfoot in older infants. *Clin Orthop Relat Res* 444:224–228