

Determining the appropriate dosage and procedure for the use of lidocaine to manage IO infusion pain, requires consideration of available research in conjunction with the clinical experience of the Medical Director and staff. Vidacare provides this bibliography as a tool to help Medical Directors develop their agency's IO pain-management protocol. This bibliography represents our current knowledge regarding the use of lidocaine for pain management during intraosseous infusion.

Philbeck TE, Miller LJ, Montez D. Pain Management during Intraosseous Infusion through the Proximal Humerus. Manuscript in preparation for submission to *Annals of Emergency Medicine*.

For the 10 volunteers in this study, the mean IO insertion VAS score was 3.9±1.5 and mean removal VAS score was 2.2±2.9. During infusion the highest VAS score was 2.0±1.2, at 300mmHg of pressure after the initial 20mg of lidocaine. At this point, infusion pressure had a significant effect on the level of pain experienced by participants (p<0.001). Following all other injections, the effect of pressure on pain levels was non-significant. Investigators concluded that, for adequate IO infusion rates with minimal and tolerable pain, 40mg of preservative-free lidocaine may be needed, followed by a rapid normal saline syringe flush of at least 10ml. Additional dosing and flushing may be required. Ultimately, EMS medical directors or the attending emergency department physician must determine the appropriate dosage of lidocaine.

Ong MEH, Chan YH, Oh JJ, Ngo AS-Y. An observational, prospective study comparing tibial and humeral intraosseous access using the EZ-IO. *American Journal of Emergency Medicine* 2009;27:8-15.

This non-randomized prospective observational study was conducted to compare flow rates and insertion success with tibial and humeral IO access in adults using the Vidacare EZ-IO. All 24 patients received a tibial insertion and 11 of those patients also received a humeral insertion. All insertions were successful on the first attempt except one tibial insertion that required two attempts. All insertions were made within 20 seconds. Mean tibial flow rate was 165mL/min using a pressure bag and 73mL/min without the bag. Mean humeral flow rate was 153mL/in using a pressure bag and 84mL/min without the bag. For conscious patients, investigators recommended a prior flush of 20mg to 50mg of 2% preservative-free lidocaine through the IO device.

Fowler RL, Pierce A, Nazeer S et al. 1,128 case series: Powered intraosseous insertion provides safe and effective vascular access for emergency patients. Manuscript submitted to *Prehospital Emergency Care*.

Large retrospective study of patients for whom emergency vascular access was obtained using the Vidacare EZ-IO intraosseous system. Insertion success was 95% and within 10 seconds for 83% of the one-attempt successful cases. Complication rate was low (2.6%), none were serious, and extravasation was the most frequent (0.9%). Researchers concluded that the powered IO device is safe and effective for achieving vascular access in the resuscitation and stabilization of emergency patients. Investigators stated, in most cases, the patient pain level could be substantially reduced by injecting 0.5mg/kg of preservative-free lidocaine through the IO port prior to the infusion.

Paxton JH, Knuth TE, Klausner HA. Humeral head intraosseous insertion: The preferred emergency venous access. *Annals of Emergency Medicine* 2008;52(4):S58.

Interim report for quasi-controlled prospective study of emergency department patients for whom emergency vascular access using the Vidacare EZ-IO intraosseous (IO) system (n=6) inserted in the proximal humerus was compared to access using central or peripheral intravenous (IV) lines (n=60). Researchers concluded that proximal humerus IO insertion is significantly faster than central or peripheral intravenous (IV) line insertion. Complications and pain profiles were similar for IO and IV techniques. Authors reported that IO pain scores (2.5±3.5) were similar to those associated with peripheral IV (0.9±1.2) and central lines (1.0±1.7); p=0.68.

Wayne MA. Intraosseous vascular access: devices, sites and rationale for IO use. *JEMS* 2007;32:s23-5.

This article reviews intraosseous vascular access in general, and summarizes the various devices available. These include the Waismed B.I.G., the Vidacare EZ-IO, and Pyng F.A.S.T.1. Author recommended, when performed on a conscious patient, lidocaine should be used for insertion and into the marrow space prior to infusion.

Frascone RJ, Jensen JP, Kaye K, Salzman JG. Consecutive field trials using two different intraosseous devices. *Prehospital Emergency Care* 2007;11:164-71.

This article describes authors' evaluation of provider performance using two IO devices; the Pyng Medical F.A.S.T.1™ and the Vidacare EZ-IO®. Of 89 insertions with each device, success rate for 72% for the F.A.S.T.1 and 87% for the EZ-IO, a significant difference (p=0.009). The time to fluid insertion for the EZ-IO was also faster (p=0.02). Authors noted that the EZ-IO is unique and much more useful than the F.A.S.T.1. Investigators routinely administered 50mg of lidocaine following the initial flush for patients with GCS >6, but found that for some patients additional medication was needed.

Fowler R, Gallagher JV, Isaacs SM, et al. The role of intraosseous vascular access in the out-of-hospital environment (resource document to NAEMSP position statement). *Prehospital Emergency Care* 2007;11(1):63-6.

Article calls for action by all EMS medical directors to consider and use the intraosseous route for adult patients requiring immediate vascular access. Also, provides the supporting documentation to a position statement by the National Association of EMS Physicians which calls for greater awareness of the advantages and benefits gained from using IO access. Includes excellent description of EZ-IO® and IO devices. Authors recommended injecting lidocaine into the marrow space over 60 seconds to reduce pain during IO infusion.

Miller L, Kramer GC, Bolleter S. Rescue access made easy. *JEMS* 2005;30(10):s8-18.

Overview of IO therapy. Includes "10 Myths about Adult IO," and description of available IO devices, including EZ-IO®. Authors recommend using 2cc of 2% preservative-free lidocaine into the IO catheter prior to infusion.

Davidoff J, Fowler R, Gordon D, et al. Clinical evaluation of a novel intraosseous device for adults: prospective, 250-patient, multi-center trial. *JEMS* 2005;30(10):s20-23.

Observational study evaluating use of the EZ-IO®. Found 97% success rate for insertion and infusion into the IO space by paramedics, nurses, physicians and other EMS personnel in using the device for emergency vascular access. No serious complications reported. Authors gave conscious patients 20-50mg of 2% preservative-free lidocaine slowly through the IO catheter prior to infusion.

Gillum L, Kovar J. Powered intraosseous access in the prehospital setting: MCHD EMS puts the EZ-IO to the test. *JEMS* 2005;30:s24-6.

Observational study of initial use of the EZ-IO® in 125 patients by EMS providers. Found 94% success rate for insertion and infusion into the IO space. No complications reported. For conscious patients, operators administered 50mg of 2% preservative-free lidocaine prior to infusion.

A complete intraosseous access annotated bibliography and additional references are available by contacting Vidacare Corp. at www.vidacare.com