



1. Johnson DL, Findlay LM, Stair TO, Robinson DJ: *Device for Fast Field Intraosseous Infusion via the Adult Manubrium*. Ann Emerg Med 1998; 32(3): Part 2 #145

### **145 Device for Fast Field Intraosseus Infusion via the Adult Manubrium**

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Study objective: To develop a safe and reliable means for infusing fluids and medications in adults without intravenous access

Methods: Intraosseus infusion via the tibia has become routine in pediatric resuscitation, and was the subject of several trials in adults, but it remains anatomically difficult. The more accessible, central, and vascular manubrium is the target of a new device (the F.A.S.T.1 Intraosseus Infusion System from Pyng Medical Corporation, Vancouver, BC) designed for EMS use. A target patch adhering to the skin ensures placement into the manubrium. The patch remains adherent to the skin to provide strain relief for the fluid system tubing. An introducer handle, incorporating a novel release mechanism, controls the depth of placement of the infusion tube into the bone. A remover probe engages the device via the lumen for removal after 24 hours. We have trained EMTs and MDs on the F.A.S.T.1 and obtained approval from our Institutional Review Board for a prospective trial in ED patients.

Results: After training, participants were able to insert the intraosseus device correctly in 90 seconds. Catheters remained securely in place when patients were moved. In cadavers and human volunteers, flow rates averaged 30 mL/min by gravity, 125 mL/min by pressure bag, and 250 mL/min by syringe. A trial is underway comparing the F.A.S.T.1 to central lines in safety, effectiveness, speed and reliability.

Conclusion: A new device, the F.A.S.T.1, provides rapid access to the marrow space and flow rates rapid enough for resuscitation.



2. Tiffany BR, Horwood BT, Pollack CV, et al: *Sternal Intraosseous Infusion: Flow Rates and Utility*. Ann Emerg Med 1999; 34(4): Part 2 #54

#### **54 Sternal Intraosseous Infusion: Flow Rates and Utility**

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Study objective: Reliable, high-flow vascular access is arguably the single most valuable tool in the resuscitation of the acutely ill patient, but can be difficult to achieve quickly because of vascular collapse and other issues. Tibial intraosseous infusion (IOI) is a widely accepted and useful route of access in the pediatric population, but is not feasible in adults because of the thickness of the tibial cortex. The adult sternum is an appropriate site for IOI because of its relatively thin cortex and highly vascular marrow, and the Food and Drug Administration has recently approved a sternal IOI device, the FAST-1 (Pyng Medical Corp, Vancouver, BC). Because the ability to rapidly infuse large fluid volumes is crucial in hypovolemic shock, and it has proved difficult to get reliable estimates of flow rates in prehospital trials of the device, we undertook a study of the flow rates achieved with sternal IOI under controlled conditions.

Methods: Preoperative informed consent was obtained for patients undergoing their first median sternotomy. The sternal IOI device was inserted according to the manufacturer's directions after the patient was anesthetized but before the opening incision. Volume infused was measured by continuous intravenous bag weights (Shimpo digital force guage, Kernco, El Paso, TX) and timed with a stopwatch. Flow was measured under gravity (1-m pressure head), pressure bag infusion (300 mm Hg), and syringe infusion using a 50-mL syringe. The device was removed before the opening incision, and the sternum was observed during the median sternotomy to identify the accuracy of device placement. "Real world" flow rates were obtained by using the device in nontraumatic cardiac arrest victims in the emergency department. Patients were eligible if they had either no conventional intravenous access, or their access was deemed inadequate.

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2. Tiffany BR, Horwood BT, Pollack CV, et al: *Sternal Intraosseous Infusion: Flow Rates and Utility*. Ann Emerg Med 1999; 34(4): Part 2 #54

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Time of insertion, gravity flow rates, drugs infused, and complications were all recorded by the inserting physician.

Results: Four of 5 FAST-1 insertion attempts made in patients undergoing median sternotomy were successful. Mean flow rates were 17.9±9.1 mL/min gravity, 104.1±46.5 mL/min pressure bag, and 232.5±131.2 mL/min for the syringe infusion. In all cases, the insertion site was identified in the manubrium, and no extravasation was noted. Eight insertions were attempted in the ED, all of which were successful, with a mean insertion time of 54.3±24.6 seconds, and an average recorded gravity rate of 34.6±20 mL/min. All standard code drugs were infused successfully, and in one case a unit of packed red blood cells was infused over 6 minutes. Complications included kinking of the infusion tube (3), difficulty with device removal (3), and poor adhesion of the target patch (3).

Conclusion: Vascular access was achieved in 12 of 13 patients, with adequate flow rates to serve as the primary line for drug and fluid infusion during resuscitation. The FAST-1 appears to be a safe and effective means of gaining rapid intravenous access in cardiac arrest patients where conventional access is unsuccessful or too time-consuming.



3. Tiffany BR, Adams J, Pollack CV, et al: *Prehospital Use of a Sternal Intraosseous Infusion Device*. Ann Emerg Med 1999; 34(4): Part 2 #251

### **251† Prehospital Use of a Sternal Intraosseous Infusion Device**

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Study objective: Reliable, high-flow vascular access is arguably the single most valuable tool in the resuscitation of the acutely ill patient, but achieving that access quickly in moribund patients can be difficult. Tibial intraosseous infusion (IOI) is a widely accepted route of access in the pediatric population, but is not feasible in adults because of the thickness of the tibial cortex. The adult sternum is an appropriate site for IOI access with its relatively thin cortex and highly vascular marrow space. The Food and Drug Administration has recently approved the first sternal IOI device in the United States, the FAST-1 (Pyng Medical Corp, Vancouver, BC, Canada). We report on our initial prehospital experience with this device.

Methods: Paramedics in a limited geographic area and the emergency department personnel at the 2 hospitals potentially receiving study patients were trained by the investigators in the insertion and removal of the device. Patients were eligible for the study if they were in nontraumatic cardiac arrest and the initial attempt at peripheral intravenous access had failed. A single FAST-1 insertion attempt was made. If successful, the IOI line was used as the primary line for drugs and fluids, with further attempts at peripheral access at the paramedics discretion. After arrival at the receiving hospital, the paramedic was asked to record basic information about the patient and the insertion attempt, drugs infused via the FAST-1 device, and approximate flow rates. A successful attempt was defined as infusion of fluid through the device without evidence of infiltration. The study was approved by the institutional review boards of the 2 base station hospitals and the Arizona Department of Health Services.

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3. Tiffany BR, Adams J, Pollack CV, et al: *Prehospital Use of a Sternal Intraosseous Infusion Device*. Ann Emerg Med 1999; 34(4): Part 2 #251

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Results: Between December 1, 1998, and May 12, 1999, there were 37 FAST-1 insertion attempts by paramedics, of which 30 (81.1%) were successful. Mean insertion time for successful attempts was  $64.36 \pm 2.1$  seconds, and the mean recorded gravity flow rate was  $23.0 \pm 9.8$  mL/min. One infusion achieved a rate of 100 mL/h with a pressure bag. Common resuscitation drugs, including epinephrine, atropine, lidocaine, bretylium, and 25% dextrose solution were successfully infused. Complications seen in successfully inserted devices included minor leakage of fluid at site (5), kinking of the infusion tubing (2), difficulty with device removal (3), and poor adhesion of the target/stabilization patch (5). Information on failed attempts is included in the Table.

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Table, abstract 251. Unsuccessful insertion attempts

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<b>Patient</b>	<b>Comments</b>
6	440 lb; device deployed into presternal soft tissue
8	220 lb; device did not deploy, infusion tubing in presternal soft tissue (probable operator error)
12	200 lb; insertion attempted at "bad angle" deployed into presternal soft tissue (operator error)
21	100 lb; device did not deploy, "poor placement of patch," "never hit bone"
23	110 lb; device did not deploy
27	"Normal body fat"; device deployed but unable to infuse with syringe pressure; no infiltration
32	120 lb; needles bent during insertion, noted "¼-in stepoff in sternum" under insertion site.

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Conclusion: Vascular access was achieved in 81.1% of patients with adequate flow rates to serve as a primary line for drug and fluid infusion in cardiac arrest. The FAST-1 device may be a useful alternative means of achieving rapid intravenous access when difficulty is encountered in obtaining timely peripheral access in the prehospital setting.



4. Dubick MA, Holcolm, JB: *A Review of Intraosseous Vascular Access: Current Status and Military Application*. *Military Medicine* 2000; 165 7:552-559

**A review of intraosseous vascular access: current status and military application.**

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Austere far-forward battlefield environments present numerous obstacles in providing adequate medical care to the injured soldier. In addition to logistical constraints that limit the volume of isotonic crystalloid fluids available to resuscitate the injured soldier, hypotension, environmental and tactical conditions, and/or the presence of mass casualties can combine to lead to excessive delays in obtaining vascular access. For many years, intraosseous infusion has been a rapid, reliable method of achieving vascular access under emergency conditions in children. Although intraosseous infusion in adults was used extensively in the 1930s and 1940s, and a sternal puncture kit for bone marrow infusions was a common component of emergency medical supplies during World War II, only recently have there been discussions and experimental studies to evaluate intraosseous infusions in adult medical emergencies. With some medical elements of the U.S. military having recently been reissued intraosseous devices, we thought it timely to review the literature on this technique. This review discusses the efficacy and safety of intraosseous infusions of drugs and fluids, including insertion times and flow rates achieved. Although the intent is to evaluate the feasibility of the technique in the injured soldier, literature citations from studies in children, experimental animals, and human cadavers are included to support the statements made and to offer the reader the opportunity to read the original literature.

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5. K. Stevens, R. Purssell, A.J. Macnab, D.L Johnson, J. Findlay and L.Susak.  
*Paramedic Evaluation of the Pyng F.A.S.T. 1 Intraosseous Infusion System.*  
Journal of Investigative Medicine 49 (1) January 2001, 34A

### **182 Paramedic Evaluation of the Pyng F.A.S.T.1™ Intraosseous Infusion System**

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**Background:** The Pyng F.A.S.T.1 Intraosseous (IO) System was designed as an alternative to peripheral or central intravenous cannulation for the administration of fluids and medications in the treatment of critically ill and injured adults. Key design objectives were safety and speed of insertion, and ease of use with minimal training. Advanced life support paramedics provided design input at several points during the development process.

**Purpose:** Paramedics tested the system for ease of training and use and compatibility with current practice in simulated field situations.

**Methods:** Ten experienced field paramedics were asked to evaluate aspects of the IO infusion system. Paramedics were trained on the system and then used it in 3 prehospital scenarios.

**Results:** Duration of the procedure from opening of package to initiation of fluid flow ranged from 52 to 127 seconds (mean  $92 \pm 32$  seconds). Using a 10 cm visual analog scale, the paramedics rated the system highly in all areas (8 or above). The only area of concern was the use of the system with cervical collars, where there was some interference between the two devices. The paramedics identified several ways in which this could be dealt with through minor changes to existing protocols.

**Conclusions:** There was consensus among paramedics that the device had high potential value for prehospital use, particularly in rural areas or for paramedics with limited opportunity to maintain peripheral vascular access skills. Clinical trial data has since confirmed the value of the IO device.