GAVeCeLT GAVePed 2025

Milano
NH Milano Congress Centre
12-13 maggio 2025

GAVePed

Il bambino DIVA in Pronto Soccorso: Accesso Periferico Ecoguidato o Accesso intraosseo?

Dott.ssa Zanaboni Clelia
Responsabile Anestesia e Rianimazione Pediatrica AOU Parma

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA
Azienda Ospedaliero - Universitaria di Parma

OSPEDALE DEI BAMBINI

La Sfida del paziente DIVA Pediatrico

L'accesso venoso è cruciale in Pronto Soccorso pediatrico per farmaci, fluidi e diagnostica

- Nel 15% dei pazienti pediatrici che giungono in PS le vene superficiali sono difficilmente visibili e/o palpabili
- L' Accesso Venoso (DIVA) è una sfida comune, soprattutto nei bambini piccoli, obesi, disidratati o con precedenti accessi difficili
- È importante riconoscere precocemente il bimbo DIVA per adottare strategie alternative e non ritardare il trattamento

Paziente pediatrico DIVA

J Vasc Access. 2021 Nov 17:11297298211059648. doi: 10.1177/11297298211059648. Online ahead of print.

Defining difficult intravenous access (DIVA): A systematic review

Amit Bahl [1], Steven Johnson [1], Kimberly Alsbrooks [2], Alicia Mares [2], Smeet Gala [2], Klaus Hoerauf [2 3]

" Un paziente è considerato affetto da DIVA se è presente uno qualsiasi dei seguenti elementi: un medico ha due o più tentativi falliti di accesso al PIV utilizzando tecniche tradizionali, i risultati dell'esame obiettivo sono suggestivi di DIVA (ad esempio, nessuna vena visibile o palpabile) o il paziente ha una storia dichiarata o documentata di DIVA "

DIVA score

Pediatr Emerg Care. 2008 Mar;24(3):143-7. doi: 10.1097/PEC.0b013e3181666f32.

Derivation of the DIVA score: a clinical prediction rule for the identification of children with difficult intravenous access

Kenneth Yen [1], Anne Riegert, Marc H Gorelick

TABLE 3. Point Values for Each Variable of the 4-Variable DIVA Score

Predictor Variable	Scores		
Vein visible after tourniquet	Visible, 0		Not visible, 2
Vein palpable after tourniquet	Palpable, 0		Not palpable, 2
Age category	≥3 years old (older), 0	1–2 years old (toddler), 1	<1 year old (infant), 3
History of prematurity	Not premature, 0		Premature, 3

The sum of point values of the variables is the DIVA score (range, 0–10).

Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine

ORIGINAL RESEARCH CONTRIBUTION

Validation and Refinement of the Difficult Intravenous Access Score: A Clinical Prediction Rule for Identifying Children With Difficult Intravenous Access

Michael W. Riker, MD, Chris Kennedy, MD, Brad S. Winfrey, RN, Kenneth Yen, MD, MS, and M. Denise Dowd, MD, MPH

Table 4
Multivariate Models Analysis for DIVA Validation study

Model	Variables	OR	95% CI	Goodness-of-fit Statistic*
DIVA 4 (Yen)	Vein not palpable	2.5	1.3–4.8	0.96
	Vein not visible	4.0	2.3–8.4	
	Age (months)			
	0–11	2.0	1.1–3.6	
	12–35	4.6	2.5–8.6	
	≥ 36	1.0	REF	
	Prematurity	1.3	0.6–2.5	
DIVA 5 (Yen)	Vein not palpable	2.5	1.3–4.8	0.79
	Vein not visible	4.3	2.3–8.4	
	Age (months)			
	0–11	2.0	1.1–3.6	
	12–35	4.6	2.5–8.5	
	≥ 36	1.0	REF	
	Prematurity	1.3	0.6–2.5	
	Skin shade			
	Light	1.0	REF	
	Dark	0.97	0.6–1.7	
DIVA 4 (Riker)	Vein not palpable	2.4	1.3–4.5	0.79
	Vein not visible	4.2	2.2–8.0	
	Age (months)			
	0–11	1.9	1.1–3.4	
	12–35	4.4	2.4–8.0	
	≥ 36	1.0	REF	
	NICU stay	1.4	0.7–2.9	
DIVA 3 (Riker)	Vein not palpable	2.5	1.4–4.7	0.97
	Vein not visible	4.2	2.2–8.0	
	Age (months)			
	0–11	1.9	1.1–3.4	
	12–35	4.5	2.5–8.2	
	≥ 36	1.0	REF	

DIVA = difficult intravenous access; NICU = newborn intensive care unit; REF = reference.
*Hosmer and Lemeshow test.

Patients with a **DIVA** score of **4** or greater had more than 50% likelihood of failed first IV attempt

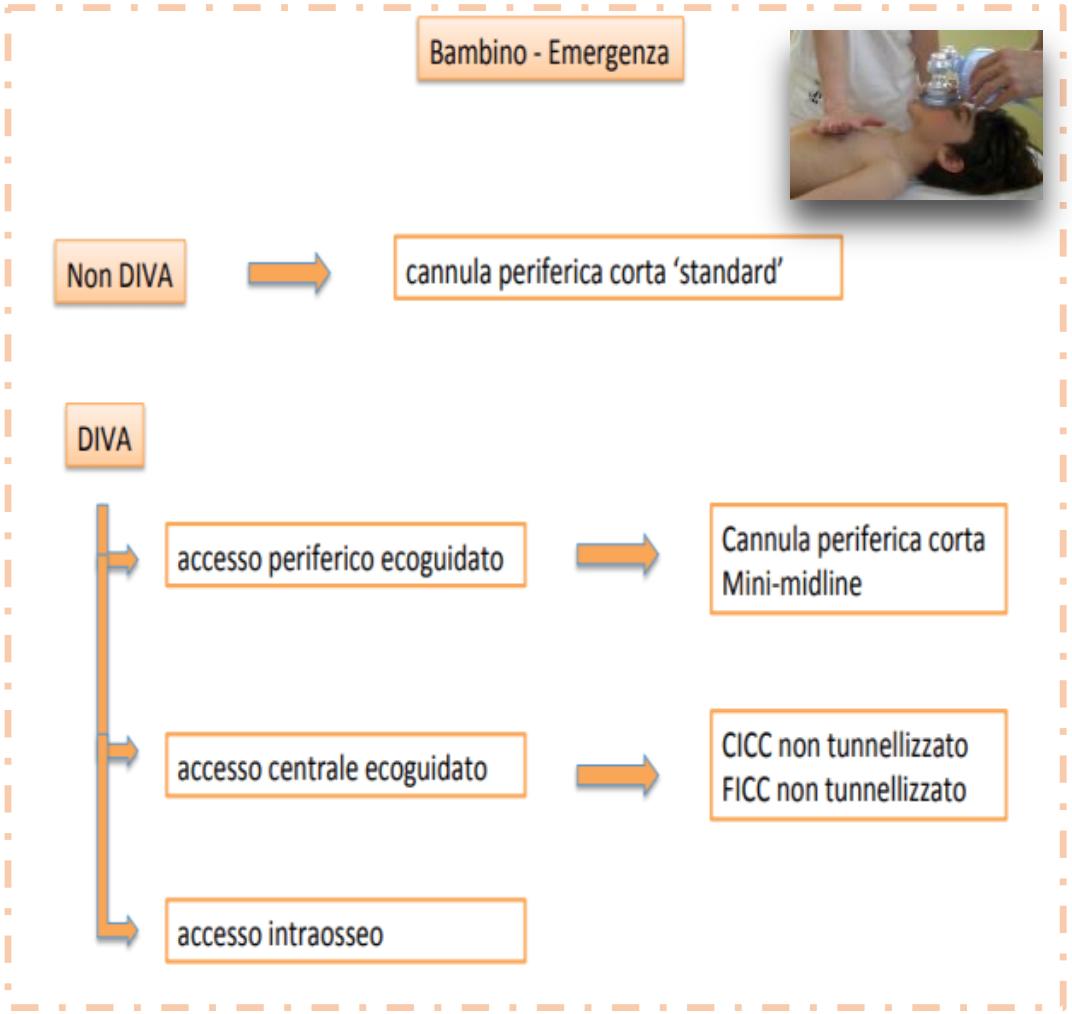
Modified from Rikers et al; doi: 10.1111/j.1553-2712.2011.01205.x

DAV-Expert nelle emergenze pediatriche

Strumento per la scelta del dispositivo più appropriato per la singola situazione clinica

Propone soluzioni basate su:

- ✓ Sicurezza per il paziente
- ✓ Efficacia clinica del dispositivo
- ✓ Costo-efficacia della scelta



Review > J Vasc Access. 2024 Jun 10:11297298241256999.
doi: 10.1177/11297298241256999. Online ahead of print.

The pediatric DAV-expert algorithm: A GAVeCeLT/GAVePed consensus for the choice of the most appropriate venous access device in children

Mauro Pittiruti [1], Alessandro Crocoli [2], Clelia Zanaboni [3], Maria Giuseppina Annetta [4], Michela Bevilacqua [5], Daniele G Biasucci [6], Davide Celentano [7], Simone Cesaro [8], Antonio Chiaretti [9], Nicola Disma [10], Aldo Mancino [11], Cristina Martucci [2], Lidia Muscheri [11], Alessio Pini Prato [12], Alessandro Raffaele [13], Simone Reali [2], Francesca Rossetti [14], Giancarlo Scoppettuolo [15], Luca Sidro [16], Geremia Zito Marinosci [16], Gilda Pepe [1]

Question 1: Which venous access is appropriate in pediatric emergencies?

In pediatric emergencies, depending on the clinical situation, several types of access may be taken into consideration:

(a) intraosseous access
(b) short peripheral cannulas inserted with or without the aid of Near Infra-Red (NIR) technology
(c) long peripheral catheters (“mini-midline”) inserted by ultrasound guidance,
(d) non-tunneled CICCs and FICCs inserted by ultrasound guidance.

VADs inserted in emergency should be preferably removed within 48h

Linee Guida Accesso in Emergenza IRC-ERC

LINEE GUIDA
EUROPEAN RESUSCITATION COUNCIL
2021

EUROPEAN
RESUSCITATION
COUNCIL

IRC | Italian Resuscitation Council

Accesso vascolare:

- La via venosa periferica rappresenta la prima scelta per l'accesso vascolare. Gli operatori competenti possono utilizzare l'ecografia per guidare l'incannulamento venoso. In emergenza, limitare il tempo di posizionamento al massimo a 5 minuti (2 tentativi). Impiegare precocemente strategie alternative quando le probabilità di successo sono considerate minime.
- Nei lattanti e nei bambini, l'alternativa principale è l'accesso intraosseo (IO). Tutti gli operatori PALS devono essere competenti nel posizionamento di un accesso IO ed essere regolarmente riaddestrati all'utilizzo dei diversi dispositivi disponibili nel loro luogo di lavoro e ai diversi siti di puntura. Garantire un'appropriata analgesia ad ogni bambino a meno che non sia in coma. Usare un ago di dimensioni adeguate. La maggior parte delle pompe standard non è in grado di infondere attraverso la via IO, quindi utilizzare un'infusione manuale o una sacca ad alta pressione. Confermare il corretto posizionamento e monitorare un eventuale stravaso che può portare alla sindrome compartimentale.

Linee Guida Accesso in Emergenza AHA

Accesso intraosseo

L'incannulamento intraosseo (IO) è un metodo relativamente semplice ed efficace per reperire rapidamente un accesso vascolare per i liquidi o i farmaci di emergenza. Offre accesso a un plesso venoso non collassabile del midollo che rappresenta una via di somministrazione sicura e affidabile di farmaci, cristalloidi, colloidi e sangue durante la rianimazione. È possibile ottenere l'accesso IO nei bambini di tutte le età, spesso in soli 30 o 60 secondi. In determinate circostanze (ad es. arresto cardiaco o grave shock con importante vasocostrizione), questo può essere il tentativo iniziale di accesso vascolare. Attraverso l'accesso IO è possibile somministrare qualsiasi farmaco somministrabile via EV. I liquidi e i farmaci somministrati con catetere IO raggiungono la circolazione centrale in pochi secondi. Se non è possibile ottenere subito un accesso vascolare periferico in un bambino in shock compensato o ipotensivo, prepararsi a reperire un accesso IO appena si renda necessario.

Aggiornamento 2020 Linee AHA

Preferenza dell'accesso EV rispetto all'IO

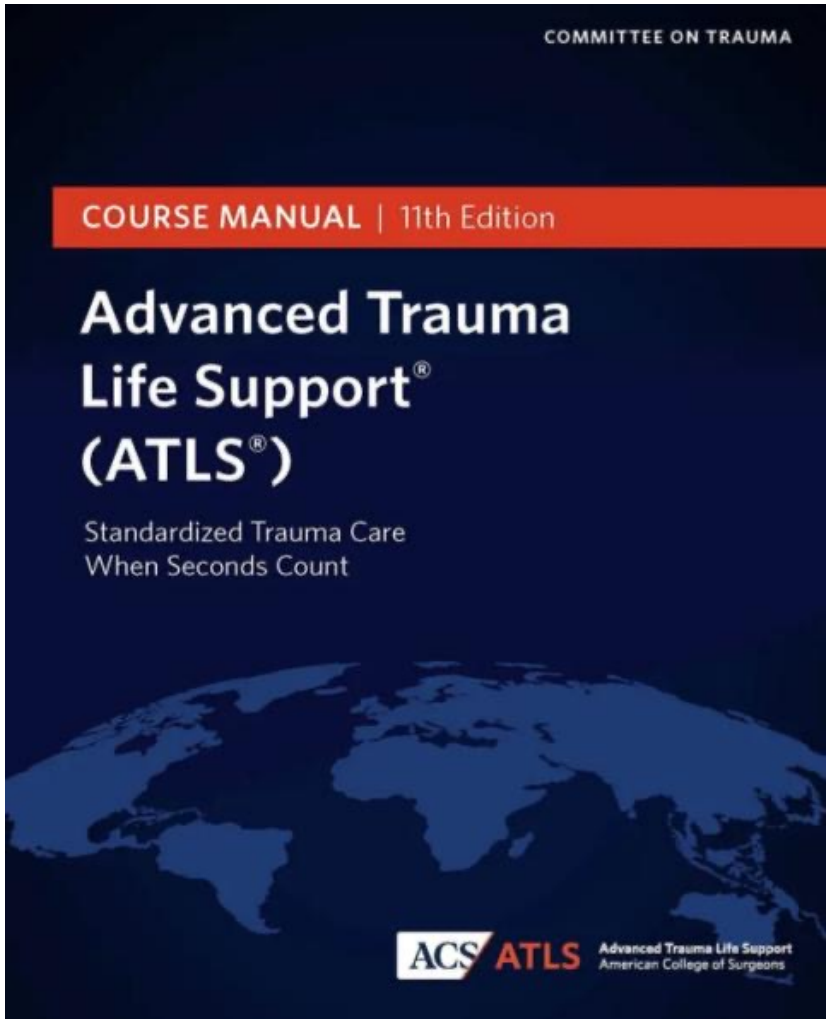
2020 (Nuovo): è ragionevole per gli operatori tentare innanzitutto di stabilire un accesso EV per la somministrazione di farmaci in caso di arresto cardiaco.

2020 (Aggiornato): l'accesso IO può essere preso in considerazione se i tentativi di accesso EV non hanno esito positivo o non sono praticabili.

2010 (Versione precedente): è ragionevole per gli operatori stabilire un accesso intraosseo (IO) se l'accesso endovenoso (EV) non è immediatamente disponibile.

Motivazione: una revisione sistematica ILCOR 2020 che confronta la somministrazione di farmaci per via EV rispetto all'IO (principalmente posizionamento pretibiale) durante l'arresto cardiaco ha rilevato che la via EV è stata associata a migliori esiti clinici in 5 studi retrospettivi. Le analisi dei sottogruppi degli RCT che si sono concentrate su altre questioni cliniche hanno riscontrato esiti paragonabili quando è stato utilizzato l'accesso EV o IO per la somministrazione di farmaci. Sebbene l'accesso EV sia preferibile, per situazioni in cui quest'ultimo è difficile, l'accesso IO è un'opzione ragionevole.

Linee GUIDA ATLS



In children younger than 6 years, the placement of an intraosseous needle should be attempted before inserting a central line

The important determinant for selecting a procedure or route for establishing vascular access is the clinician's experience and skill

Intraosseous access with specially designed equipment is possible in all age groups, and is being used with increasing frequency

As in the pediatric population, this access may be used in hospital until intravenous access is obtained

Cosa è cambiato nelle Linee Guida in Emergenza ?

Tengono conto dell'ecoguida (*IRC-ERC*) , dell'esperienza e del training operatore

Anche se la maggior parte degli studi che confrontano PIV vs IO vs CVC non considerano le tecniche avanzate : ecografia e NIR

Linee Guida Accesso in Emergenza AVA

Protect Patients
Educate Clinicians
Save Lines

POSITION PAPER

Intraosseous Device Insertion

for Adults and Pediatrics

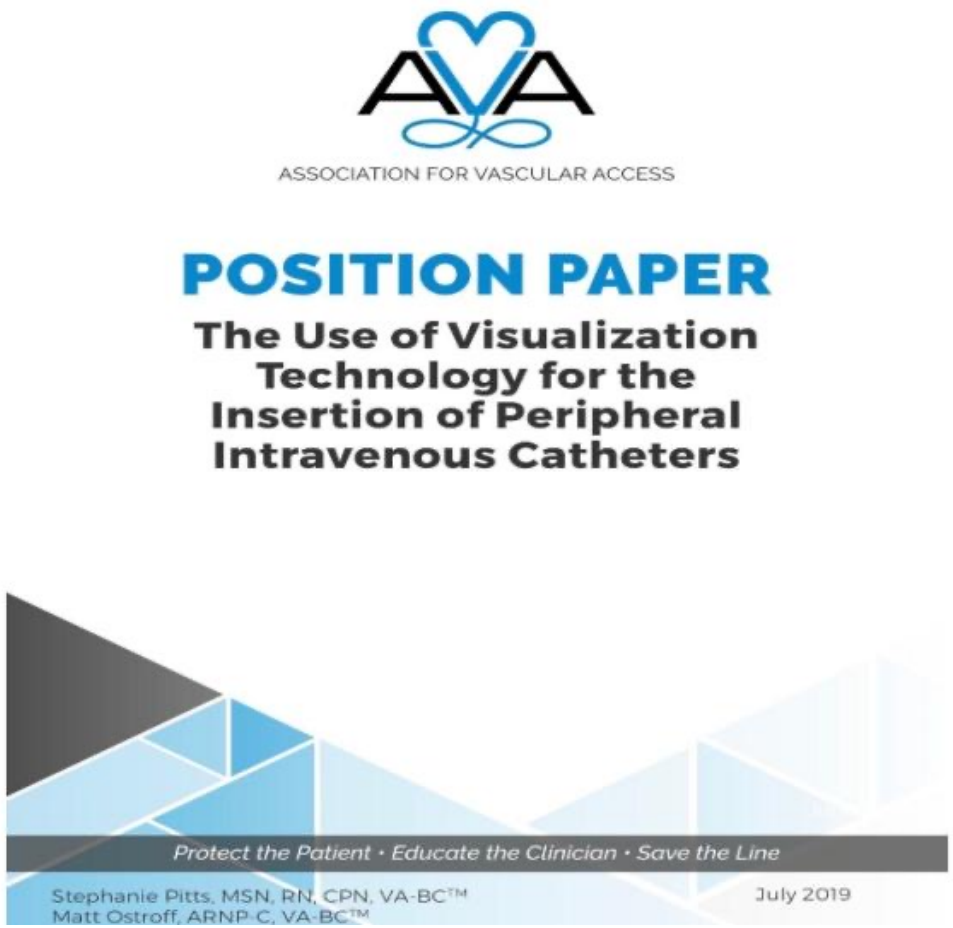
Authors: Jack Lau BS, Judy Thompson MSNEd., RN, VA-BC™

Intraosseous (IO) access was introduced over 100 years ago, a direct insertion method offering immediate access to central circulation.[1] Despite these devices' long history, high first-attempt success rate, and extremely low complication profile, the use of IO's is still greatly underutilized.[2] Their low complication profile is even more impressive considering they are primarily utilized in high stress, emergent, critical, and life-threatening situations, where sterile (or even clean) technique is not prioritized.

The purpose of this position paper is to encourage the reader to incorporate IO use in their vascular access algorithm and use this device to its full potential. The position of the Association for Vascular Access is that IO cannulation should be employed by qualified clinicians in all critical situations (excluding neonates) when vascular access is not established.

The position of the Association for Vascular Access is that IO cannulation should be employed by qualified clinicians in all critical situations (excluding neonates) when vascular access is not established.

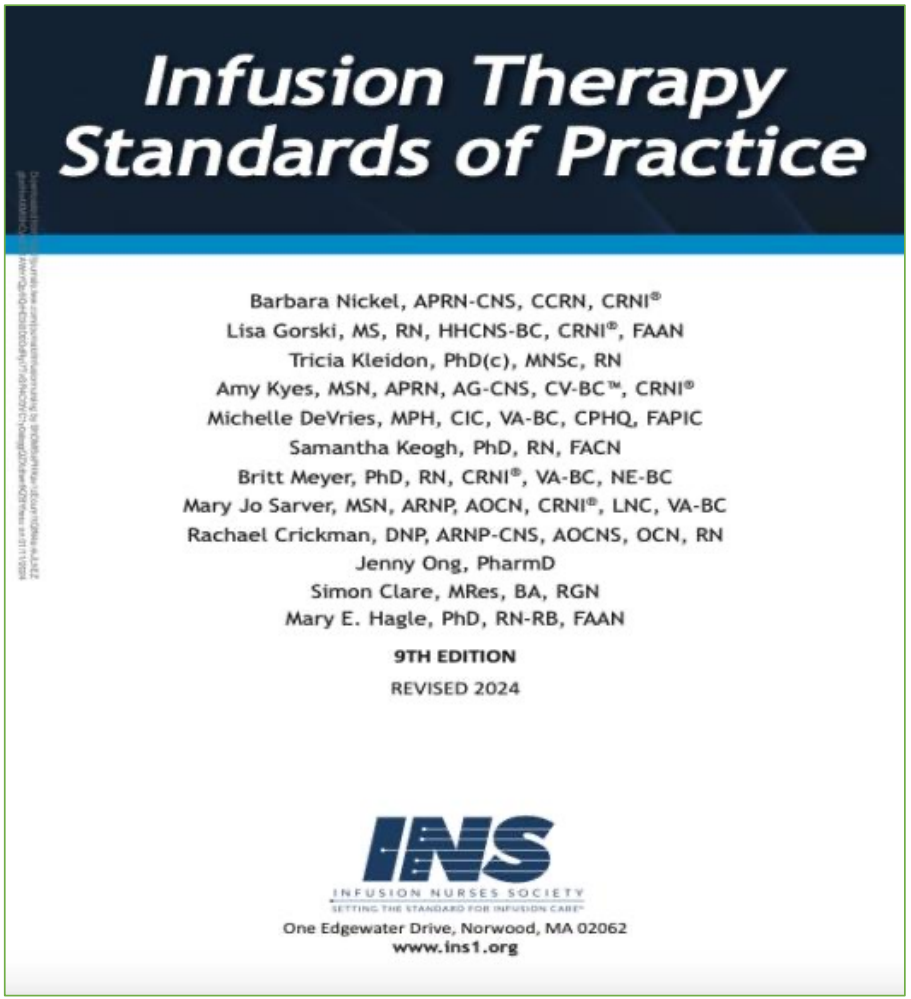
Raccomandazioni AVA utilizzo tecnologia



The Association for Vascular Access (AVA) recommendations: Practice Recommendations
Evidence indicates that the use of vein visualization technology may improve first stick success, improve vessel identification, decrease procedure time, decrease procedural pain, and improve overall cost.

First stick success is dependent on the combination of visualization technology, clinician experience, skill, and training. Common vascular visualization technologies for the insertion of peripheral intravenous catheters include:
Transillumination – Light technology placed underneath or around the intended PIVC insertion site and often used to visualize veins in neonates and infants, especially the hands and feet

Linee Guida INS 2024



21. VASCULAR VISUALIZATION

Standard

21.1 Vascular visualization technology is used to increase insertion success of the most appropriate, least invasive vascular access device (VAD), minimizing the need to escalate to an unnecessary, more invasive device and to reduce insertion-related complications.

B. Use vascular visualization technology (eg, near infrared, ultrasound) to increase success for patients with difficult

Vantaggi Tecnica Ecoguidata in Emergenza

Pediatric Anesthesia

Explore this journal >

ORIGINAL ARTICLE

Ultrasound guidance allows faster peripheral IV cannulation in children under 3 years of age with difficult venous access: a prospective randomized study

Mehdi Benkhadra, Mathieu Collignon, Isabelle Fournel, Christian Oeuvrard, Patricia Rollin, Murielle Perrin, François Volot, Claude Girard

- Tecnica meno invasiva rispetto a IO
- Visualizzazione diretta del vaso
- Richiede formazione e attrezzatura
- Tempo maggiore rispetto all'IO in emergenza
- Principali siti: vena basilica, cefalica, femorale

Rispetto alla tecnica BLIND:

- Maggior % di successo al primo tentativo
- Minor tempo impiegato
- Minor numero di punture ripetute

Expert Panel WoCoVA

Intensive Care Med
DOI 10.1007/s00134-012-2597-x

CONFERENCE REPORTS AND EXPERT PANEL

Massimo Lamperti
Andrew R. Bodenham
Mauro Pittiruti
Michael Blaivas
John G. Augoustides
Mahmoud Elbarbary
Thierry Pirotte
Dimitrios Karakitsos
Jack LeDonne
Stephanie Doniger
Giancarlo Scoppettuolo
David Feller-Kopman
Wolfram Schummer
Roberto Biffi
Eric Desruennes
Lawrence A. Melniker
Susan T. Verghese

International evidence-based recommendations on ultrasound-guided vascular access

WoCoVA
World Congress Vascular Access

Table 3 Recommendations on ultrasound vascular access in neonates and children

Ultrasound vascular access in neonates and children		
Domain code	Suggested definition	Level evider
D4.SD1.S1–2	Ultrasound guidance should be routinely used for short- and long-term central venous access in children and neonates	A
D4.SD1.S3	Ultrasound vessel imaging with ultrasound assistance as "a minimum" should be routinely performed before internal jugular vein puncture in neonates	A
D4.SD1.S4	In neonates, ultrasound screening should be used before subclavian vein puncture. Ultrasound-guided puncture should be considered for catheterization using the supra-clavicular route, but this technique requires experienced operators	C
D4.SD1.S5	Ultrasound vessel screening should be routinely used before femoral vein puncture. Ultrasound-guided femoral puncture is recommended to	B
D4.SD1.S6	Ultrasound guidance can be considered when difficult peripheral venous access is required in areas such as the antecubital fossa and ankle. Blind deep antecubital fossa puncture should disappear	C
D4.SD1.S7	Ultrasound-guided arterial catheterization improves first-pass success and should be used routinely in children and neonates	A
D4.SD1.S8	After central venous catheter placement in paediatric patients including neonates, the ultrasound equipment should remain easily accessible at the patient's bedside to detect early life-threatening catheter-related complications such as pneumothorax, cardiac tamponade and hemothorax	B
D4.SD1.S9	There is no ideal site for cannulation in children; the best site should be determined after ultrasound examination	A

Linee guida ESA a vantaggio dell'ecoguida

Eur J Anaesthesiol 2020; **37**:344–376

European Society of Anaesthesiology guidelines on peri-operative use of ultrasound-guided for vascular access (PERSEUS vascular access)

Massimo Lamperti, Daniele Guerino Biasucci, Nicola Disma, Mauro Pittiruti, Christian Breschan, Davide Vailati, Matteo Subert, Vilma Traškaitė, Andrius Macas, Jean-Pierre Estebe, Regis Fuzier, Emmanuel Boselli and Philip Hopkins

European Society of Anaesthesiology ESA

- Is USG better that "any other technique" for
  - IJV
  - FV
  - AxV, BCV, SCV
  - Arterial cannulation
  - Peripheral veins (DIVA)

L'USG migliora il tasso di successo in caso di accesso endovenoso difficile (DIVA) nei bambini e in mani esperte questa tecnica può dare dei benefici

Quali accessi sono indicati nelle urgenze pediatriche?

La scelta tra le diverse opzioni deve essere dettata

- dalla situazione clinica di urgenza o emergenza
- dalle condizioni cliniche del bambino
- dall'età del bambino
- dalle risorse e competenze disponibili

L'accesso ecoguidato e l'inserzione di intraossea richiedono una formazione specifica. L'operatore deve avere esperienza in entrambe le procedure

Algoritmo di scelta Urgenza / Emergenza Intraospedaliera

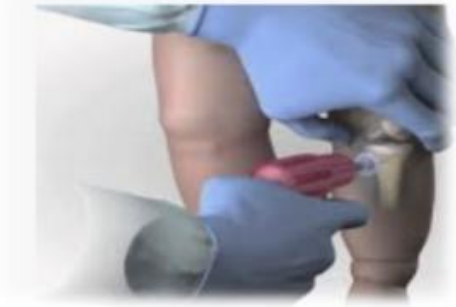
URGENZA

Scelta razionale dell'accesso venoso su base clinica e della valutazione ecografica preliminare

EMERGENZA

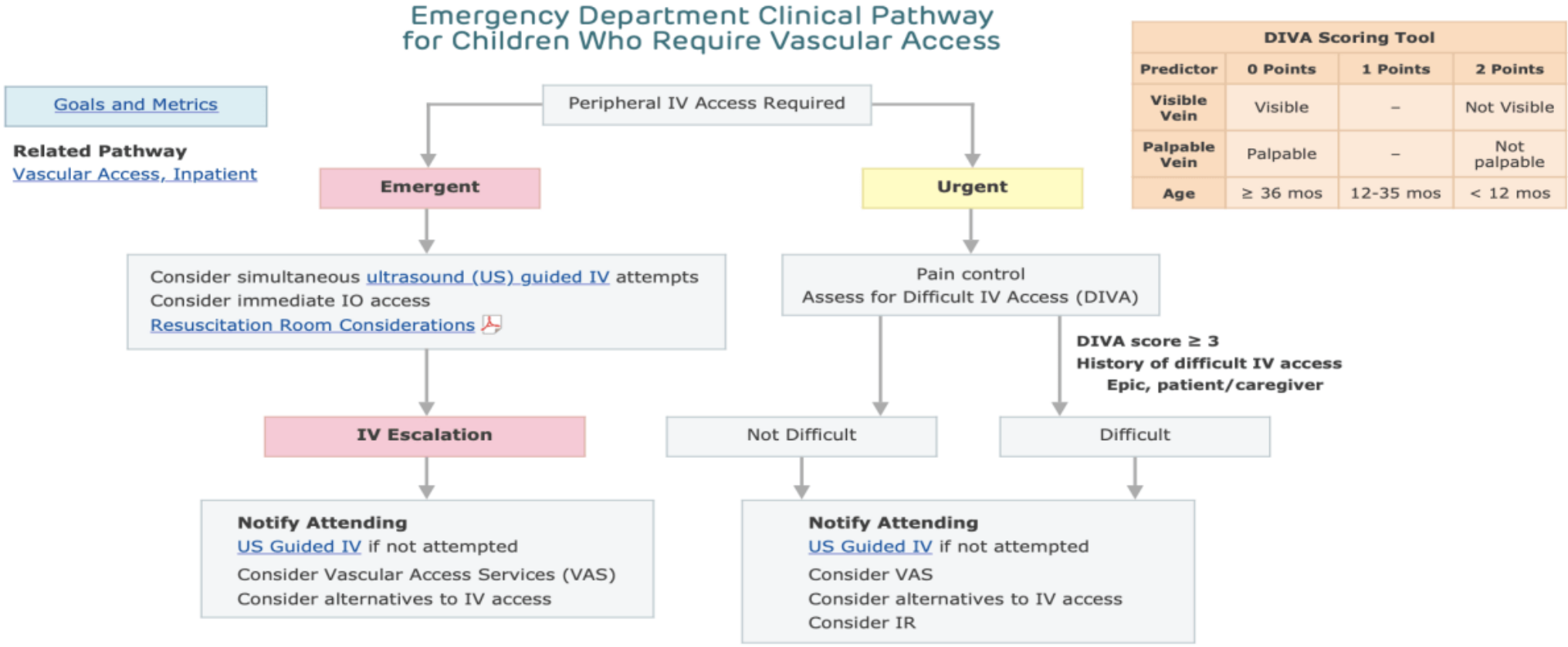
- ARRESTO CARDIACO
- SHOCK SEVERO
- DISIDRATAZIONE
- TRAUMA MAGGIORE
- COMPROMISSIONE VIE AEREE
- DISTRESS RESPIRATORIO SEVERO
- INGESTIONE DI TOSSICI

NON DIVA



DIVA

Esempio di Algoritmo di scelta

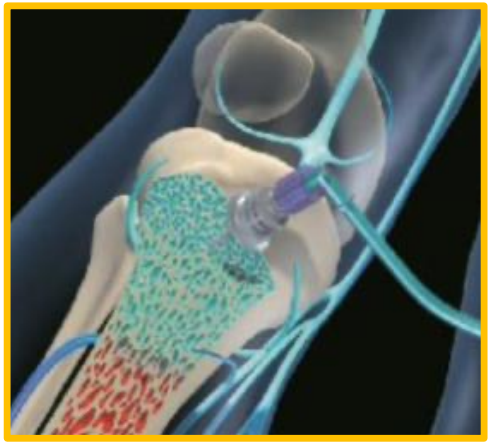


Children's Hospital of Philadelphia

Accesso intraosseo pediatrico in Extraospedaliero

CRITERI CLINICI	CRITERI AMBIENTALI	CRITERI DINAMICI
• Traumi maggiori: • Open book • Frattura 2 ossa lunghe • RTS < 11 GCS > 14 • Trauma spinale • Ustione: BSA > 30% nel bambino	• Ambiente ostile • Exposure limitata • Scarsa visibilita' • Ipotermia ambiente severa	• Precipitazione > 5 mt • Altri pazienti deceduti sulla scena • Previsione/necessità estricazione prolungata • Proiezione/sbalzamento

ACCESSO VENOSO NON REPERITO RAPIDAMENTE



IO nel bambino

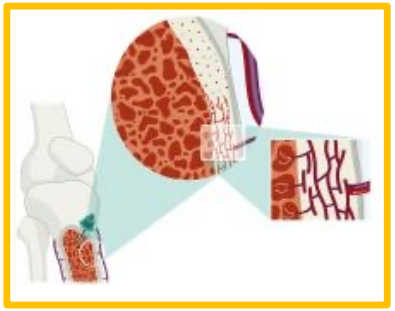
Resources

Resources for Management of Circulatory Emergencies

Intraosseous Access

Intraosseous (IO) cannulation is a relatively simple and effective method of rapidly establishing vascular access for emergency fluids or medications. It provides access to a noncollapsible marrow venous plexus, which serves as a rapid, safe, and reliable route for administration of drugs, crystalloids, colloids, and blood during resuscitation. IO access can be achieved in children of all ages, often in about 30 to 60 seconds. In certain circumstances (eg, cardiac arrest or severe shock with severe vasoconstriction), it may be the *initial* vascular access attempted. Any medication that can be

l midollo osseo altamente vascolarizzato. Il canale venoso midollare è collegato al sistema vascolare tramite le vene emissarie nutrienti. La consistenza compatta dell'osso e la presenza di spicole ossee (in cui è contenuto il midollo osseo) fanno di questa cavità un sistema non collassabile anche in presenza di shock o ipovolemia profonda

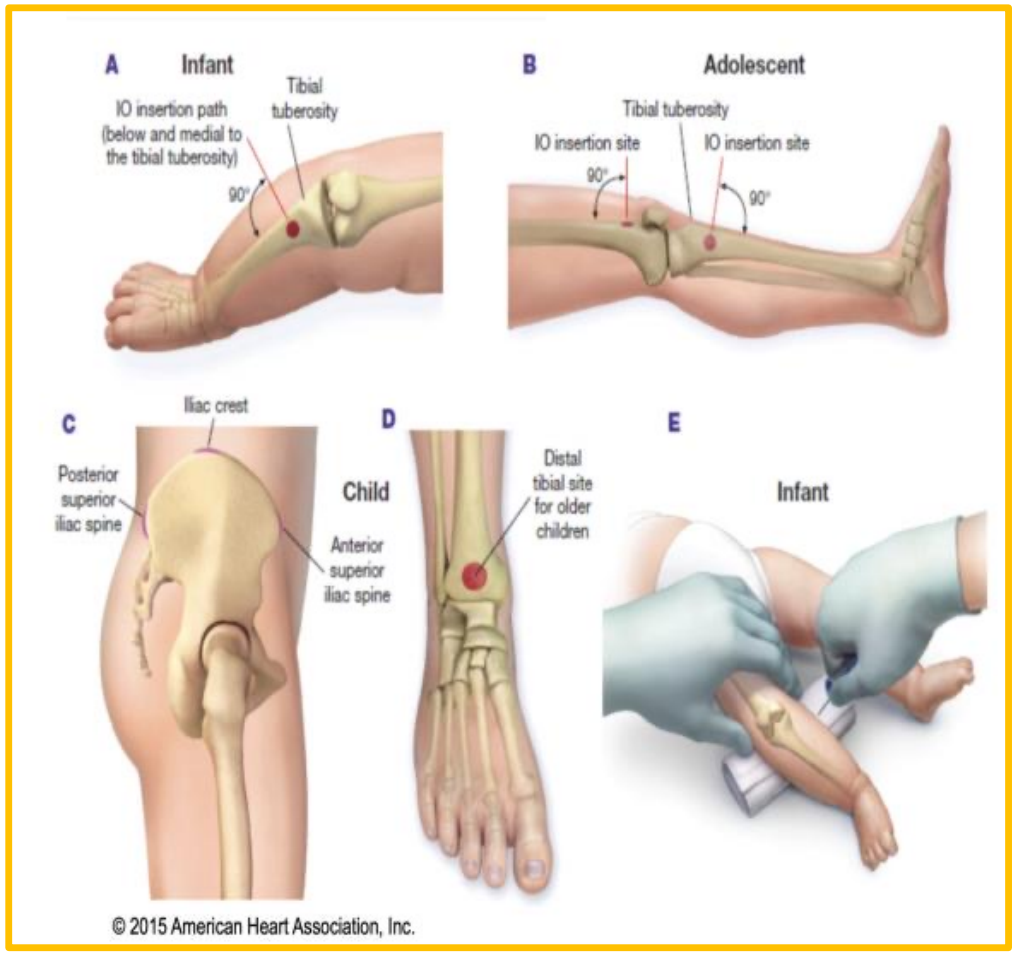


L'IO rappresenta una via rapida, sicura e affidabile

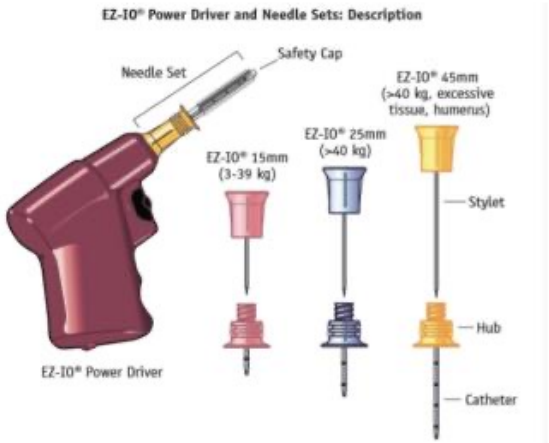
- Alta percentule di successo
- Fornisce accesso a un plesso venoso non collassabile del midollo
- Consente la somministrazione di liquidi, cristalloidi e colloidi durante la rianimazione
- E' possibile somministrare qualsiasi farmaco somministrabile ev che raggiunge la circolazione centrale in pochi secondi
- E' possibile ottenere l'IO nei bambini in tutte le età in 30-60 secondi
- Richiede una tecnica specifica e formazione adeguata
- Esistono appositi dispositivi per facilitarne l'inserimento
- Procedura invasiva / Complicanze

Sede preferenziale posizionamento IO

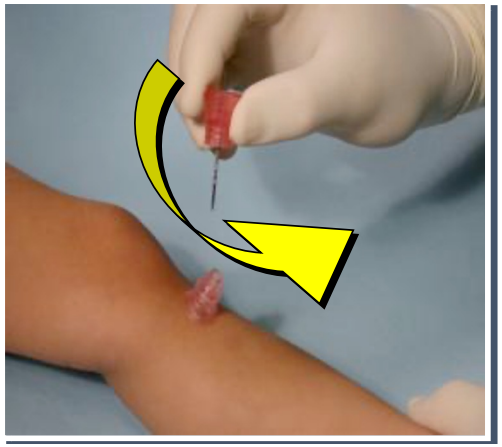
- Nei bambini < 6 anni, la **tibia prossimale** è il sito preferito. L'ago viene posizionato sulla superficie anteromediale ampia e piatta, 1-3 cm distalmente al tubercolo tibiale.
- **Il femore distale** è un sito alternativo. L'ago viene inserito 2-3 cm sopra il condilo femorale laterale, sulla linea mediana e angolato cefalico di 10-15 gradi. Gli spessi tessuti molli e i muscoli sovrastanti possono rendere difficile la palpazione dei punti di riferimento ossei in questa posizione.
- Per i bambini più grandi, può essere più comoda la **superficie mediale della tibia distale**, 2 cm sopra il malleolo mediale.

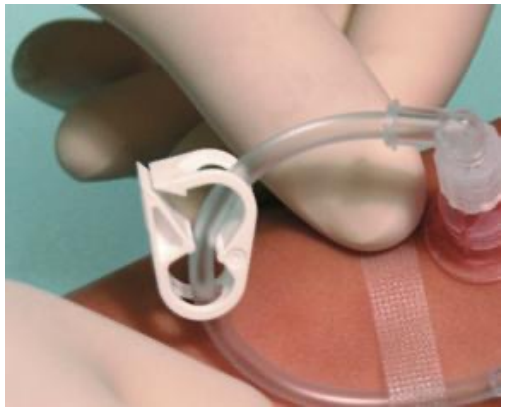


Tecnica di posizionamento IO nel bambino



Prestare attenzione alla perdita di resistenza che indica la penetrazione nel canale midollare.
STOP – QUANDO SI SENTE IL "POP"





Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Letter to the Editor

Intraosseous devices in small children: The need for a clearly defined strategy

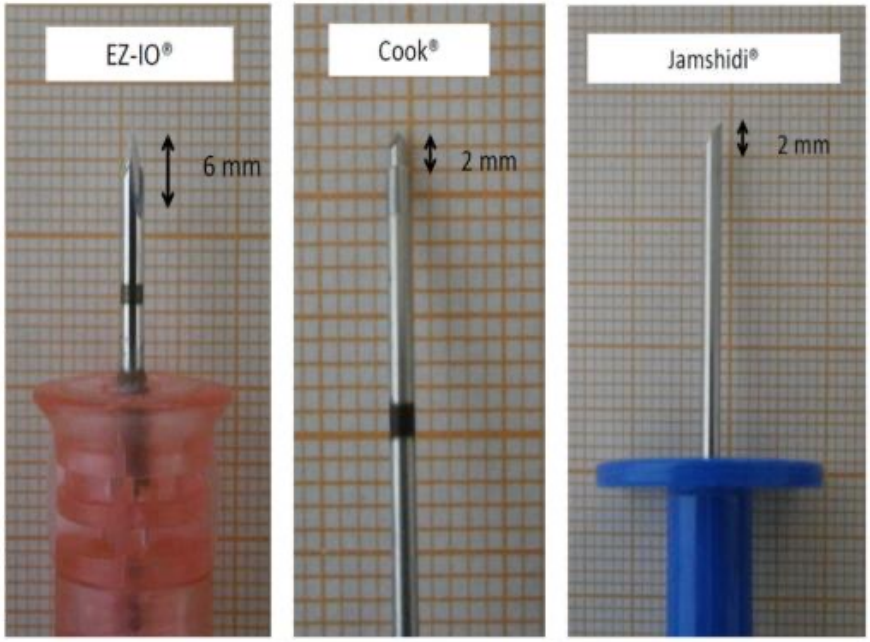


Fig. 1 – Comparison of the tip of the needle of 3 IO devices.

Malposition of intraosseous (IO) needles in pediatric cadavers.
The study showed a high malposition rate, up to 64%, especially in infants of less than one-year-old.
Three classical IO devices are utilized in infants: **The Cook Intraosseous Infusion Needle the Jamshidi Intraosseous Needle and the EZ-IO device** with a motor-driven drilling system. Each needle has specific characteristics. For all three devices, the tip of the needle without the stylet, measures less than **4 mm**. However, for the EZ-IO device, the tip of the needle with the stylet grows up to 5-6 mm compared to 2 mm for the other two needles . The small diameter of the bone marrow space as well as the length difference between the three devices makes it an arduous task to correctly place an IO device in small children.

The small diameter of the bone marrow space as well as the length difference between the three devices makes it an arduous task to correctly place an IO device in small children.
The diameter of the medullary cavity of the proximal tibia is estimated to 7 mm 3 mm for infants <1year, to 4 mm for newborn and only 2 mm in 2041 weeks of gestation neonate.14 The correct placement of the EZ-IO needle is therefore a challenging task in the proximal tibial site for small children. The risks are mainly that the needle penetrates the opposite cortex or protrudes outside the cortex. Manual IO devices do not encounter this difficulty because of their smaller tip of needle length.
IO access remains challenging in neonates and infants in regard of their age and different existing IO devices. We need anatomical studies to precise which site offers the largest intramedullary cavity. In addition, we should develop strategies to determine the best IO site according to the type of drugs we need to infuse in order to limit potentially serious extravasation complications. The modalities of IO uses in the pediatric population still remain to be written.

Clinical paper

Intraosseous needles in pediatric cadavers: Rate of malposition

Results

Infant cadavers (< 1 year)

Table 2 – Infant cadavers (age <1 year).

	All IO devices		EZ-IO		Manual devices	
	n Cases	%	n Cases	%	n Cases	%
Cadavers	22		16[b]		7[b]	
ION[a]	34		25		9	
Number of cadavers with at least one malpositioned ION	14	64	11	69	4	44
Number of malpositioned ION	16	47	12	48	4	44
Number of malpositioned ION perforating the bone on both sides	5	31	4	33	1	25
Cadavers without a correctly placed ION	7	32	5	31	1	11
Cadavers with two ION	10	45	8[b]	50	3[b]	33
Cadavers with three ION	1	5	1	6	0	0

[a] Intraosseous needle.
[b] One cadaver with one EZ-IO and one manual device.

The mean measured depth from the skin surface to the borders of the intraosseous space at the medial surface of the proximal tibia was:

11mm (SD ± 3; min 7mm; max 23mm) for the proximal border;
18mm (SD ± 4 mm; min 12 mm; max 31 mm) for the distal border.

Child cadavers (≥ 1 year)

	All IO devices		EZ-IO		Manual devices	
	n Cases	%	n Cases	%	n Cases	%
Cadavers	16		14		2	
ION[a]	23		22		2	
Number of subjects with at least one malpositioned ION	8	50	7	50	1	50
Number of malpositioned ION	9	39	8	38	1	50
Number of malpositioned ION perforating the proximal and distal cortical bone	1	11	1	13	0	0
Cadavers without a correctly placed ION	3	19	2	14	1	50
Cadavers with two ION	5	31	5	31	0	0
Cadavers with three ION	1	6	1	6	0	0

[a] Intraosseous needle.

The mean measured depth from the skin surface to the borders of the intraosseous space at the medial surface of the proximal tibia was 14mm (SD ± 3; min 10mm; max 23mm) for the proximal 31mm (SD ± 10 mm; min 18 mm; max 49 mm) for the distal border

Comparison of four different intraosseous access devices during simulated pediatric resuscitation. A randomized crossover manikin trial

Karol Bielski[1] · Lukasz Szarpak[2] · Jacek Smereka[3] · Jerzy R. Ladny[4] · Steve Leung[5] · Kurt Ruetzler[5,6]

Eur J Pediatr (2017) 176:865–871
DOI 10.1007/s00431-017-2922-z

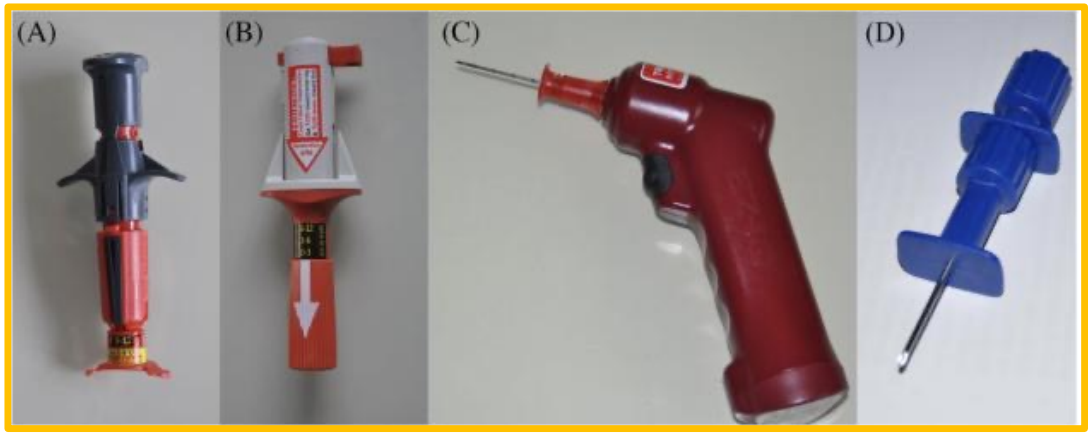
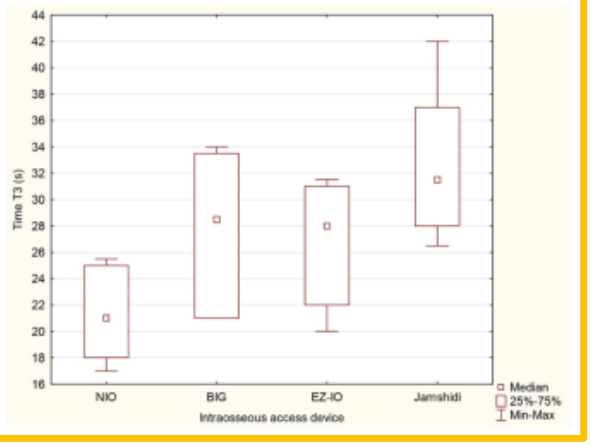


Table 1 The test parameters. The results are presented as the median (interquartile ranges IQR)

Parameter	NIO	BIG	EZ-IO	Jamshidi	*p* value
T1—time to obtain the intraosseous access	9 (8–12)	12 (9–16)	13.5 (11–17)	15 (13–19)	NIO vs. BIG = .022 NIO vs. EZ-IO = .019 NIO vs. Jamshidi <.001 BIG vs. Jamshidi = .026 EZ-IO vs. Jamshidi = .031
T2—time to stabilize the intraosseous access	9 (8–12)	15.5 (12–19.5)	13.5 (11–17)	19 (16–23)	NIO vs. BIG = .002 NIO vs. EZ-IO = .007 NIO vs. Jamshidi <.001 BIG vs. Jamshidi = .017 EZ-IO vs. Jamshidi = .012
T3—time to connect the infusion line	21 (18–25)	28.5 (21–33.5)	28 (22–31)	31.5 (28–37)	NIO vs. BIG = .011 NIO vs. EZ-IO = .013 NIO vs. Jamshidi <.001 BIG vs. Jamshidi = .035 EZ-IO vs. Jamshidi = .033
The ease of the procedure	1.5 (0.5–1.5)	2.5 (2–4)	2 (2–3.5)	6 (5–7.5)	NIO vs. BIG <.001 NIO vs. EZ-IO <.001 NIO vs. Jamshidi <.001 BIG vs. Jamshidi <.001 EZ-IO vs. Jamshidi <.001



The correct location of intraosseous access was indicated in the vast majority of all insertion attempts (NIO 100%, BIG 90%, EZ-IO 90%, and Jamshidi 90%). In summary, our study found that NIO-P is superior to BIG, EZ-IO, and Jamshidi. NIO-P achieved the highest first attempt success rate.

Comparison of 4 Pediatric Intraosseous Access Devices
A Randomized Simulation Study

Lukasz Szarpak, PhD, DPH, EMT-P, Jerzy R. Ladny, PhD, MD,† Marek Dabrowski, MSc, EMT-P,‡ Michael Ladny, MD,§ Jacek Smereka, PhD, MD,|| Sanchit Ahuja, MD,¶ and Kurt Ruetzler, PhD, MD¶#*

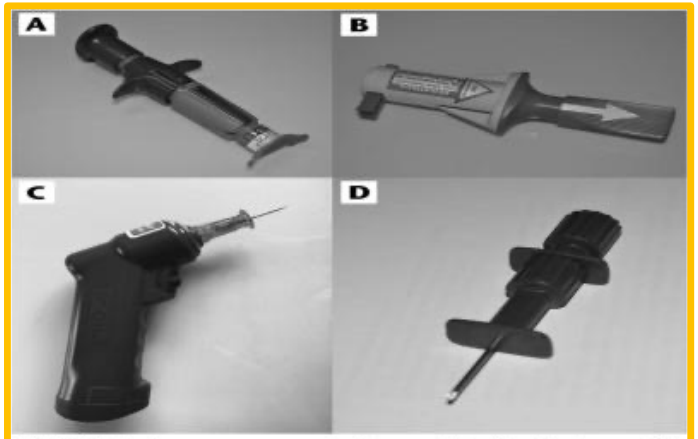


FIGURE 1. Intraosseous access devices used for this study were (A) NIO-P, (B) BIG-P, (C) EZ-IO, and (D) Jamshidi needle.

Correct IO Location Placement

The correct IO placement site was identified by 68 participants (91%), whereas 7 participants (9%) failed. Out of these 7 participants, 2 indicated the location outside of the tibia, and 5 of them indicated the location of the medial tibia tuberosity 2 centimeters above the line of tuberosity. All of those participants who did not identify the correct location were excluded and did not participated in the second part of the study.

Successful IO Attempts

During the study, a total of 272 IO access procedures were performed, from which overall 224 (82%) were successful within one single placement attempt. First placement attempt success rate ranged between Jamshidi (43%), BIG-P (90%), EZ-IO (97%), and NIO-P (100%) (Table 1).

IO Access Procedure Time

The fastest median time to achieve IO access was performed with the NIO-P using 18 seconds (IQR, 16–21), followed by EZ-IO, 23 seconds (IQR, 18–24), and BIG-P, 23 seconds (20.5–29). Placement of the Jamshidi needle took 34 seconds (IQR, 29.5–45) and was therefore the most time-consuming device (Fig. 3, Table 1).

TABLE 1. Intraosseous Access Parameters

Parameter	NIO-P	BIG-P	EZ-IO	Jamshidi	*P*
IO success rate on first attempt	68/68 (100%)	61/68 (90%)	66/68 (97%)	29/68 (43%)	0.044, NIO-P vs BIG-P <0.001, NIO-P vs Jamshidi <0.001, BIG-P vs Jamshidi <0.001, EZ-IO vs Jamshidi Others: not significant
Procedure time, s	18 (IQR, 16–21)	23 (IQR, 20.5–29)	23 (IQR, 18–24)	34 (IQR, 29.5–45)	0.034, NIO-P vs BIG-P 0.048, NIO-P vs EZ-IO <0.001, NIO-P vs Jamshidi <0.001, BIG-P vs Jamshidi <0.001, EZ-IO vs Jamshidi Others: not significant
"Ease of use"	1.5 (IQR, 1.0–1.9)	3.0 (IQR, 2.2–3.9)	2.7 (IQR, 2.4–3.8)	6.5 (IQR, 5.3–7.3)	<0.001, NIO-P vs BIG-P <0.001, NIO-P vs EZ-IO <0.001, NIO-P vs Jamshidi <0.001, BIG-P vs Jamshidi <0.001, EZ-IO vs Jamshidi Others: not significant
First choice device	39/68	11/68	18/68	0/68	<0.001, NIO-P vs BIG-P <0.001, NIO-P vs EZ-IO <0.001, NIO-P vs Jamshidi 0.031, BIG-P vs EZ-IO <0.001, BIG-P vs Jamshidi <0.001, EZ-IO vs Jamshidi

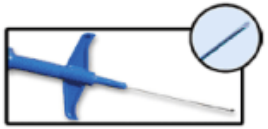
CONCLUSIONS

Obtaining IO access using mechanical devices like the NIO-P, BIG-P, and EZ-IO were much more successful, faster, associated with lower complications rate, and more user-friendly as compared with the manual device Jamshidi. Although this study provides significant evidence, further clinical trials are indicated.

Use of Intraosseous Needles in Neonates: A Systematic Review

Alexandra Scrivens[a] Peter R. Reynolds[c] Faith E. Emery[d] Calum T. Roberts[e,f]
Graeme R. Polglase[g] Stuart B. Hooper[g] Charles Christoph Roehr[a,b]

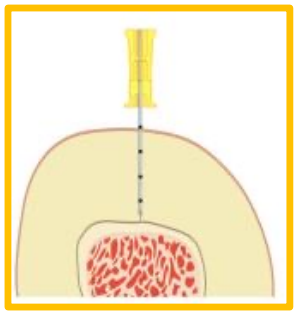
There is no evidence to suggest that IO access is preferable to UVC, it represents an effective alternative when all methods of UVC and IV access have failed or are not possible in a resuscitation scenario, either in the delivery suite or on the neonatal unit. IO is likely to be more help-ful in the latter where the umbilical cord has dried.
Safe and successful use of IO devices requires training in their insertion and monitoring
Additional studies are required to establish the effective- ness and pharmacokinetics of drugs given IO in the transi- tional circulation of a newborn.
There is very little neonatal-specific literature on IO access.

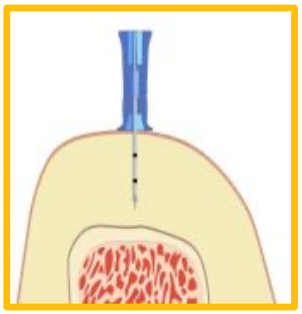
Image	Manufacturer	Device type	Purpose-built for IO?	Licenced weight or age use	Needle descriptions
 Arrow®EZ-IO®	Teleflex, USA	Battery-powered driver	Yes	>3 kg	15 G 15, 25, 45 mm needles
 Cook Needle	Cook Medical, USA	Hand driven	Yes	<24 months for smallest needle	14, 16, or 18 G 25, 30, or 40 mm needle
 Bone injection gun (BIG)*	PerSys Medical, USA	Spring loaded	Yes	0–12 years (with adjustable depth)	18 G (paediatric)
 New intraosseous device (NIO) paediatric*	PerSys Medical, USA	Spring loaded	Yes	3–12 years (with adjustable depth)	
 Butterfly needle	Multiple	Hand driven	No	Not licensed for IO	19–25 G 19 mm
 Mallarme needle	Laurane Medical, France	Hand driven	Bone marrow biopsy needle		16 G 20, 30, or 50 mm
 Spinal needle	Multiple	Hand driven	No	Not licenced for IO	Paediatric needles 22–25 G 50 mm (may not connect to standard syringes)

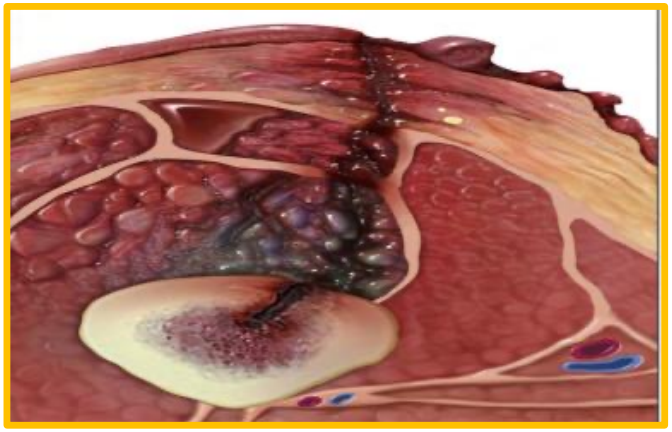
Accesso intraosseo controindicazioni e complicanze

CONTROINDICAZIONI:

- Infezioni vicino a sito d'inserzione
- Frattura dell'arto in cui si vuole introdurre l'ago
- Precedente (24 h) IO nello stesso arto
- Assenza di riferimenti anatomici (obesità grave)
- Osteogenesi imperfecta
- Osteomielite
- Ustioni
- Recente fallimento di tentativo IO nello stesso osso







COMPLICANZE:

- Stravaso di liquidi: 12% dei casi
- Osteomielite: 0,6% dei casi

Barriers to utilization of intraosseous vascular access in pediatric emergencies

Hussein Omari Sombi

College of Medicine, Sulaiman Al Rajhi University, Bukayriyah, Saudi Arabia

Clin Exp Emerg Med 2024;11(3):309-313
https://doi.org/10.15441/ceem.24.247

IO vascular access is an increasingly common procedure for quickly establishing vascular access in most pediatric emergency settings **. Familiarity with both indications and contraindications for IO access is crucial for providers of emergency medical services** (EMS).

Espite the higher success rates reported in a wide variety of clinical settings, IO access is not widely utilized in emergencies that require quick vascular access . **Recent studies report barriers to fully utilizing IO access, primarily in adult emergency situations. However, there is limited synergistic information on the factors contributing to the underutilization of the IO approach in pediatric emergency patients**

IO access should always be performed by trained, qualified, and competent professionals to ensure the safest outcomes for patients .

Considerazioni Pratiche e Best Practices

- **Attuare una corretta valutazione del paziente:** Considerare sempre la situazione clinica, l'età e le condizioni del bambino.
- **E' mandatorio conoscere e applicare protocolli chiari:** ogni PS dovrebbe avere protocolli per la gestione del DIVA pediatrico
- La **formazione** migliora efficacia e sicurezza ed è essenziale per entrambe le tecniche: IO è salvavita e va incluso nel core training

Conclusioni

Non ci sono studi che confrontino l'efficacia e la sicurezza di ***NIR & Ecoguida vs accesso IO*** in condizioni di emergenza (arresto cardiaco, politrauma maggiore con instabilità emodinamica)

Nessuna tecnica è "migliore" in assoluto

La situazione clinica e le risorse disponibili guidano la scelta con l'obiettivo di:

- Riconoscere precocemente il bambino DIVA
- Ottenere un accesso sicuro e rapido nel minor tempo possibile
- Applicare un algoritmo rapido: EV → ecoguidato → IO

Grazie per l'attenzione