XI 11TH Congresso GAVeCeLT Congress

GAVeCeLT
Gli Accessi Venosi Centrali a Lungo Termine

2019 Verona
2-3-4 Dicembre
December 2nd-3rd-4th

The new *ESA guidelines* about *ultrasound* for venous access

Daniele G. Biasucci

ESA

Gemelli

Fondazione Policlinico Universitario A. Gemelli
Università Cattolica del Sacro Cuore

EcoTIME
Ecografia in Terapia Intensiva e Medicina dell'Emergenza

Conflict of interests

- Economics
  - No conflicts of interest

- Intellectuals
  - Member of the taskforce for PERSEUS (PERioperative uSE of UltraSound) guidelines of the ESA (European Society of Anestesiology)
  - Very passionate about ultrasound in ICU ad VA!

Taskforce Coordinator

Massimo Lamperti

US guided VA in adults

Coordinator: *Daniele G. Biasucci*

Members: Massimo Lamperti, Mauro Pittiruti, Matteo Subert, Davide Vailati

US guided VA in pediatrics

Coordinator: Nicola Disma

Member: Christian Breschan

Training

Coordinators: Philip Hopkins, Andrius Macas

Members: Vilma Traškaitė Massimo Lamperti, *Daniele G. Biasucci*

Collaborators

Jean-Pierre Estebe, Regis Fuzier, Emmanuel Boselli

… once upon a time … 1978

Internal Jugular Vein Location with the Ultrasound Doppler Blood Flow Detector

JAMES I. ULLMAN, MD*
ROBERT K. STOELTING, MD†
Indianapolis, Indiana‡

Anesthesia & Analgesia

… it was the 1983 …

Anesthesiology
60:481–482, 1984

Doppler Localization of the Internal Jugular Vein Facilitates Central Venous Cannulation

DWIGHT LEGLER, M.D.,* AND MICHAEL NUGENT, M.D.†

cannulation attempts.[6,7] To avoid multiple needle probes and hopefully reduce the incidence of complications, we investigated the use of an ultrasonic Doppler to locate the IJ prior to its catheterization.[8]

- *Anesthesiology*

...few years later...

Anesthesiology
64:830–831, 1986

Real-time Ultrasonic Guidance for Percutaneous Puncture of the Internal Jugular Vein

To the Editor:—Anatomical landmarks[1] and ultrasound Doppler flowmetry[2] have been employed for the location of the internal jugular vein (IJV). We have used transcutaneous ultrasonographic scanning to determine the precise location of the IJV and to observe the procedures of venous puncture and catheterization. An ultrasonographic scanner (Echo® Camera, Model SSD-256, Aloka, Japan) equipped with a 5 MHz ultrasound transducer was used to obtain the real-time ultrasound images. With the head rotated approximately 45 degrees contralateral to the side of the puncture, povidone iodine gel was used as the acoustic coupling medium. The probe was sterilized with ethylene oxide and applied longitudinally to the neck (fig. 1). The carotid artery is the only observable structure that bears a fixed relationship to the IJV at the levels scanned.[3] Both the IJV and carotid artery are identified as echo-free band images on the oscilloscope (fig. 2). Dur-

FIG. 1. Puncture of the right internal jugular vein. T-shaped probe is positioned in right internal jugular vein.

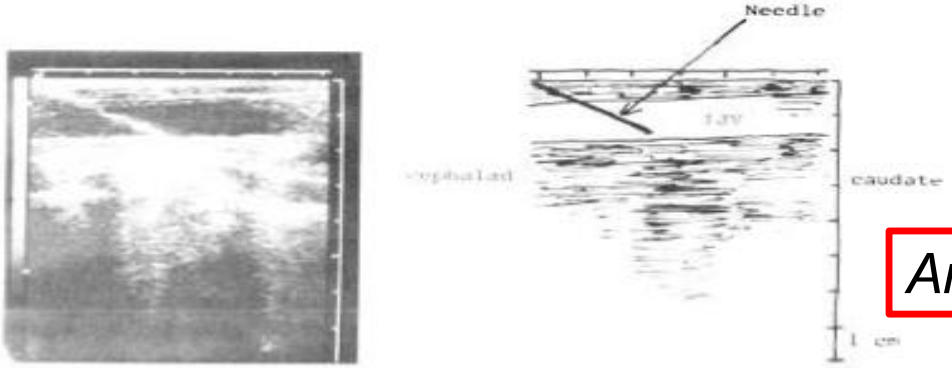


FIG. 2. The longitudinal ultrasound image of the internal jugular vein with the puncture needle in place. The internal jugular vein is observed as an echo-free band.

Anesthesiology, 1986

… since then… a lot of original papers…

REFERENCES

References to studies included in this review

Agarwal 2009 *{published data only}*

* Agarwal A, Singh DK, Singh AP. Ultrasonography: a novel approach to central venous cannulation. *Indian Journal of Critical Care Medicine* 2009;**13**(4):213–6. [DOI: 10.4103/0972-5229.60174]

Alderson 1992 *{published data only}*

* Alderson PJ, Burrows FA, Holtby HM. The use of ultrasound to facilitate central venous cannulation in young children. *Anesthesiology* 1992;**77**(3A):A1196.

Armstrong 1993 *{published data only}*

* Armstrong PJ, Cullen M, Scott DH. The 'SiteRite' ultrasound machine-an aid to internal jugular vein cannulation. *Anaesthesia* 1993;**48**(4):319–23.

Bansal 2005 *{published data only}*

Bansal R, Agarwal SK, Tiwari SC, Dash SC. A prospective randomized study to compare ultrasound-guided with nonultrasound-guided double lumen internal jugular catheter insertion as a temporary hemodialysis access. *Renal Failure* 2005;**27**(5):561–4. [PUBMED: 16152994]

Böck 1999 *{published data only}*

* Böck U, Möllhoff T, Förster R. Ultrasonography guided versus anatomically oriented puncture of the internal jugular vein for central venous catheterization [Ultraschall gesteuerte versus anatomisch orientierte Punktion der Vena jugularis interna zur zentralvenösen Katheterisierung]. *Ultraschall in der Medizin* 1999;**20**(3):98–103.

Branger 1994 *{published data only}*

* Branger B, Zabadani B, Vecina F, Juan JM, Dauzat M. Continuous guidance for venous punctures using a new pulsed Doppler probe: efficiency, safety [Guidage continu des ponctions veineuses par une nouvelle sonde Doppler pulsee: efficacite, securite]. *Nephrologie* 1994;**15**(2):137–40.

Branger 1995 *{published data only}*

* Branger B, Dauzat M, Zabadani B, Vecina F, Lefranc JY. Pulsed Doppler sonography for the guidance of vein puncture: a prospective study. *Artificial Organs* 1995;**19**(9):933–8.

Chuan 2005 *{published data only}*

* Chuan Wx, Wei W, Yu L. A randomized controlled study of ultrasound prelocation vs anatomical landmark-guided cannulation of the internal jugular vein in infants and children. *Pediatric Anesthesia* 2005;**15**(9):733–8.

Denys 1993 *{published data only}*

* Denys BG, Uretsky BF, Reddy PS. Ultrasound-assisted cannulation of the internal jugular vein. A prospective comparison to the external landmark-guided technique. *Circulation* 1993;**87**(5):1557–62.

Gilbert 1995 *{published data only}*

* Gilbert TB, Seneff MG, Becker RB. Facilitation of internal jugular venous cannulation using an audio-guided Doppler ultrasound vascular access device: results from a prospective, dual-center, randomized, crossover clinical study. *Critical Care Medicine* 1995;**23**(1):60–5.

Gratz 1994 *{published data only}*

* Gratz I, Afshar M, Kidwell P, Weiman DS, Shariff HM. Doppler-guided cannulation of the internal jugular vein: a prospective, randomized trial. *Journal of Clinical Monitoring* 1994;**10**(3):185–8.

Grebenik 2004 *{published data only}*

* Grebenik CR, Boyce A, Sinclair ME, Evans RD, Mason DG, Martin B. NICE guidelines for central venous catheterization in children. Is the evidence base sufficient?. *British Journal of Anaesthesia* 2004;**92**(6):827–30.

Hayashi 1998 *{published data only}*

* Hayashi H, Tsuzuku M, Amano M. Simplfied echo-guided internal jugular vein puncture: a comparison to the landmark-guided technique. Anesthesia and Analgesia. 1998; Vol. 86:SCA89.

Hayashi 2002 *{published data only}*

* Hayashi H, Amano M. Does ultrasound imaging before puncture facilitate internal jugular vein cannulation? Prospective randomized comparison with landmark-guided puncture in ventilated patients. *Journal of Cardiothoracic and Vascular Anesthesia* 2002;**16**(5):572–5.

Heatly 1995 *{published data only}*

* Heatly T, Berger R. Comparison of the conventional landmark technique and an ultrasound-guided approach for the placement of central venous catheters. *American Journal of Respiratory and Critical Care Medicine* 1995;**151(S)**:A333.

Hrics 1998 *{published data only}*

* Hrics P, Wilber S, Blanda MP, Gallo U. Ultrasound-assisted internal jugular vein catheterization in the ED. *The American Journal of Emergency Medicine* 1998;**16**(4):401–3.

Johnson 1994 *{published data only}*

* Johnson R, ODonnell J, Fielder K. Ultrasound guidance for cannulation of the internal jugular vein (IJV) in the critically ill. A randomized prospective study. *Critical Care Medicine* 1994;**22**(1):A28.

Karakitsos 2006 *{published data only}*

* Karakitsos D, Labropoulos N, De Groot E, Patrianakos AP, Kouraklis G, Poularas J, et al.Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients. *Critical Care* 2006;**10**(6):R162.

Legler 1983 *{published data only}*

* Legler D, Nugent M. Doppler localization of the internal jugular vein facilitates its cannulation. *Anesthesiology* 1983; **59**:A179.

Lin 1998 *{published data only}*

* Lin BS, Huang TP, Tang GJ, Tarng DC, Kong CW. Ultrasound-guided cannulation of the internal jugular vein for dialysis vascular access in uremic patients. *Nephron* 1998;**78**(4):423–8.

Mallory 1990 *{published data only}*

* Mallory DL, McGee WT, Shawker TH, Brenner M, Bailey KR, Evans RG, et al.Ultrasound guidance improves the success rate of internal jugular vein cannulation. A prospective, randomized trial. *Chest* 1990;**98**:157–60.

Milling 2005 *{published data only}*

Milling TJ Jr, Rose J, Briggs WM, Birkhahn R, Gaeta TJ, Bove JJ, et al.Randomized, controlled clinical trial of point-of-care limited ultrasonography assistance of central venous cannulation: the Third Sonography Outcomes Assessment Program (SOAP-3) Trial. *Critical Care Medicine* 2005;**33**(8):1764–9. [PUBMED: 16096454]

Ovezov 2010 *{published data only}*

* Ovezov A, Zakirov I, Vishnyakova M. Effectiveness and safety of the internal jugular vein catheterization in pediatrics: ultrasound navigation vs anatomical landmarks (a prospective, randomized, double-blind study). Electronic poster. Barcelona, ESICM, 2010.

Palepu 2009 *{published data only}*

* Palepu GB, Deven J, Subrahmanyam M, Mohan S. Impact of ultrasonography on central venous catheter insertion in intensive care. *Indian Journal of Radiology and Imaging* 2009;**19**(3):191–8. [DOI: 10.4103/0971-3026.54877]

Scherhag 1989 *{published data only}*

Scherhag A, Klein A, Jantzen JP. Cannulation of the internal jugular vein using 2 ultrasonic technics. A comparative controlled study. [Die Vena jugularis interna–Kanülierung mit Hilfe zweier Ultraschallverfahren. Eine vergleichende, kontrollierte Untersuchung]. *Anaesthesist* 1989;**38**(11):633–8.

Soyer 1993 *{published data only}*

* Soyer P, Lacheheb D, Levesque M. High-resolution sonographic guidance for transjugular liver biopsy. *Abdominal Imaging* 1993;**18**(4):360–2.

Sulek 2000 *{published data only}*

Sulek CA, Blas ML, Lobato EB. A randomized study of left versus right internal jugular vein cannulation in adults. *Journal of Clinical Anesthesia* 2000;**12**(2):142–5. [PUBMED: 10818329]

Teichgräber 1997 *{published data only}*

* Teichgräber UK, Benter T, Gebel M, Manns MP. A sonographically guided technique for central venous access. *American Journal of Roentgenology* 1997;**169**(3):731–3.

Troianos 1990 *{published data only}*

* Troianos CA, Jobes DR, Ellison N. Ultrasound guided cannulation of the internal jugular vein. *Anesthesiology* 1990;**73, No 3A**:A451.

…and meta-analysis…

  - Randolph 1996
  - Keenan 2002
  - Calvert 2003
  - Cochrane (on IJV) 2015
  - Cochrane (on ScV and FV) 2015
  - …
- All evidence prove that the systematic adoption of US guidance allows:
  - To increase first attempt success rate
  - To decrease number of complications
  - To decrease number of attempts
  - To increase cost-effectiveness
  - To decrease time to success

Calvert 2003: US guidance is cost-effective!

‘Economic modeling indicates that US is likely to save NHS resources as well as improve failure and complication rates’

‘For every 1000 procedures, a resource saving of 2000 pounds is suggested’

…different guidelines, position statements, consensus conference…
…recommend US guidance…

- ☐ AHRQ Recommendations (2001 and 2013)
- ☐ NICE Guidelines
- ☐ ESPEN Guidelines
- ☐ BCSH Guidelines
- ☐ AVA 2008 Position Statement
- ☐ ACS 2008 Position Statement
- ☐ ESPEN Guidelines
- ☐ CDC 2011 Guidelines
- ☐ SHEA-IDSA 2014 Guidelines
- ☐ EPIC 3 Guidelines
- ☐ GAVeCeLT – WINFOCUS – WoCoVA Consensus 2012
- ☐ AIEOP Position Paper 2014
- ☐ AAGBI 2016 Guidelines
- ☐ SIAARTI Good Clinical Practice 2018
- ☐ ESA Guidelines

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

JVA
ISSN 1129-7298

J Vasc Access 2014; 00 (00): 000-000
DOI: 10.5301/jva.5000314

ORIGINAL ARTICLE

Central venous access devices in pediatric malignancies: a position paper of Italian Association of Pediatric Hematology and Oncology

Alessandro Crocoli[1], Assunta Tornesello[2], Mauro Pittiruti[3], Angelica Barone[4], Paola Muggeo[5], Alessandro Inserra[1], Angelo Claudio Molinari[6], Valeria Grillenzoni[7], Viviana Durante[8], Maria Pia Cicalese[9], Giulio Andrea Zanazzo[10], Simone Cesaro[7]

Guidelines

Association of Anaesthetists of Great Britain and Ireland*

Safe vascular access 2016

A. Bodenham (Chair),[1] S. Babu,[2] J. Bennett,[3] R. Binks,[4] P. Fee,[5] B. Fox,[6] A. J. Johnston,[7] A. A. Klein,[8] J. A. Langton,[9] H. Mclure[10] and S. Q. M. Tighe[11]

LE BUONE PRATICHE PER GLI ACCESSI VASCOLARI

SIAARTI

PRO VITA CONTRA DOLOREM SEMPER

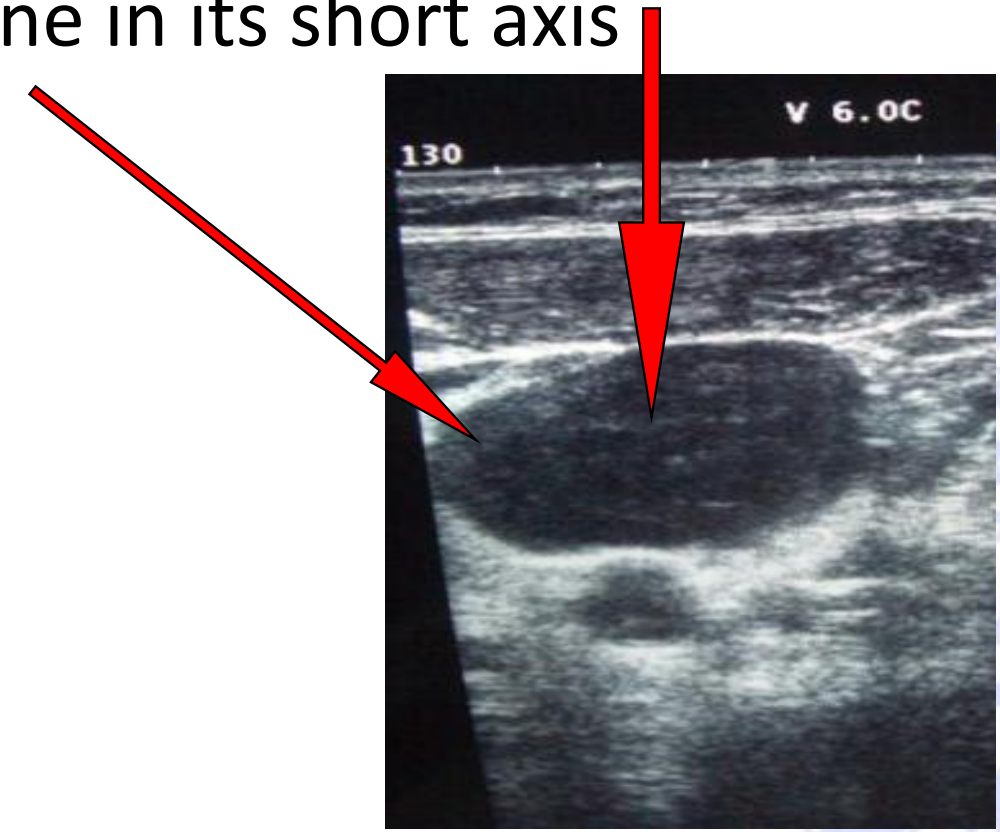
Buone pratiche cliniche SIAARTI

Autori

Cerotto V, Vailati D, Montrucchio G,
Capozzoli G, Brazzi L, Gori F

…first experiences were focused only on IJV…

- out-of-plane puncture in its short axis
- In-plane in its short axis



British Journal of Anaesthesia **106** (5): 732–7 (2011)
Advance Access publication 17 March 2011 · doi:10.1093/bja/aer031

BJA

REGIONAL ANAESTHESIA

Consecutive, prospective case series of a new method for ultrasound-guided supraclavicular approach to the brachiocephalic vein in children

C. Breschan[1]*, M. Platzer[1], R. Jost[2], H. Stettner[3], A.-S. Beyer[3], G. Feigl[4] and R. Likar[1]

British Journal of Anaesthesia **109** (5): 762–8 (2012)
Advance Access publication 23 August 2012 · doi:10.1093/bja/aes262

BJA

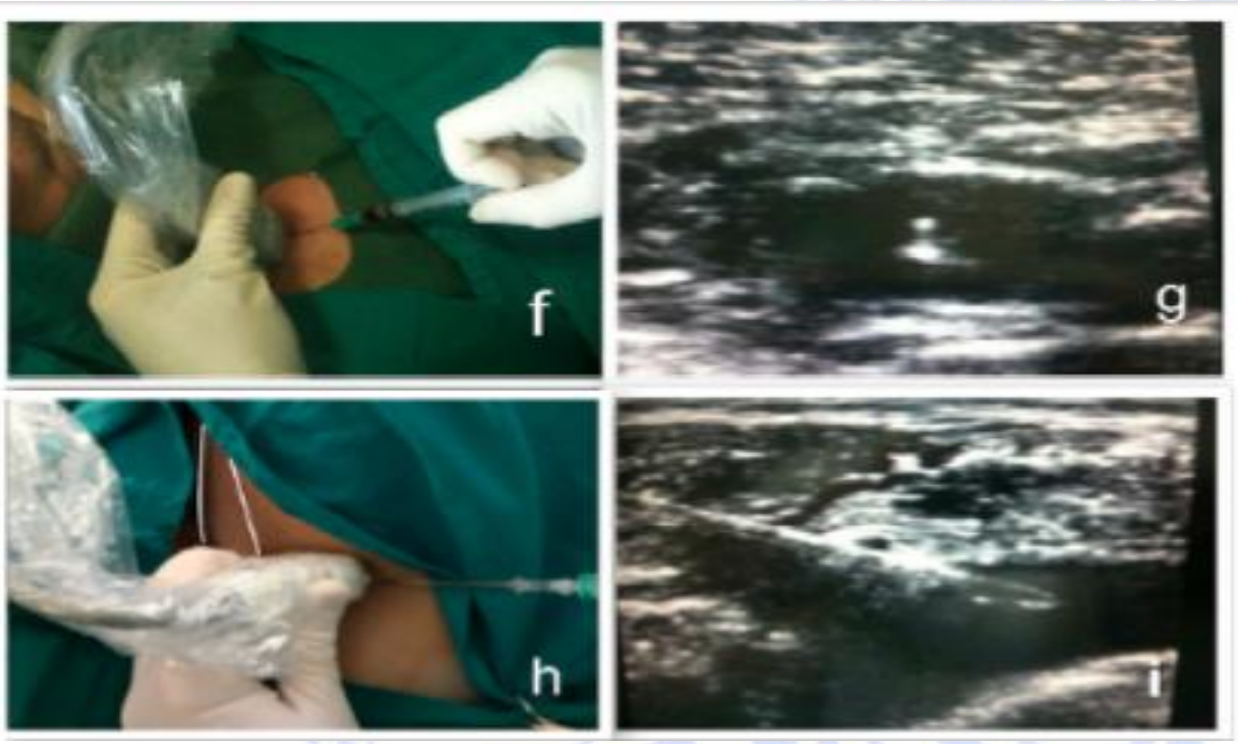
Ultrasound-guided infraclavicular axillary vein cannulation: a useful alternative to the internal jugular vein†

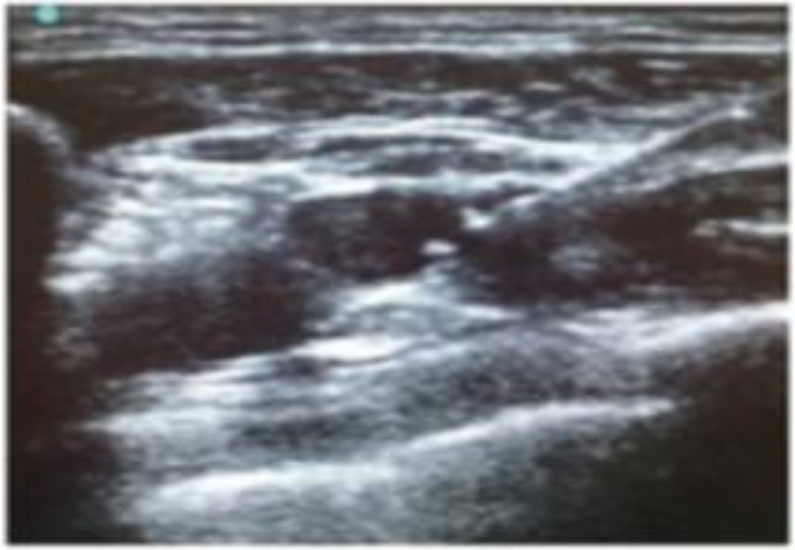
R. O'Leary, S. M. Ahmed, H. McLure, J. Oram, A. Mallick, B. Bhambra and A. R. Bodenham*

Department of Anaesthesia, Critical Care and Pain, Leeds Teaching Hospitals NHS Trust, Great George Street, Leeds LS1 3EX, UK

Editor's key points

- Cannulation of the axillary vein (AxV) provides a potential alternative to subclavian vein cannulation that is more amenable to ultrasound (US) guidance.
- A retrospective analysis evaluated the success and complications reported in a large prospectively collected database of central vein catheterization at a large UK centre.
- US-guided internal jugular and AxV catheterization were both effective and relatively safe.





Techniques in vascular access

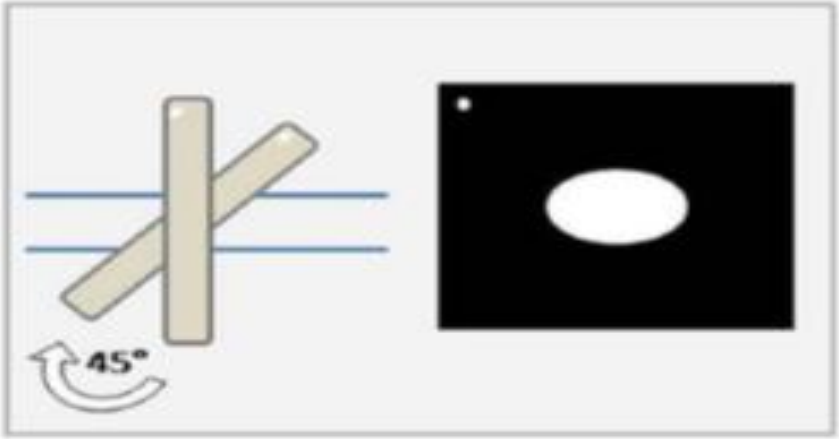
JVA The Journal of Vascular Access

A novel ultrasound-guided approach to the axillary vein: Oblique-axis view combined with in-plane puncture

Fabrizio Brescia[1], Daniele G Biasucci[2], Fabio Fabiani[1], Michela Favarato[1], Fabio Costa[3], Ferdinando Longo[3], Matteo Martuscelli[3], Michelangelo Vitiello[4] and Mauro Pittiruti[5,6]

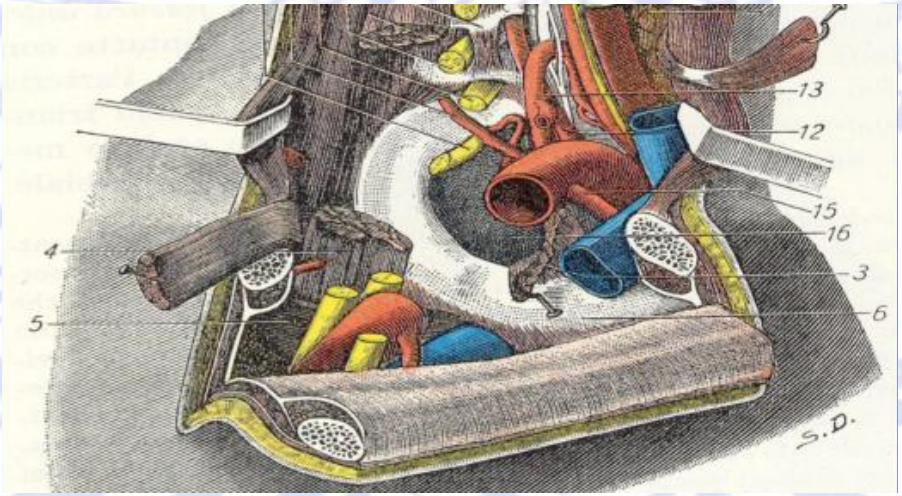
The Journal of Vascular Access
1–6

DOI: 10.1177/1129729819826034
journals.sagepub.com/home/jva
SAGE



Terminological confusion…

- US guided puncture of the ScV is possible only above the clavicle
- US guided puncture below the clavicle is a puncture of
  - Axillary Vein (on the chest)
  - Cephalic Vein (on the chest)



Ultrasound-Guided Subclavian Vein Catheterization: A Systematic Review and Metaanalysis

Manoj M. Lalu, MD, PhD, FRCPC[1,2]; Ashraf Fayad, MD, FRCPC[1,2]; Osman Ahmed, MD[3];

TABLE 2. Characteristics of Ultrasound Technology and Technique Used in Individual Studies

Study	Ultrasound Technique	Ultrasound Machine	Transducer	Patient Positioning	Approach for Imaging	Axis of Imaging	Approach for Needle	Landmark Technique Approach
Oh et al (27)	Dynamic 2D	SonoSite S-nerve (SonoSite, Bothell, WA)	7.5-MHz high-resolution	Trendelenburg	NR	Longitudinal	NR	Infraclavicular
Campbell et al (20)	Dynamic 2D	NR	NR	NR	Infraclavicular	NR	NR	NR
Fragou et al (25)	Dynamic 2D	HD11 XE ultrasound Machine (Philips, Andover, MA)	7.5-MHz high-resolution	Trendelenburg	Infraclavicular	Longitudinal	In plane	Infraclavicular
Alic et al (19), 2009	Dynamic 2D	GE Logiq Book XP	5–13 MHz transducer	NR	NR	Longitudinal	In plane	NR
Palepu et al (26)	Dynamic 2D	SonoSite (Bothell, WA)	6–13 MHz, 38-mm linear-array transducer	Trendelenburg	Infraclavicular—middle third of the clavicle	Transverse	NR	Infraclavicular
Gualtieri et al (23)	Dynamic 2D	Site Rite (Dymax Corporation, Pittsburgh, PA)	7.5 MHz	Trendelenburg	Infraclavicular—lateral aspect of clavicle	Transverse	NR	Infraclavicular
Mansfield et al (3)	Static 2D	Model 633(Hitachi Aloka, Wallingford, CT)	7.5-MHz linear arra	Trendelenburg	Infraclavicular	NR	NR	Infraclavicular
Bold et al (22)	Dynamic Doppler	Smart Needle (Peripheral Systems Group, Mountain View, CA)	14-MHz continuous-wave	NR	NR	NA	NR	Infraclavicular
Lefrant et al (21)	Dynamic Doppler	Pulsed Doppler system (Medical Biophysics Laboratory, Faculty of Medicine, Tours, France)	4-MHz pulsed single, circular	Trendelenburg	Infraclavicular	NA	Through probe indentation	Infraclavicular
Branger et al (24)	Dynamic Doppler	Pulsed Doppler system (Medical Biophysics Laboratory, Faculty of Medicine, Tours, France)	4 MHz pulsed, circular	Trendelenburg	Infraclavicular	NA	30° angulation to body of probe	Infraclavicular

NR = not reported, NA = not applicable.

Review

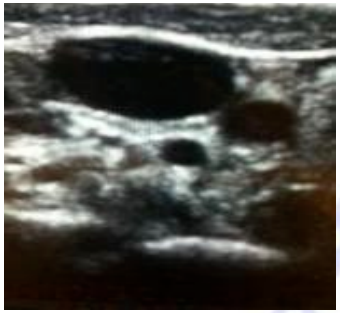
JVA | The Journal of Vascular Access

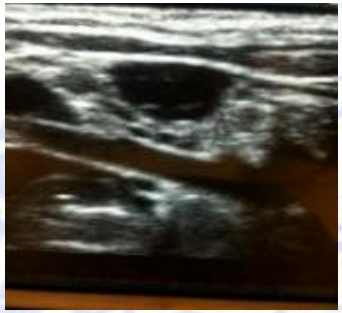
Rapid Central Vein Assessment (RaCeVA): A systematic, standardized approach for ultrasound assessment before central venous catheterization

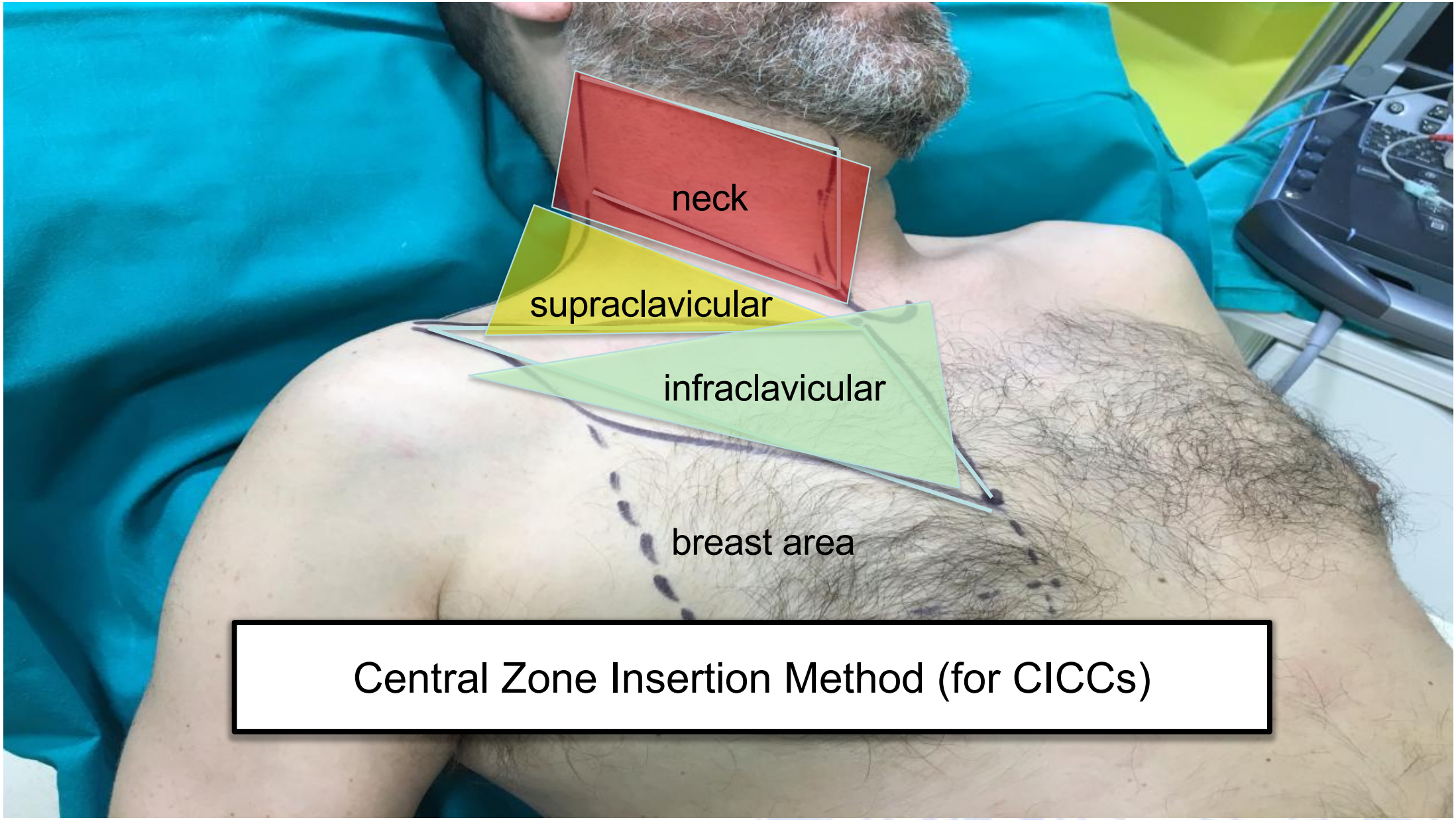
The Journal of Vascular Access
1–11

DOI: 10.1177/1129729818804718
journals.sagepub.com/home/jva
SAGE

Timothy R Spencer[1] and Mauro Pittiruti[2]



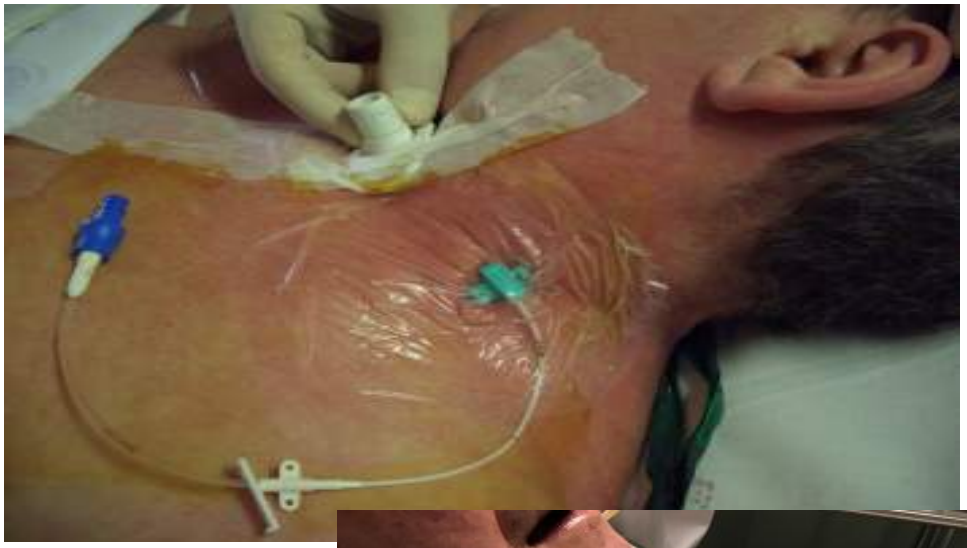




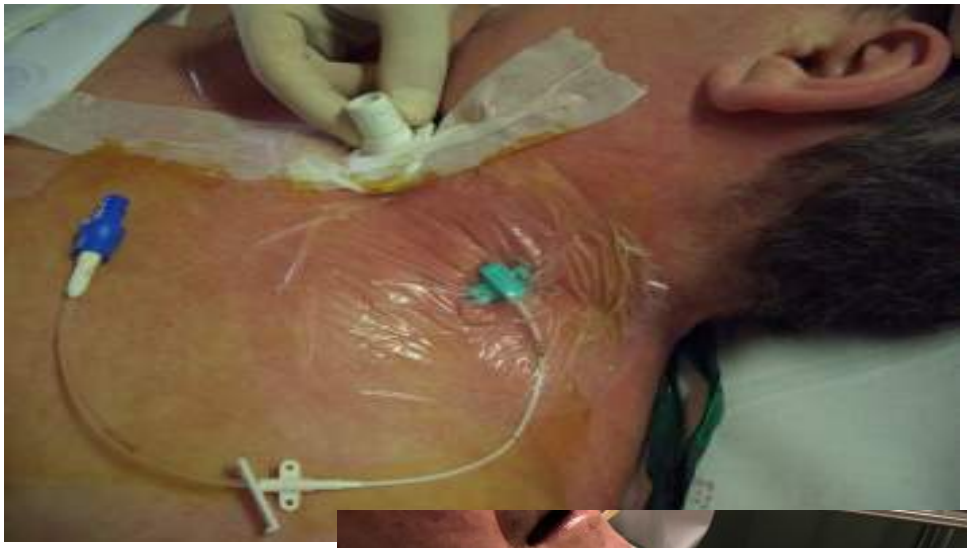
Central Zone Insertion Method (for CICCs)

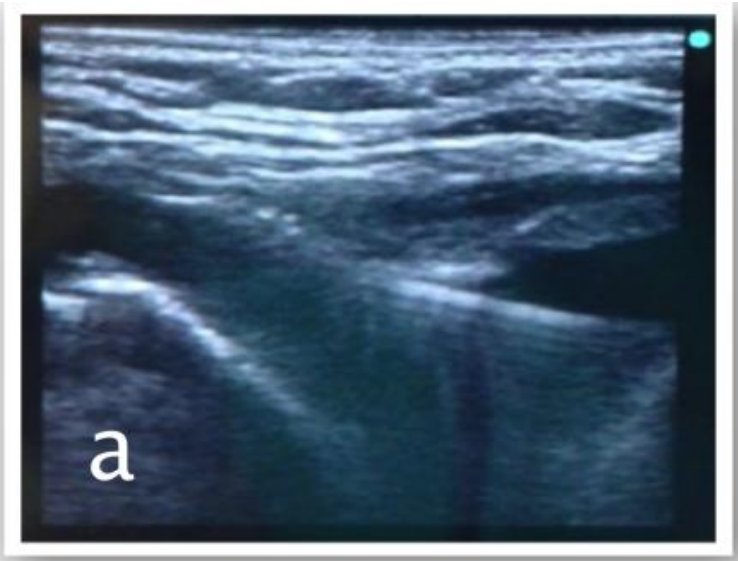
Exit site location

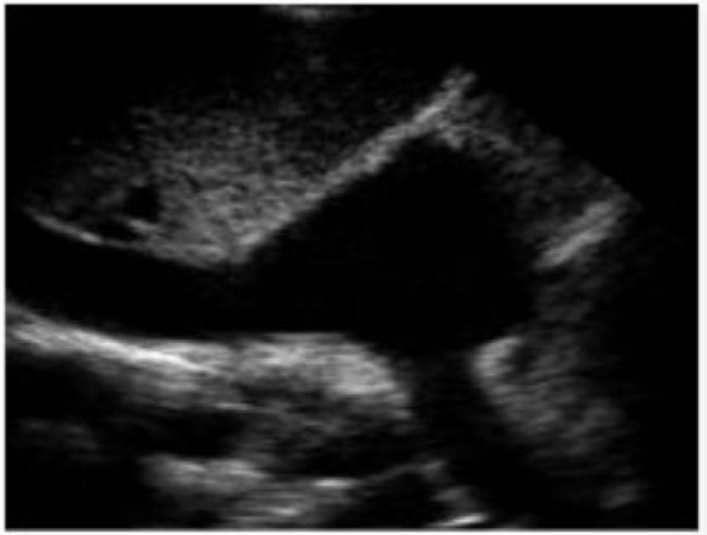
Exit site location

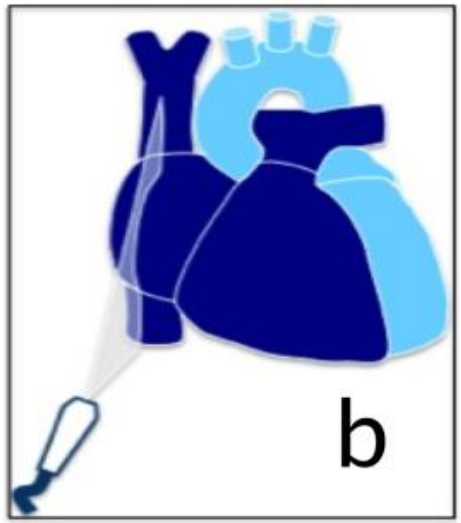


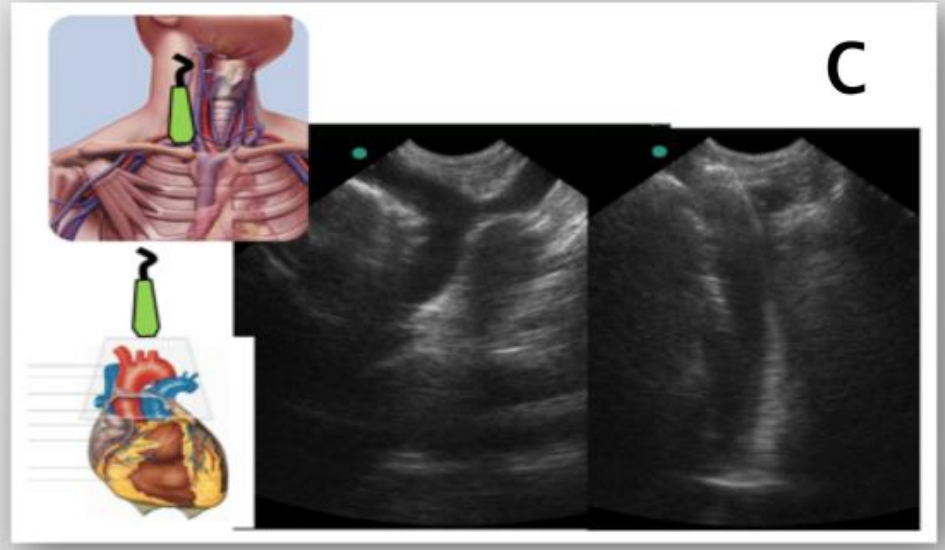

23/6

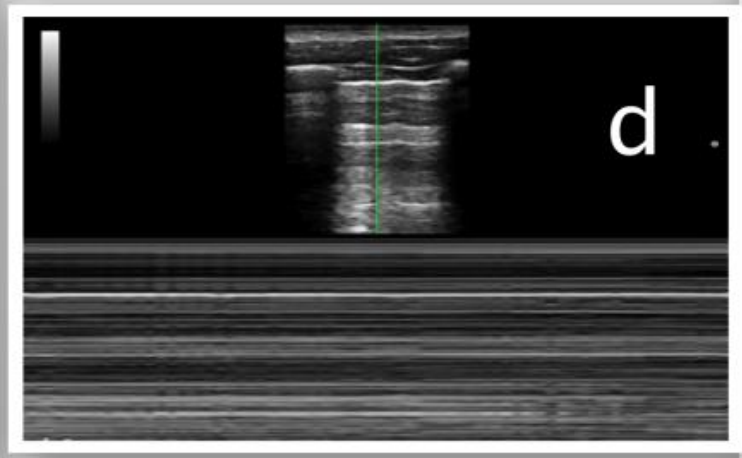


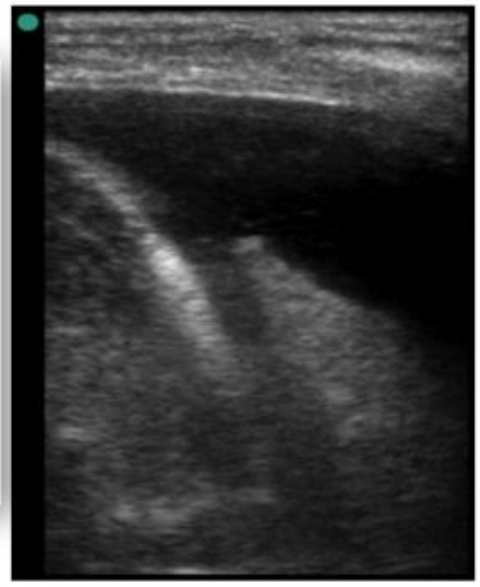

a




b


c


d



EUROPEAN GUIDELINES ON PERIOPERATIVE USE OF ULTRASOUND (PERSEUS): VASCULAR ACCESS

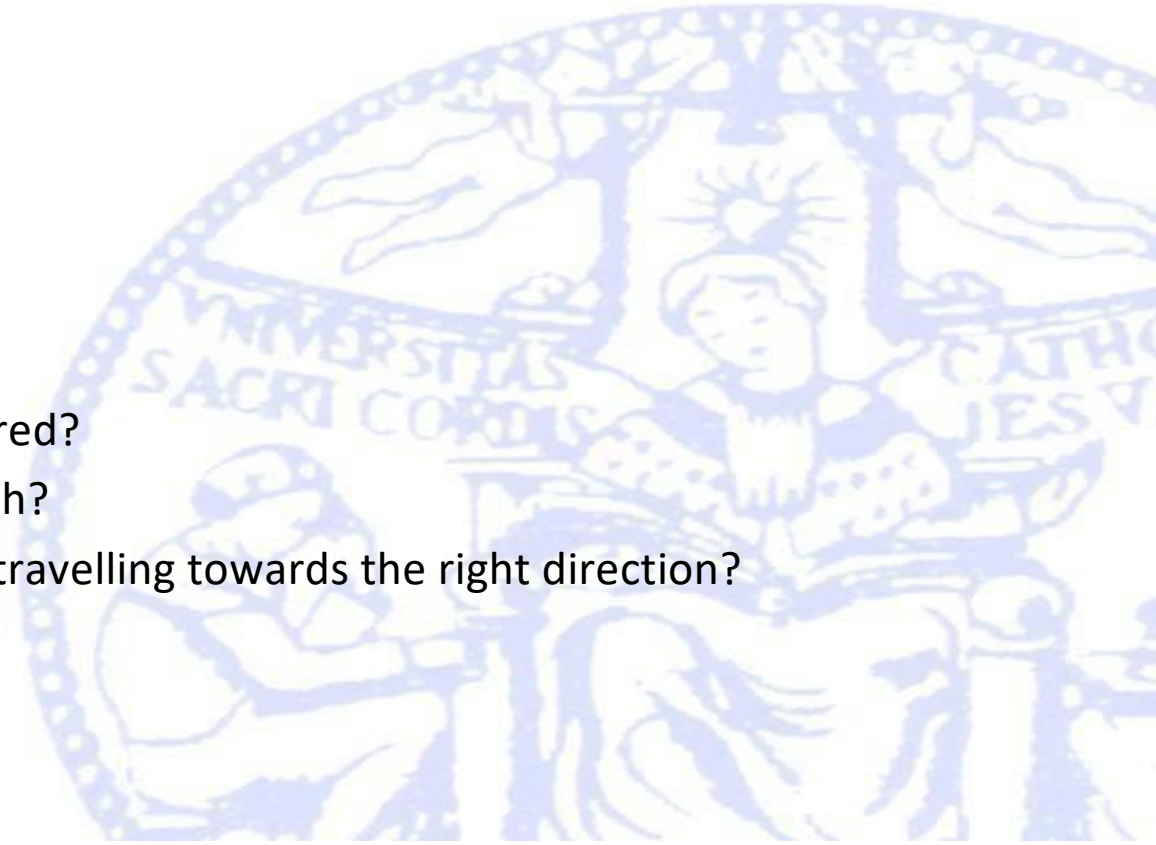
EJA
Eur J Anaesthesiol

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

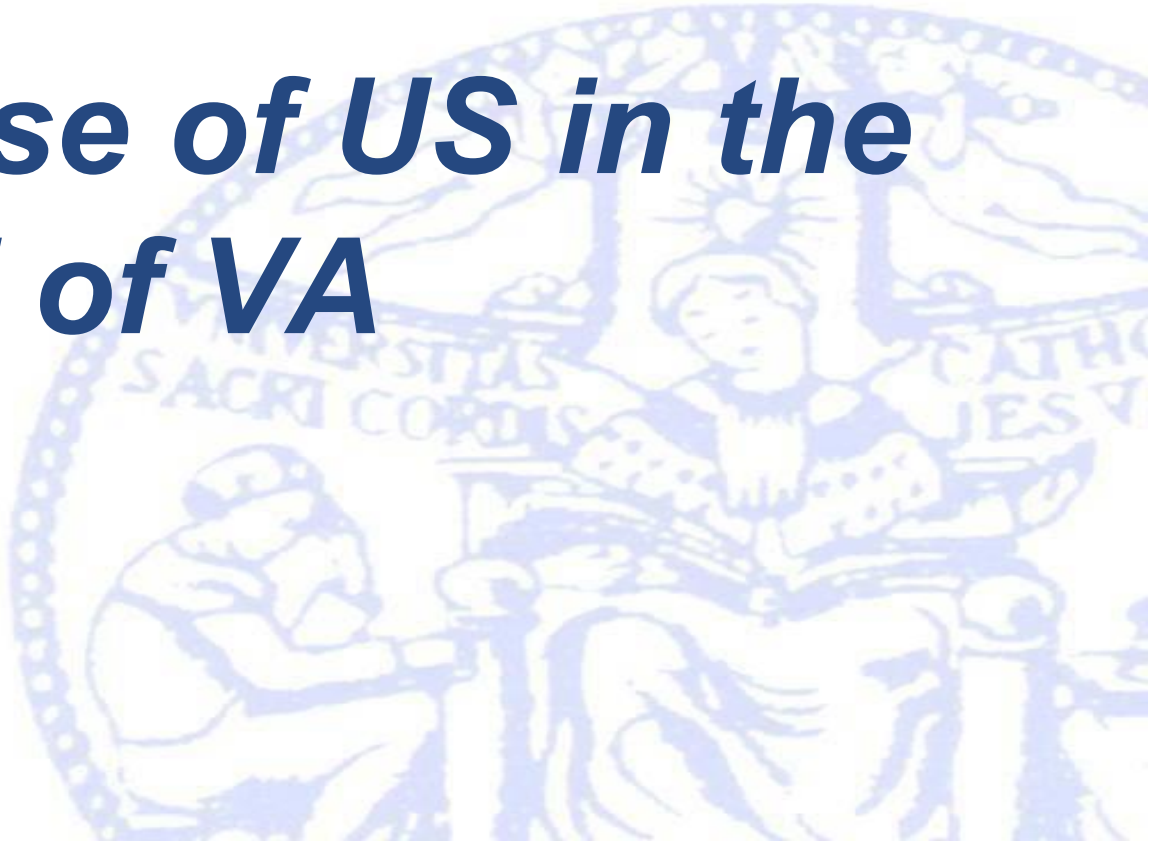
European Society of Anaesthesiology
ESA

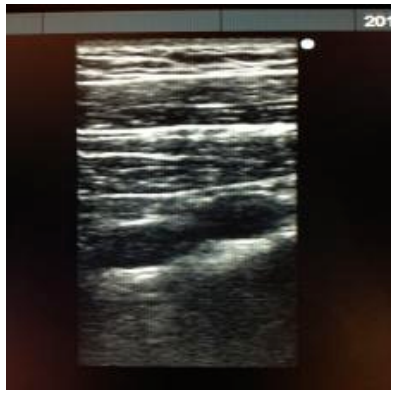
CLINICALLY-INTEGRATED POCUS

- Answer simple clinical questions
- Focused ultrasound view
  - Clinically guided
- Rapid
  - exam time approx. 10 sec-5 min
- Simple interpretation
  - Which is the safest vein to be punctured?
  - Which is the proper and safe approach?
  - Is the guidewire and/or the catheter travelling towards the right direction?
  - Where is located the tip?
  - Is there any complications?
  - …



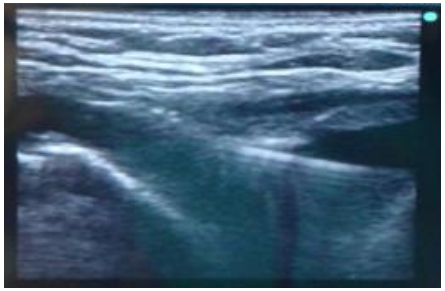
The global use of US in the field of VA





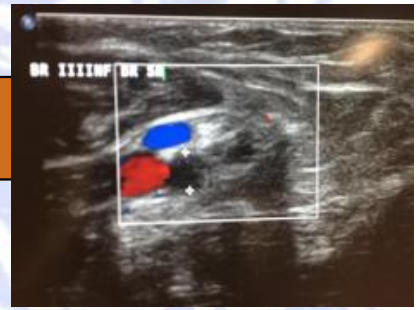
Pre-procedural US evaluation

US guided puncture



Tip navigation and Tip location

Exclusion of early and late complications



Methodology

- Literature Search
  - *Eligibility Criteria and Studies Selection*
- Meta-analysis
- Strength of evidence
- Delphi
- Review Process

Literature Search

- PICOT process
  - *Population, Intervention, Comparison, Outcome, Timing*
- Professional librarian from Cochrane Anaesthesia, Critical and Emergency Care Group, Herlev, Denmark
- From January 2010 to August 2017 and then an update up to September 2018
  - *PubMed, EMBASE (Ovid SP), Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL (EBSCO) and trial registries for on-going and unpublished studies*

PICOT Process

PICO 2

Population/problem

Adult patients requiring a femoral venous access

Intervention

Ultrasound-guided cannulation of the femoral vein

Comparators

Any other technique of femoral vein cannulation

Outcomes

Major complications (haematoma, nerve injury, thrombosis, infections)

Overall success

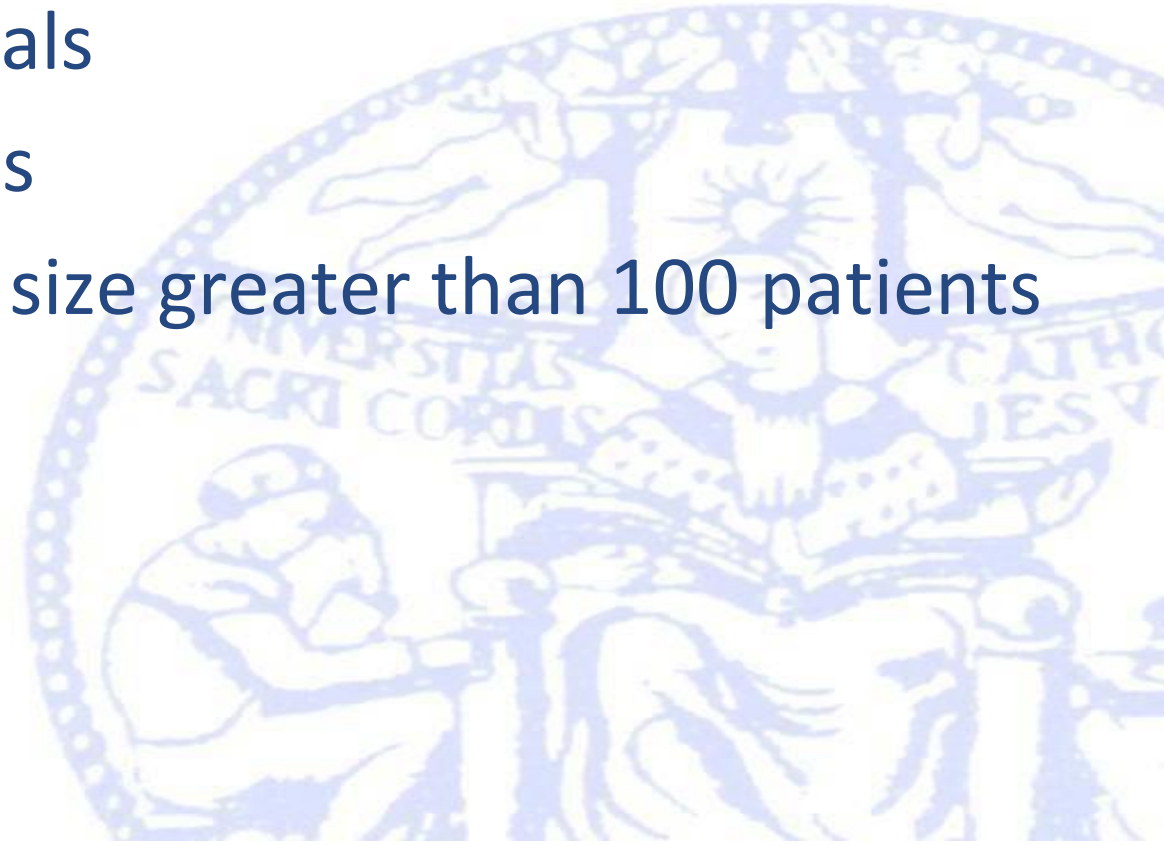
First attempt success

Timing

Any elective or emergency procedure

Eligibility Criteria and Studies Selection

- randomized controlled trials
- prospective cohort studies
- case series with a sample size greater than 100 patients



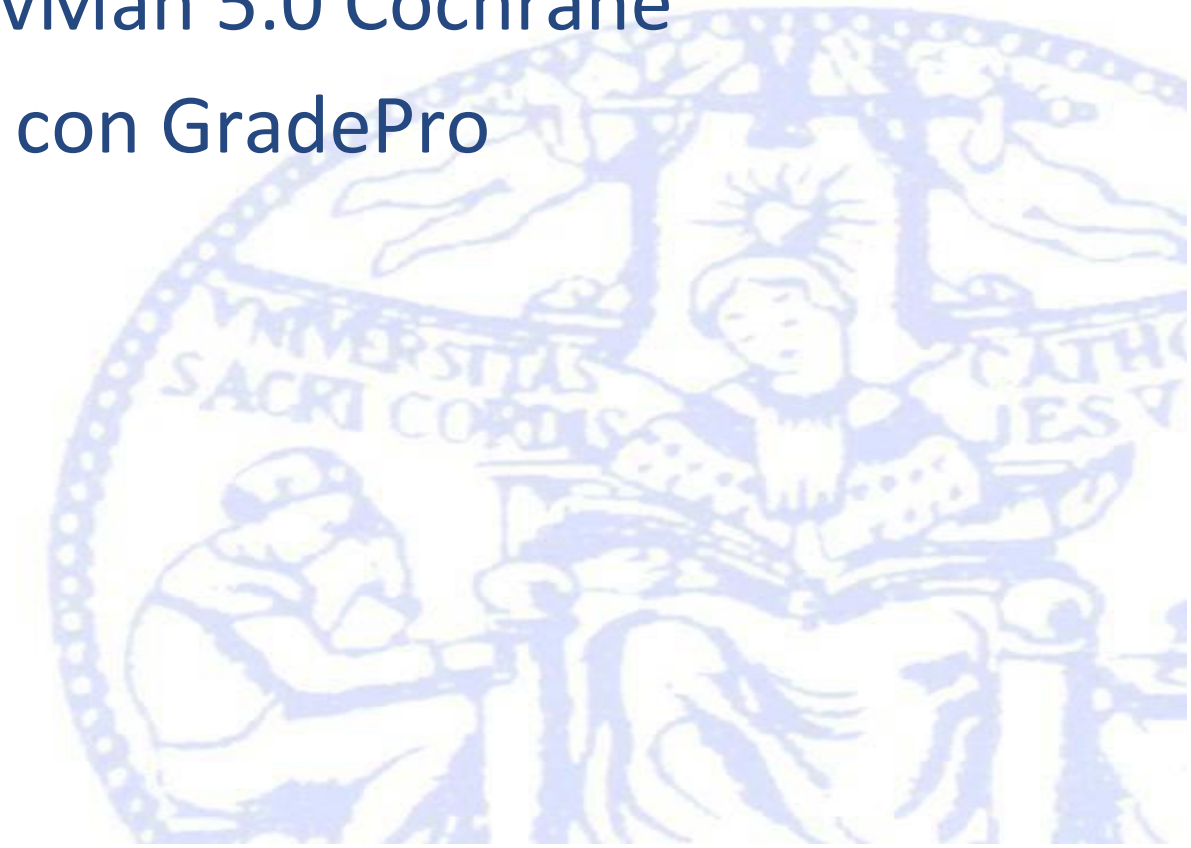
Strength of evidence

- GRADE system for assessing levels of evidence and grade of recommendations (GoR)
- RAND method with a modified Delphi process when literature did not provide enough evidence

Grade of Recommendation	Clarity of risk/benefit	Quality of supporting evidence	Implications
1A. Strong recommendation, high quality evidence	Benefits clearly outweigh risk and burdens, or vice versa.	Consistent evidence from well performed randomized, controlled trials or overwhelming evidence of some other form. Further research is unlikely to change our confidence in the estimate of benefit and risk.	Strong recommendations, can apply to most patients in most circumstances without reservation. Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
1B. Strong recommendation, moderate quality evidence	Benefits clearly outweigh risk and burdens, or vice versa.	Evidence from randomized, controlled trials with important limitations (inconsistent results, methodologic flaws, indirect or imprecise), or very strong evidence of some other research design. Further research (if performed) is likely to have an impact on our confidence in the estimate of benefit and risk and may change the estimate.	Strong recommendation and applies to most patients. Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
1C. Strong recommendation, low quality evidence	Benefits appear to outweigh risk and burdens, or vice versa.	Evidence from observational studies, unsystematic clinical experience, or from randomized, controlled trials with serious flaws. Any estimate of effect is uncertain.	Strong recommendation, and applies to most patients. Some of the evidence base supporting the recommendation is, however, of low quality.
2A. Weak recommendation, high quality evidence	Benefits closely balanced with risks and burdens.	Consistent evidence from well performed randomized, controlled trials or overwhelming evidence of some other form. Further research is unlikely to change our confidence in the estimate of benefit and risk.	Weak recommendation, best action may differ depending on circumstances or patients or societal values.
2B. Weak recommendation, moderate quality evidence	Benefits closely balanced with risks and burdens, some uncertainly in the estimates of benefits, risks and burdens.	Evidence from randomized, controlled trials with important limitations (inconsistent results, methodologic flaws, indirect or imprecise), or very strong evidence of some other research design. Further research (if performed) is likely to have an impact on our confidence in the estimate of benefit and risk and may change the estimate.	Weak recommendation, alternative approaches likely to be better for some patients under some circumstances.
2C. Weak recommendation, low quality evidence	Uncertainty in the estimates of benefits, risks, and burdens; benefits may be closely balanced with risks and burdens.	Evidence from observational studies, unsystematic clinical experience, or from randomized, controlled trials with serious flaws. Any estimate of effect is uncertain.	Very weak recommendation; other alternatives may be equally reasonable.

Grading

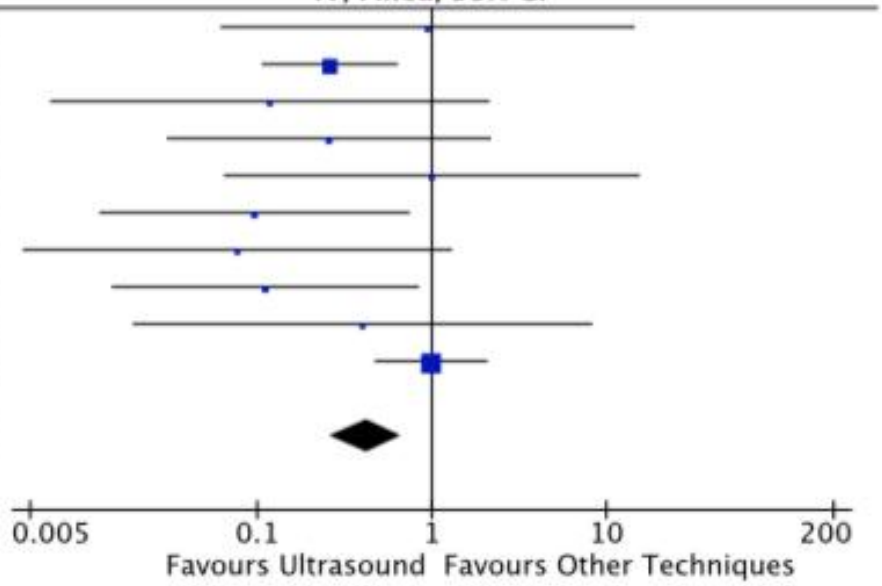
- Meta-analysis using RevMan 5.0 Cochrane
- Grading delle evidenze con GradePro



Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio IV, Fixed, 95% CI
Bobbia 2013	1	37	1	35	3.1%	0.95 [0.06, 14.55]
Burad 2016	5	49	20	51	28.5%	0.26 [0.11, 0.64]
Hansen 2014	0	22	3	18	2.7%	0.12 [0.01, 2.15]
Levin 2003	1	34	4	35	5.0%	0.26 [0.03, 2.19]
Nasreen 2016	1	50	1	50	3.0%	1.00 [0.06, 15.55]
Seto 2013	1	246	10	237	5.5%	0.10 [0.01, 0.75]
Shiver 2006	0	30	6	30	2.9%	0.08 [0.00, 1.31]
Tangwiwat 2016	1	50	9	50	5.6%	0.11 [0.01, 0.84]
Ueda 2015	0	249	2	500	2.5%	0.40 [0.02, 8.32]
Zaremski 2013	12	92	12	91	41.3%	0.99 [0.47, 2.09]
Total (95% CI)		**859**		**1097**	**100.0%**	**0.42 [0.26, 0.68]**
Total events	22		68			

Heterogeneity: $Chi^2 = 12.83$, df = 9 (P = 0.17); $I^2 = 30\%$

Test for overall effect: Z = 3.53 (P = 0.0004)



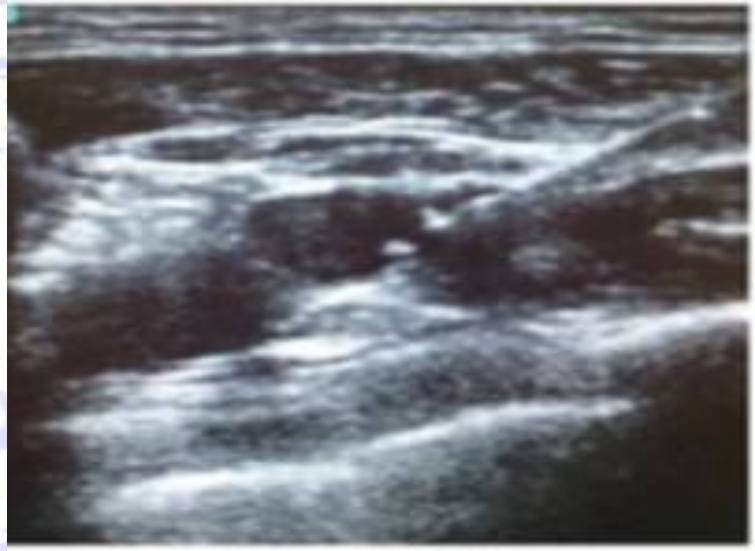
Certainty assessment							Sintesi dei risultati				
							№ di pazienti		Effetto		
№ degli studi	Disegno dello studio	Rischio di distorsione	Mancanza di riproducibilità dei risultati	Mancanza di generalizzabilità	Imprecisione	Ulteriori considerazioni	USG	LM or any other techniques	Relativo (95% CI)	Assoluto (95% CI)	Certainty
Overall success											
10	studi randomizzati	non importante	non importante	non importante	non importante	forte associazione	829/859 (96.5%)	1031/1097 (94.0%)	**OR 2.90** (1.22 a 6.93)	**39 più per 1.000** (da 10 più a 51 più)	⨁⨁⨁⨁ ALTA
First time success											
11	studi randomizzati	non importante	non importante	non importante	non importante	forte associazione	823/1226 (67.1%)	687/1469 (46.8%)	**RR 1.40** (1.22 a 1.61)	**187 più per 1.000** (da 103 più a 285 più)	⨁⨁⨁⨁ ALTA

Delphi Rounds

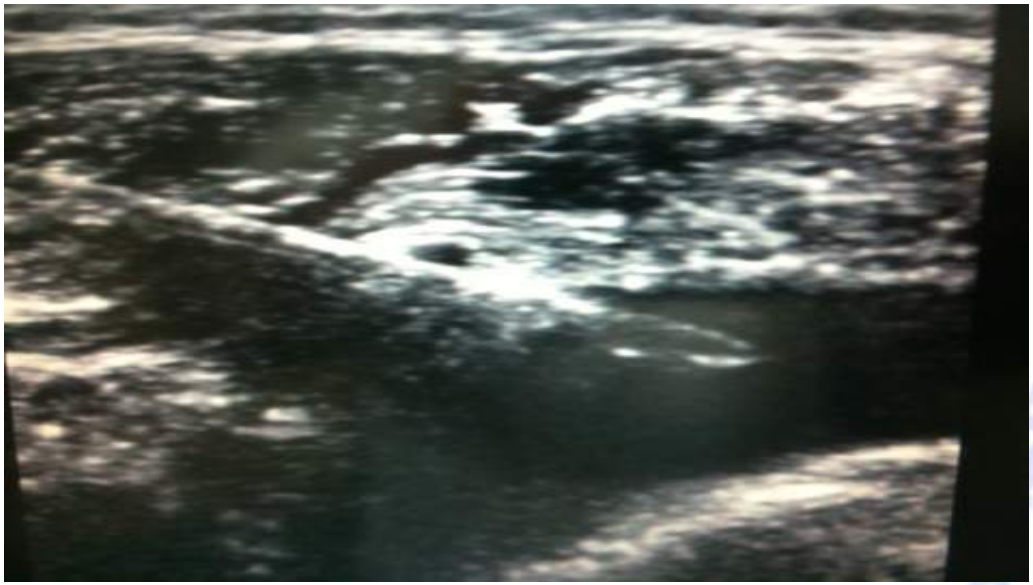
- 3 Rounds
- The median appropriateness score (MAS) to categorize a statement
  - inappropriate (MAS 1 – 3.4), uncertain appropriateness (MAS 3.5-6.9) or appropriate (MAS 7-9).
- disagreement index (DI) to quantify consensus
  - the smaller the value of DI, the greater is the consensus: a DI > 1 indicates a lack of consensus

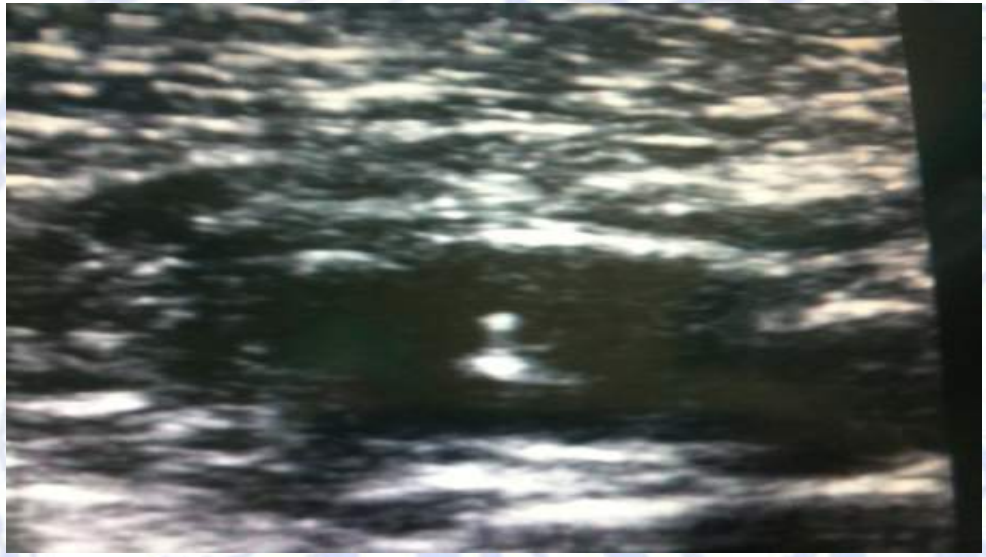
DEFINITIONS

Short, Long and Oblique Axis



‘In plane’ vs. ‘out of plane’





Nuova terminologia (WoCoVA)

CVC = cateteri venosi centrali (punta in VCS, VCI, atrio destro)

- **CICC – centrally inserted central catheters**
  - Puntura e incannulamento di vene della regione cervico-toracica (anonima, succlavia, ascellare, giug.int., giug.est., cefalica)
- **PICC – peripherally inserted central catheters**
  - Puntura e incannulamento di vene del braccio (basilica, brachiale, cefalica, ascellare)
- **FICC – femorally inserted central catheters**
  - Puntura e incannulamento di vene della regione inguinale (femorale com., femorale supf., safena)

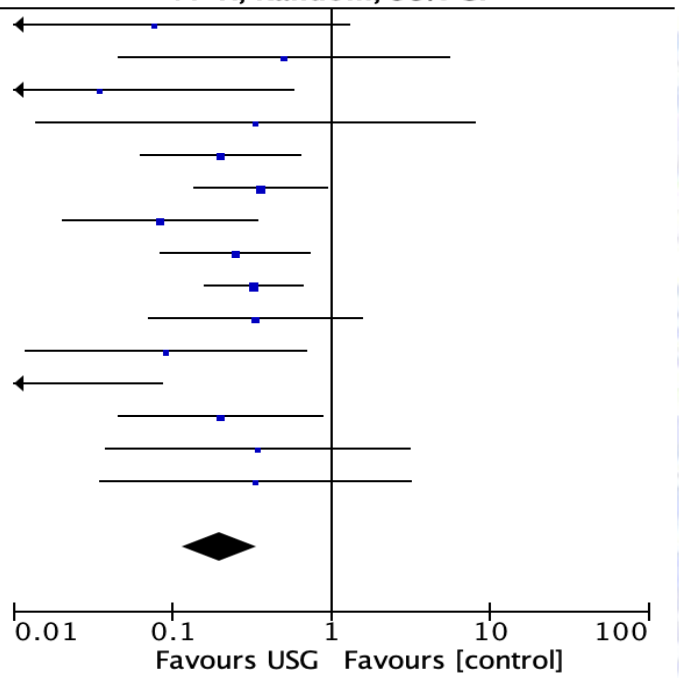
US-GUIDED VA IN ADULTS

IJV – Overall Success

Study or Subgroup	USG Events	USG Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
Airapetian 2013	0	22	6	22	3.0%	0.08 [0.00, 1.29]
Fathi 2016	1	160	2	161	3.9%	0.50 [0.05, 5.49]
Karakitsos 2006	0	225	14	225	3.0%	0.03 [0.00, 0.57]
Karimi-Sari 2014	0	50	1	50	2.4%	0.33 [0.01, 7.99]
Lee 2009	3	38	15	38	10.1%	0.20 [0.06, 0.63]
Leung 2006	5	65	14	65	11.9%	0.36 [0.14, 0.93]
Milling 2005	2	67	24	67	8.3%	0.08 [0.02, 0.34]
Palepu 2009	4	200	16	199	10.8%	0.25 [0.08, 0.73]
Rando 2014 (1)	9	128	28	129	14.5%	0.32 [0.16, 0.66]
Ray 2013	2	40	6	40	7.4%	0.33 [0.07, 1.55]
Riaz 2015	1	100	11	100	5.0%	0.09 [0.01, 0.69]
Serafimidis 2009	0	275	93	276	3.1%	0.01 [0.00, 0.09]
Shresta 2011	2	60	10	60	7.8%	0.20 [0.05, 0.87]
Tagliari 2015	1	30	3	31	4.4%	0.34 [0.04, 3.13]
Wang 2015	1	100	3	100	4.3%	0.33 [0.04, 3.15]
Total (95% CI)		**1560**		**1563**	**100.0%**	**0.20 [0.12, 0.34]**
Total events	31		246			

Heterogeneity: $Tau^2 = 0.37$; $Chi^2 = 23.04$, df = 14 (P = 0.06); $I^2 = 39\%$

Test for overall effect: Z = 6.00 (P < 0.00001)



Footnotes

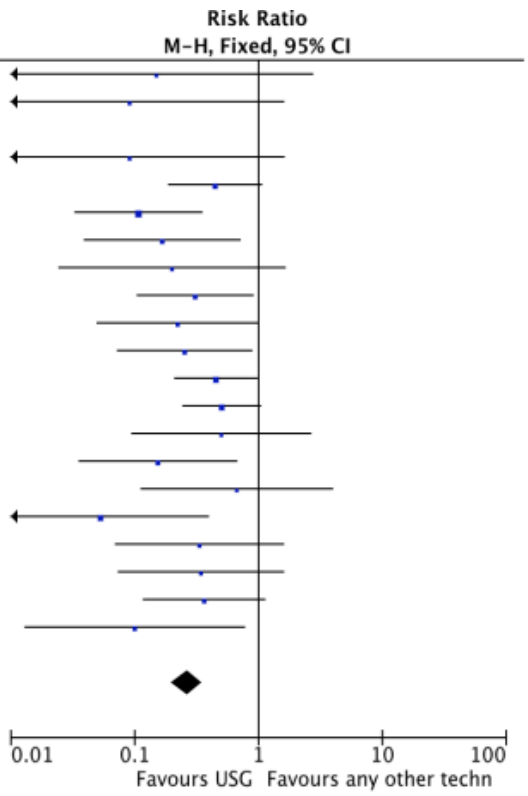
(1) overall outcome

IJV – Overall Complications

Study or Subgroup	USG Events	USG Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Airapetian 2013	0	21	3	22	1.5%	0.15 [0.01, 2.73]
Argawal 2009	0	40	5	40	2.5%	0.09 [0.01, 1.59]
Bansal 2006	0	30	0	30		Not estimable
Dolu 2014	0	50	5	50	2.5%	0.09 [0.01, 1.60]
Fathi 2016	7	159	16	162	7.2%	0.45 [0.19, 1.05]
Karakitsos 2006	3	225	28	225	12.7%	0.11 [0.03, 0.35]
Karimi-Sari 2014	2	50	12	50	5.4%	0.17 [0.04, 0.71]
Lee 2009	1	38	5	38	2.3%	0.20 [0.02, 1.63]
Leung 2006	4	75	13	75	5.9%	0.31 [0.11, 0.90]
Milling 2005	2	67	9	67	4.1%	0.22 [0.05, 0.99]
Nazali 2015	3	167	12	169	5.4%	0.25 [0.07, 0.88]
Palepu 2009	9	199	20	200	9.0%	0.45 [0.21, 0.97]
Rando 2014	10	128	20	129	9.0%	0.50 [0.25, 1.03]
Ray 2013	2	60	4	60	1.8%	0.50 [0.10, 2.63]
Riaz 2015	2	100	13	100	5.9%	0.15 [0.04, 0.66]
Schummer 2006	2	169	3	169	1.4%	0.67 [0.11, 3.94]
Serafimidis 2009	1	225	19	226	8.6%	0.05 [0.01, 0.39]
Shresta 2011	2	60	6	60	2.7%	0.33 [0.07, 1.59]
Tagliari 2015	2	36	6	37	2.7%	0.34 [0.07, 1.59]
Turker 2009	4	190	11	190	5.0%	0.36 [0.12, 1.12]
Wang 2015	1	100	10	100	4.5%	0.10 [0.01, 0.77]
Total (95% CI)		**2159**		**2169**	**100.0%**	**0.27 [0.20, 0.35]**
Total events	57		220			

Heterogeneity: $Chi^2 = 16.42$, df = 19 (P = 0.63); $I^2 = 0\%$

Test for overall effect: Z = 9.25 (P < 0.00001)



IJV

USG compared to LM or other techniques in IJV CANNULATION

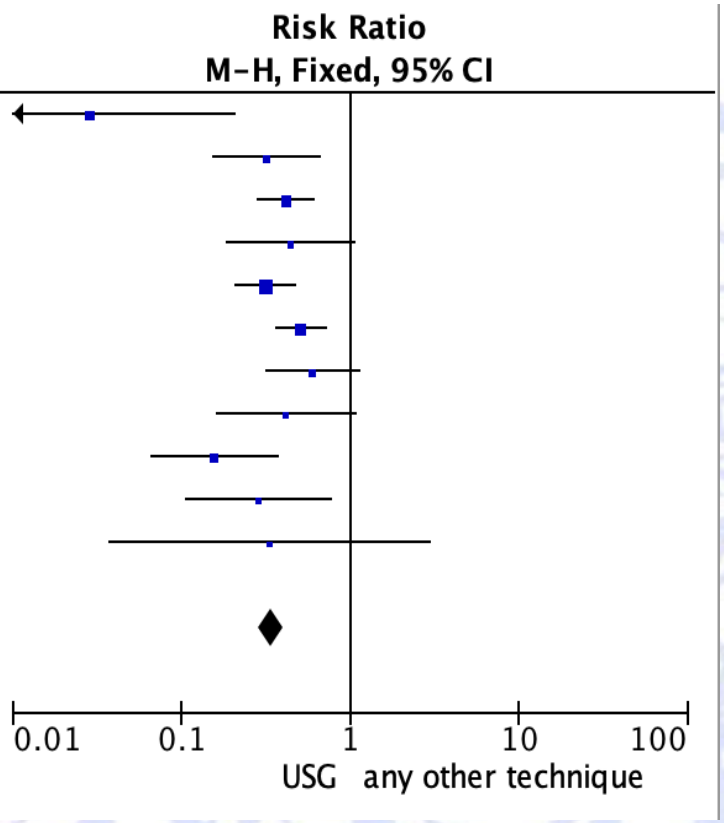
Certainty assessment							Summary of findings				
							№ of patients		Effect		
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	USG	LM or other techniques	Relative (95% CI)	Absolute (95% CI)	Certainty
overall success											
18	randomised trials	not serious	not serious	not serious	not serious	strong association	60/1739 (3.5%)	316/1741 (18.2%)	**OR 0.16** (0.12 to 0.21)	**147 fewer per 1.000** (from 137 fewer to 156 fewer)	⨁⨁⨁⨁ HIGH
major complications											
22	randomised trials	not serious	not serious	not serious	not serious	strong association	76/2175 (3.5%)	232/2177 (10.7%)	**OR 0.19** (0.14 to 0.26)	**84 fewer per 1.000** (from 76 fewer to 90 fewer)	⨁⨁⨁⨁ HIGH

IJV – first time success

Study or Subgroup	USG Events	USG Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Wang 2015	1	100	35	100	10.7%	0.03 [0.00, 0.20]
Tagliari 2015	7	38	22	38	6.7%	0.32 [0.15, 0.65]
Shresta 2011	20	60	48	60	14.7%	0.42 [0.29, 0.61]
Schummer 2006	7	168	16	170	4.9%	0.44 [0.19, 1.05]
Nazali 2015	24	168	76	168	23.2%	0.32 [0.21, 0.47]
Milling 2005	25	67	49	67	15.0%	0.51 [0.36, 0.72]
Leung 2006	12	65	20	65	6.1%	0.60 [0.32, 1.12]
Lee 2009	5	38	12	38	3.7%	0.42 [0.16, 1.07]
Dolu 2014	5	50	32	50	9.8%	0.16 [0.07, 0.37]
Bansal 2006	4	30	14	30	4.3%	0.29 [0.11, 0.77]
Airapetian 2013	1	22	3	22	0.9%	0.33 [0.04, 2.96]
Total (95% CI)		**806**		**808**	**100.0%**	**0.34 [0.28, 0.41]**
Total events	111		327			

Heterogeneity: $Chi^2 = 19.73$, $df = 10$ ($P = 0.03$); $I^2 = 49\%$

Test for overall effect: $Z = 11.56$ ($P < 0.00001$)



IJV

Recommendations

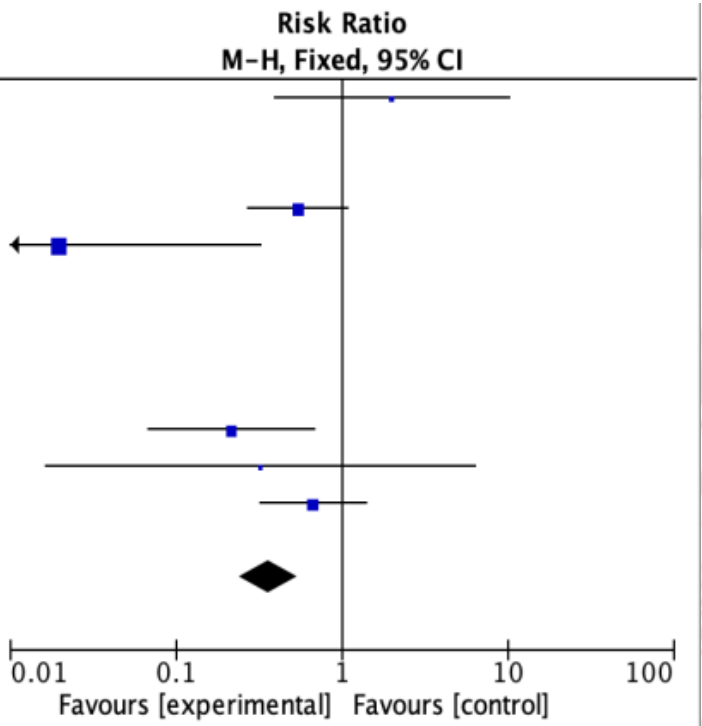
- We recommend the use of US guidance for IJV cannulation in adults, since it is safer in terms of reduction of overall complications, it improves overall and first-time success and it reduces the time to obtain a successful puncture and cannulation of the vein **(1B).**
- Use of out-of-plane approach is similar to in-plane approach when USG is used for IJV cannulation in terms of safety and efficacy [39] **(2A).**

ScV – Overall Success

Study or Subgroup	USG Events	USG Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Alic 2009	4	35	2	35	2.7%	2.00 [0.39, 10.22]
Bold 1998	36	119	13	143		Not estimable
Branger 1995	3	48	4	50		Not estimable
Campbell 2011	9	42	17	43	22.4%	0.54 [0.27, 1.08]
Fragou 2011	0	200	25	201	33.8%	0.02 [0.00, 0.32]
Gualtieri 1995	2	25	15	27	0.0%	0.14 [0.04, 0.57]
Lefrant 1998	19	143	13	143		Not estimable
Mansfield 1994	51	411	49	410		Not estimable
Milone 2010	0	0	0	0		Not estimable
Oh 2014	3	33	14	33	18.6%	0.21 [0.07, 0.68]
Palepu ScV 2009	0	17	2	28	2.5%	0.32 [0.02, 6.34]
Perbert 2015	10	75	15	75	20.0%	0.67 [0.32, 1.39]
Total (95% CI)		**402**		**415**	**100.0%**	**0.36 [0.24, 0.54]**
Total events	26		75			

Heterogeneity: $Chi^2 = 13.18$, $df = 5$ ($P = 0.02$); $I^2 = 62\%$

Test for overall effect: $Z = 4.89$ ($P < 0.00001$)

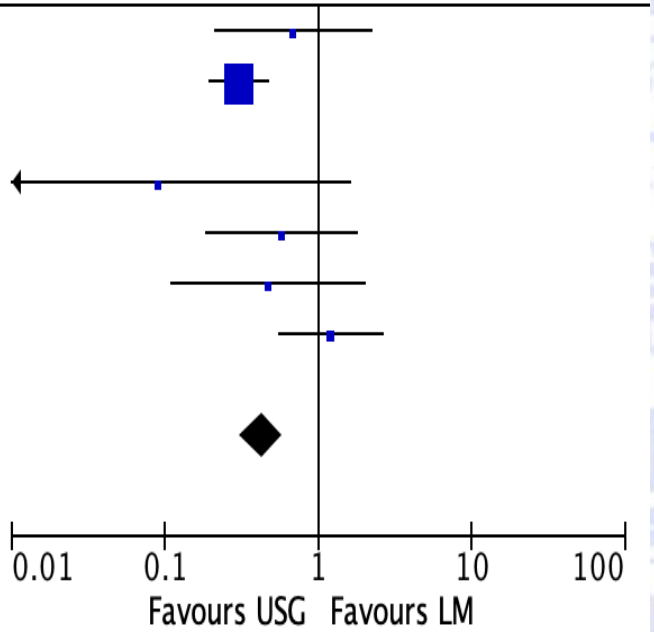


ScV – Overall Complications

Study or Subgroup	USG Events	USG Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Alic 2009	4	35	6	36	5.6%	0.69 [0.21, 2.22]
Fragou 2011	22	200	73	201	68.3%	0.30 [0.20, 0.47]
Gualtieri 1995	1	25	7	27		Not estimable
Milone 2010	0	149	5	148	5.2%	0.09 [0.01, 1.62]
Oh 2014	4	33	7	33	6.6%	0.57 [0.18, 1.77]
Palepu ScV 2009	2	17	7	28	5.0%	0.47 [0.11, 2.01]
Perbert 2015	12	75	10	75	9.4%	1.20 [0.55, 2.61]
Total (95% CI)		**509**		**521**	**100.0%**	**0.42 [0.31, 0.58]**
Total events	44		108			

Heterogeneity: $Chi^2 = 11.25$, df = 5 (P = 0.05); $I^2 = 56\%$

Test for overall effect: Z = 5.25 (P < 0.00001)



ScV

USG compared to LM or other techniques for SCV cannulation

Certainty assessment							Summary of findings			
							№ of patients		Effect	
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	USG	LM or other techniques	Relative (95% CI)	Absolute (95% CI)
overall success										
5	randomised trials	not serious	not serious	not serious	not serious	very strong association	32/376 (8.5%)	63/376 (16.8%)	**OR 0.46** (0.29 to 0.73)	**83 fewer per 1.000** (from 39 fewer to 112 fewer)
major complications										
5	randomised trials	not serious	not serious	not serious	not serious	none	10/481 (2.1%)	25/483 (5.2%)	**OR 0.39** (0.19 to 0.83)	**31 fewer per 1.000** (from 8 fewer to 41 fewer)

ScV

Recommendations

- We recommend the use of USG for SCV cannulation in adult patients, since it is safer and it reduces both the incidence of failures and of overall complications if compared to the landmark technique **(1C)**

- Weak evidence in the last decade
- No evidence on BCV

Hazardous journeys

Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials

Gordon C S Smith, Jill P Pell

BMJ VOLUME 327 20–27 DECEMBER 2003 bmj.com

Abstract

Objectives To determine whether parachutes are effective in preventing major trauma related to gravitational challenge.
Design Systematic review of randomised controlled trials.
Data sources: Medline, Web of Science, Embase, and the Cochrane Library databases; appropriate internet sites and citation lists.
Study selection: Studies showing the effects of using a parachute during free fall.
Main outcome measure Death or major trauma, defined as an injury severity score > 15.
Results We were unable to identify any randomised controlled trials of parachute intervention.
Conclusions As with many interventions intended to prevent ill health, the effectiveness of parachutes has not been subjected to rigorous evaluation by using randomised controlled trials. Advocates of evidence based medicine have criticised the adoption of interventions evaluated by using only observational data. We think that everyone might benefit if the most radical protagonists of evidence based medicine organised and participated in a double blind, randomised, placebo controlled, crossover trial of the parachute.

accepted intervention was a fabric device, secured by strings to a harness worn by the participant and released (either automatically or manually) during free fall with the purpose of limiting the rate of descent. We excluded studies that had no control group.

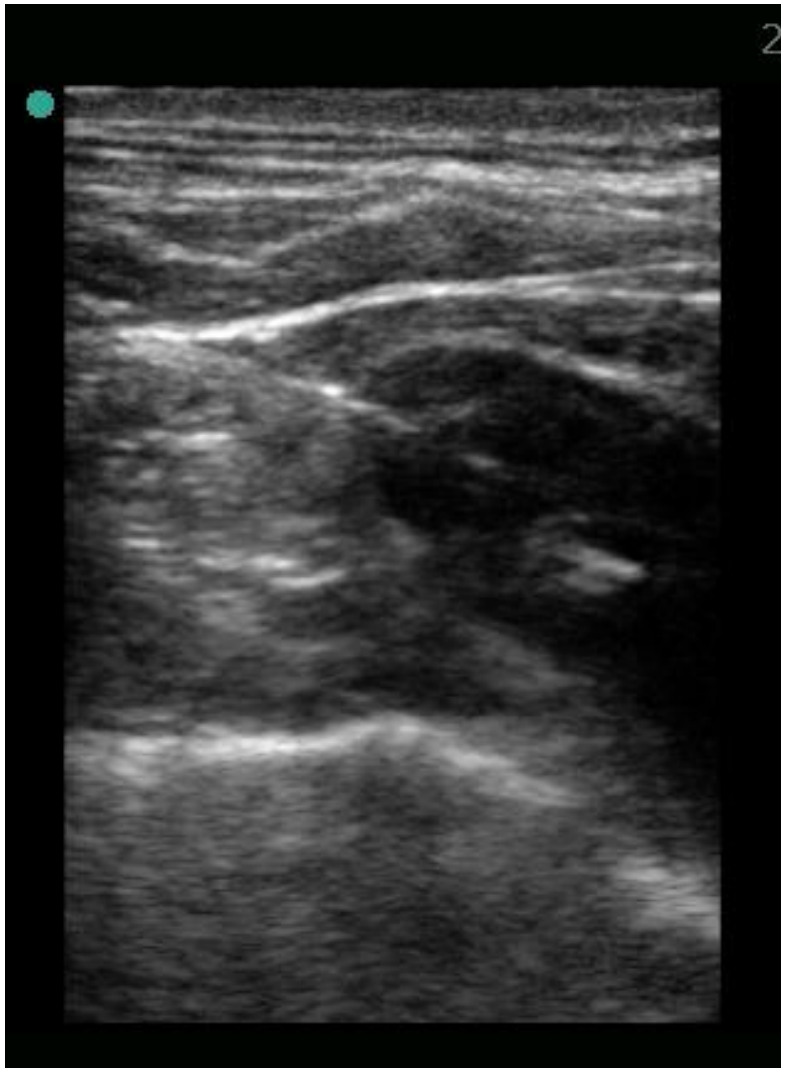
Definition of outcomes
The major outcomes studied were death or major trauma, defined as an injury severity score greater than 15.[5]

Meta-analysis
Our statistical apprach was to assess outcomes in parachute and control groups by odds ratios and quantified the precision of estimates by 95% confidence intervals. We chose the Mantel-Haenszel test to assess heterogeneity, and sensitivity and subgroup analyses and fixed effects weighted regression techniques to explore causes of heterogeneity. We selected a funnel plot to assess publication bias visually and Egger's and Begg's tests to test it quantitatively. Stata software, version 7.0, was the tool for all statistical analyses.

Results

Our search strategy did not find any randomised controlled trials of the parachute.

Parachutes reduce the risk of injury after gravitational challenge, but their effectiveness has not been proved with randomised controlled trials



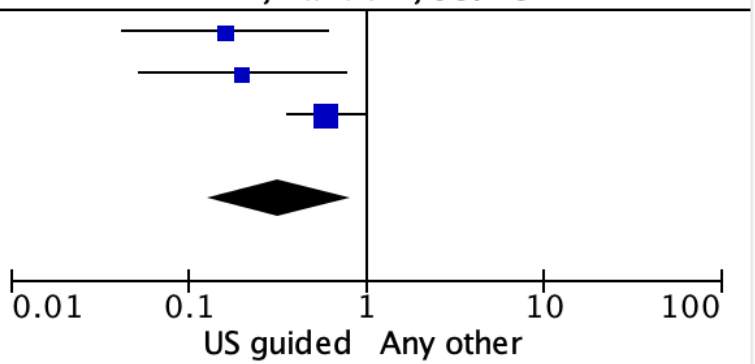

2003

BCV in Children - Complications

Study or Subgroup	US guided Events	Total	Any other Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Iwashima_2008	3	43	14	44	25.9%	0.16 [0.04, 0.61]
Law_2014	3	48	12	48	25.8%	0.20 [0.05, 0.76]
Ouleg-Erroz_2018	41	323	35	177	48.2%	0.59 [0.36, 0.97]
Total (95% CI)		**414**		**269**	**100.0%**	**0.32 [0.13, 0.81]**
Total events	47		61			

Heterogeneity: $Tau^2 = 0.40$; $Chi^2 = 4.90$, df = 2 (P = 0.09); $I^2 = 59\%$

Test for overall effect: Z = 2.42 (P = 0.02)



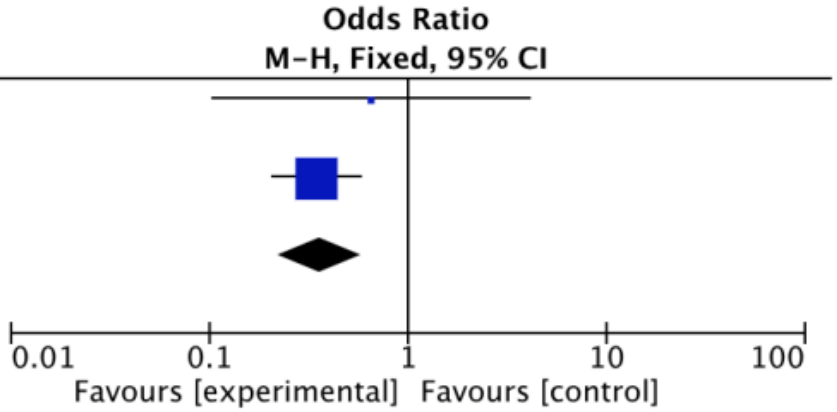
GoR 1C

AxV – First Time Success

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Licardo 2015	2	45	3	45	4.9%	0.65 [0.10, 4.10]
Licardo 2016	0	0	0	0		Not estimable
Xu 2013	21	687	57	682	95.1%	0.35 [0.21, 0.58]
Total (95% CI)		**732**		**727**	**100.0%**	**0.36 [0.22, 0.59]**
Total events	23		60			

Heterogeneity: $Chi^2 = 0.42$, $df = 1$ ($P = 0.52$); $I^2 = 0\%$

Test for overall effect: $Z = 4.06$ ($P < 0.0001$)



EUROPEAN GUIDELINES ON PERIOPERATIVE USE OF ULTRASOUND (PERSEUS): VASCULAR ACCESS

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

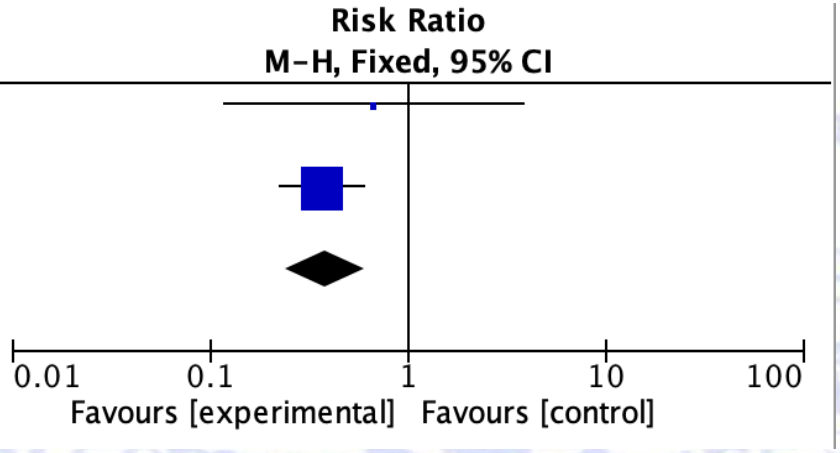
ESA

AxV– Overall Complications

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Licardo 2015	2	45	3	45	5.0%	0.67 [0.12, 3.80]
Licardo 2016	0	0	0	0		Not estimable
Xu 2013	21	687	57	682	95.0%	0.37 [0.22, 0.60]
Total (95% CI)		**732**		**727**	**100.0%**	**0.38 [0.24, 0.61]**
Total events	23		60			

Heterogeneity: $Chi^2 = 0.42$, df = 1 (P = 0.52); $I^2 = 0\%$

Test for overall effect: Z = 4.03 (P < 0.0001)



EUROPEAN GUIDELINES ON PERIOPERATIVE USE OF ULTRASOUND (PERSEUS): VASCULAR ACCESS

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

ESA

AxV

USG compared to LM or other techniques for AXV cannulation

Certainty assessment							Summary of findings			
							№ of patients		Effect	
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	USG	LM or other techniques	Relative (95% CI)	Absolute (95% CI)
overall success										
3	observational studies	not serious	not serious	not serious	not serious	none	34/906 (3.8%)	198/908 (21.8%)	**OR 0.22** (0.15 to 0.33)	**160 fewer per 1.000** (from 134 fewer to 178 fewer)
major complications										
3	observational studies	not serious	not serious	not serious	not serious	none	6/906 (0.7%)	37/908 (4.1%)	**OR 0.16** (0.07 to 0.37)	**34 fewer per 1.000** (from 25 fewer to 38 fewer)

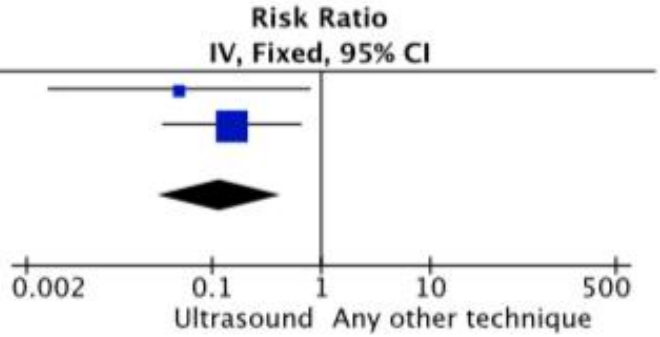
AxV

- Recommendations
  - …
  - We recommend the use of USG during axillary vein cannulation, since it reduces the risk of major complications and increases the first-time success if compared to the landmark technique (2A).

FV – Overall Success

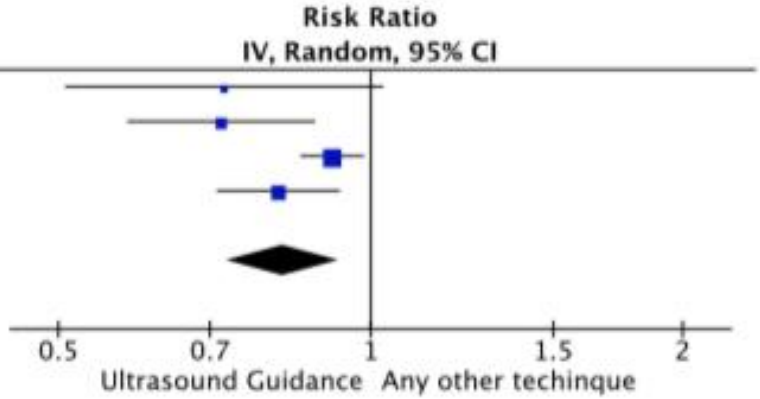
Study or Subgroup	Ultrasound Events	Ultrasound Total	Any other technique Events	Any other technique Total	Weight	Risk Ratio IV, Fixed, 95% CI
Airapetian 2013	0	36	22	82	22.0%	0.05 [0.00, 0.80]
Prabhu 2010	2	110	12	100	78.0%	0.15 [0.03, 0.66]
Total (95% CI)		**146**		**182**	**100.0%**	**0.12 [0.03, 0.44]**
Total events	2		34			

Heterogeneity: $Chi^2 = 0.48$, df = 1 (P = 0.49); $I^2 = 0\%$
Test for overall effect: Z = 3.21 (P = 0.001)



Study or Subgroup	Ultrasound Guidance Events	Ultrasound Guidance Total	Any other technique Events	Any other technique Total	Weight	Risk Ratio IV, Random, 95% CI
Hilty 1997	13	20	18	20	9.8%	0.72 [0.51, 1.03]
Kwon 1997	27	38	28	28	20.2%	0.72 [0.58, 0.88]
Powell 2014	76	83	60	60	40.3%	0.92 [0.86, 0.99]
Zollo 2001	44	55	54	55	29.7%	0.81 [0.71, 0.93]
Total (95% CI)		**196**		**163**	**100.0%**	**0.82 [0.73, 0.93]**
Total events	160		160			

Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 7.44$, df = 3 (P = 0.06); $I^2 = 60\%$
Test for overall effect: Z = 3.05 (P = 0.002)



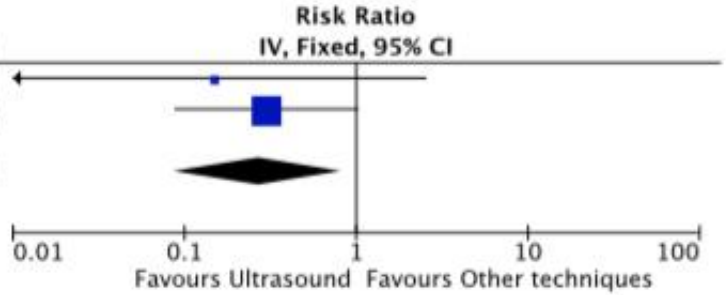
FV – Overall Success

№ degli studi	Disegno dello studio	Rischio di distorsione	Mancanza di riproducibilità dei risultati	Mancanza di generalizzabilità	Imprecisione	Ulteriori considerazioni	№ di pazienti		Effetto	
							USG	LM or any other techniq ue	Relativo (95% CI)	Assoluto (95% CI)
										23 meno)
Overall Success - observational prospective studies										
4	studi osservazionali	non importante	non importante	non importante	non importante	associazione molto forte	160/163 (98.2%)	160/196 (81.6%)	**OR 9.40** (3.09 a 28.66)	**160 più per 1.000** (da 116 più a 176 più)
Overall Success - RCTs										
2	studi randomizzati	non importante	non importante	non importante	non importante	associazione molto forte	144/146 (98.6%)	148/182 (81.3%)	**OR 9.70** (2.58 a 37.74)	**164 più per 1.000** (da 105 più a 181 più)

FV – Major Complications

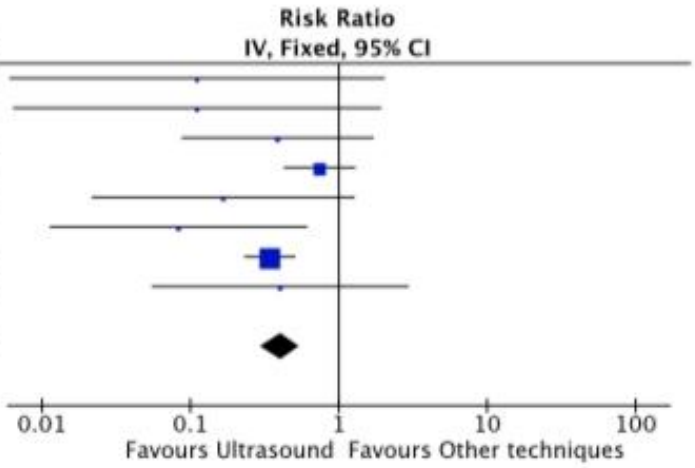
Study or Subgroup	Ultrasound Guidance Events	Total	Any Other Technique Events	Total	Weight	Risk Ratio IV, Fixed, 95% CI
Airapetian 2013	0	36	7	82	15.9%	0.15 [0.01, 2.55]
Prabhu 2010	3	55	10	55	84.1%	0.30 [0.09, 1.03]
Total (95% CI)		**91**		**137**	**100.0%**	**0.27 [0.09, 0.83]**
Total events	3		17			

Heterogeneity: $Chi^2 = 0.19$, df = 1 (P = 0.66); $I^2 = 0\%$
Test for overall effect: Z = 2.28 (P = 0.02)



Study or Subgroup	Ultrasound Guidance Events	Total	Any other technique Events	Total	Weight	Risk Ratio IV, Fixed, 95% CI
Errahmouni 2014	0	150	4	150	1.1%	0.11 [0.01, 2.05]
Hilty 1997	0	20	4	20	1.1%	0.11 [0.01, 1.94]
Kwon 1997	2	28	7	38	4.1%	0.39 [0.09, 1.73]
Powell 2014	14	60	26	83	29.4%	0.74 [0.43, 1.30]
Rodriguez-Munoz 2015	1	25	6	25	2.2%	0.17 [0.02, 1.29]
Rodriguez-Munoz_2015	1	24	6	12	2.3%	0.08 [0.01, 0.62]
Wynn 2014	24	146	78	163	57.5%	0.34 [0.23, 0.51]
Zollo 2001	1	38	15	230	2.3%	0.40 [0.05, 2.97]
Total (95% CI)		**491**		**721**	**100.0%**	**0.40 [0.30, 0.55]**
Total events	43		146			

Heterogeneity: $Chi^2 = 9.90$, df = 7 (P = 0.19); $I^2 = 29\%$
Test for overall effect: Z = 5.86 (P < 0.00001)



FV – Major Complications

№ degli studi	Disegno dello studio	Rischio di distorsione	Mancanza di riproducibilità dei risultati	Mancanza di generalizzabilità	Imprecisione	Ulteriori considerazioni	№ di pazienti		Effetto	
							USG	LM or any other techniques	Relativo (95% CI)	Assoluto (95% CI)
Major complications - observational prospective studies										
8	studi osservazionali	non importante	non importante	non importante	non importante	forte associazione	43/491 (8.8%)	146/721 (20.2%)	**RR 0.40** (0.30 a 0.55)	**121 meno per 1.000** (da 142 meno a 91 meno)
Major complications - RCTs										
2	studi randomizzati	non importante	non importante	non importante	non importante	forte associazione	3/91 (3.3%)	17/137 (12.4%)	**OR 0.23** (0.07 a 0.79)	**93 meno per 1.000** (da 114 meno a 23 meno)

FV

Recommendations

- We recommend the use of USG for cannulation of FV (or other groin veins) in adults, since it is safer, it reduces the incidence of major complications, it improves the success rate and it reduces the time to obtain a successful cannulation **(1C).**
- We also recommend the use of USG for cannulation of FV (or other groin veins) in adults, since it may indirectly decrease infectious and thrombotic complications by reducing the likelihood of some risk factors (e.g. haematoma) related to the puncture **(1C).**
- We suggest considering USG puncture of the superficial femoral vein at the mid-thigh as to have an exit site in a safe area, allowing the reduction of the risk of infection and thrombosis **(2C).**
- We recommend the out-of-plane puncture of FV in short axis. In fact, short axis allows a panoramic view of arteries and nerves so to avoid inadvertent damage of these structures **(1C).**

- **<u>Ultrasound-guided cannulation of any peripheral vein</u>**

  - ***We recommend adopting and applying a tool for the assessment of the difficult peripheral venous access*** in order to early identify those patients who may benefit US guided peripheral vein cannulation (**1C**).
  - ***We recommend the use of USG for peripheral vein cannulation in adults with moderate to difficult venous access, both in emergency and elective situations, as it is safer and more effective in terms of reduction of complications and improved overall success rate and reduced time*** to achieve vascular access (***1C***).
  - ***We recommend routine use of USG for PICC placement, taking care that the exit site be located at mid arm level (1C).***

- **<u>Ultrasound-guided cannulation of any central vein for long-term central vascular devices</u>**

  - We recommend USG for placement of long term VADs since it has been shown to significantly reduce early mechanical complications (arterial puncture, hematoma, PNX, haemothorax) (1C).
  - ***We recommend USG for placement of long term VADs since it has been shown to be a cost-effective procedure allowing to indirectly reduce complications like catheter-related thrombosis and early catheter-related infections (1C)***
  - ***We recommend USG puncture of the axillary vein at the thorax for long-term central VADs placement since it has been shown to reduce the risk of pinch-off syndrome (1C)***
  - …

- **Ultrasound-guided cannulation of an artery during elective procedures**

  - The quality of evidence on which to base recommendations is generally weak, with relatively few RCTs that have a high degree of heterogeneity.
  - ***We recommend the use of USG for radial artery catheterization in all adult hypotensive, hypovolemic and hemodynamically unstable patients*** and in those with vascular diseases and small arteries with a weak and/or thin pulse, ***since it has been proved to be more effective in reducing complications, time to obtain cannulation and number of attempts, and in increasing overall success and first-time success rate (1B).***
  - ***We recommend the use of USG in all adults needing femoral artery catheterization since it has been proved to be safer in reducing major and minor complications, and more effective increasing overall success and first-time success rate, and, thus, decreasing time to obtain cannulation*** (**1B**).
  - Before cannulation of the radial artery an Allen-test should be applied (**2C**)

- **Ultrasound for confirmation of the correct position of the central venous catheter's tip of in any patient and any elective or emergency situation**

  - ***When IC-ECG is not applicable, we recommend using US to detect and prevent CVC malposition in real-time, since it has been shown to be safe, feasible, quickly performed and interpreted at bedside, and more accurate and faster than CXR (1C).***
  - ***We recommend combining and integrating vascular US for wires and CVC tip navigation with TTE for tip location (1C).***

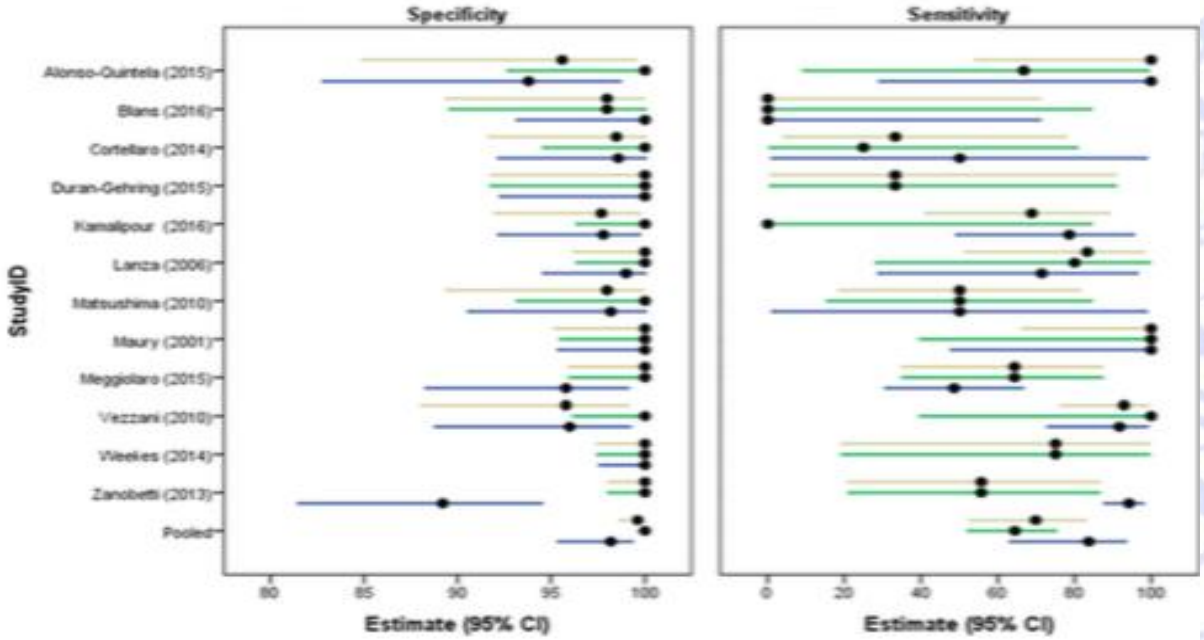
Smit *et al. Critical Care* (2018) 22:65
https://doi.org/10.1186/s13054-018-1989-x

Critical Care

REVIEW Open Access

Bedside ultrasound to detect central venous catheter misplacement and associated iatrogenic complications: a systematic review and meta-analysis

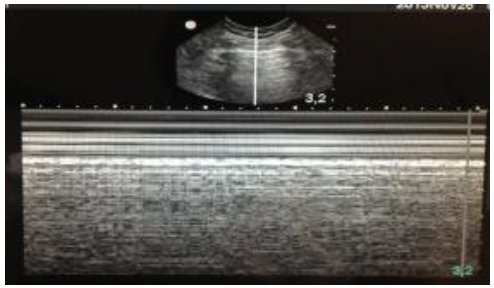
Jasper M. Smit[1,2*], Reinder Raadsen[1,2], Michiel J. Blans[3], Manfred Petjak[4], Peter M. Van de Ven[5] and Pieter R. Tuinman[1,2]



- ***"….CVC position, according to our meta-analysis, is best verified by vascular US combined with TTE…"***
- Theoretically, the best protocol is an US method incorporating a scan of the central vessels bilaterally (if needed) and visualizing the migration of the CVC tip into the heart through CEUS

- **Ultrasound for verification of immediate post-procedural life-threatening complications in patients receiving central venous catheters**

  - ***We recommend performing PLUS to rule-out potential pleura-pulmonary complications (mainly PNX) soon after the procedure in any difficult puncture of the subclavian or axillary vein, and particularly if the patient complains of shortness of breath or discomfort worsening after catheter placement (1B)***
  - We recommend using PLUS to monitor the development of a confirmed pleura-pulmonary complication or for treatment's follow-up (**1B**)
  - ***We recommend US for diagnosis and follow-up of catheter-related thrombosis (1C)***



CHEST

Official publication of the American College of Chest Physicians

Test Characteristics of Ultrasonography for the Detection of Pneumothorax: A Systematic Review and Meta-analysis

Khaled Alrajhi, Michael Y. Woo and Christian Vaillancourt

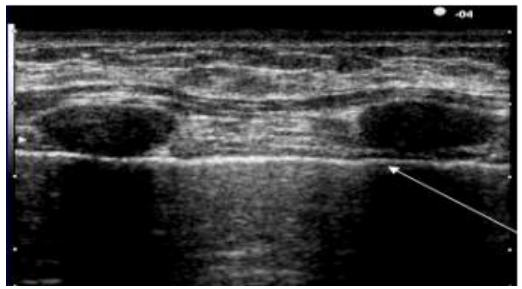
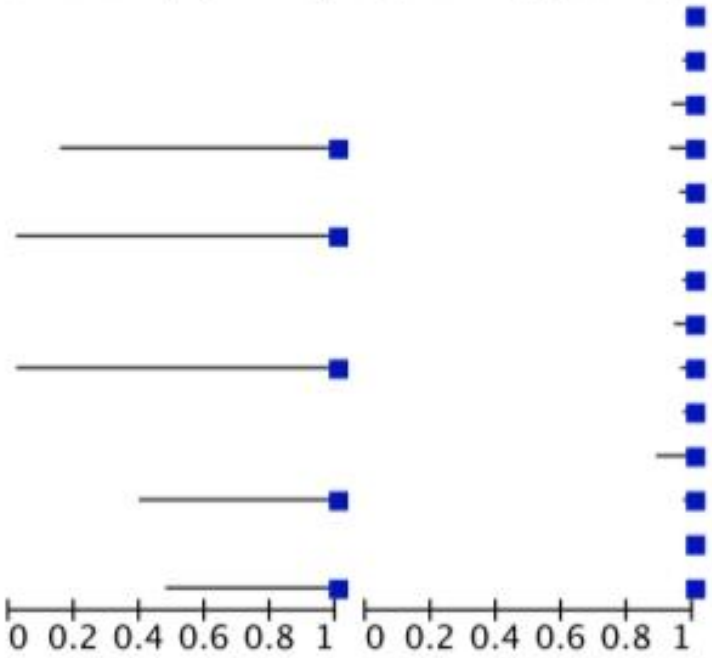


Table 2: Summary of sensitivity and specificity for included studies

Author	N	Ultrasonography		Chest X-ray	
		Sensitivity	Specificity	Sensitivity	Specificity
Blaivas[14]	176	98.1%	99.2%	75.5%	100.0%
Chung[15]	97	88.2%	89.3%	47.1%	94.0%
Garofalo[13]	184	95.7%	100%	-	-
Kirkpatrick[11]	133	48.8%	98.7%	20.9%	99.6%
Rowan[16]	27	100%	93.8%	36.4%	100.0%
Soldati[17]	186	98.2%	100%	53.6%	100.0%
Soldati[18]	109	92.0%	99.5%	52.0%	100.0%
Zhang[19]	135	86.2%	97.2%	27.6%	100.0%

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Amir 2017	0	0	0	137	Not estimable	1.00 [0.97, 1.00]
Bedel 2013	0	0	0	101	Not estimable	1.00 [0.96, 1.00]
Blans 2016	0	0	0	53	Not estimable	1.00 [0.93, 1.00]
Duran-Gehring 2015	2	0	0	48	1.00 [0.16, 1.00]	1.00 [0.93, 1.00]
Gekle 2015	0	0	0	81	Not estimable	1.00 [0.96, 1.00]
Lanza 2006	1	0	0	106	1.00 [0.03, 1.00]	1.00 [0.97, 1.00]
Madhulika 2014	0	0	0	100	Not estimable	1.00 [0.96, 1.00]
Matsushima 2010	0	0	0	59	Not estimable	1.00 [0.94, 1.00]
Maury 2001	1	0	0	84	1.00 [0.03, 1.00]	1.00 [0.96, 1.00]
Meggiolaro 2015	0	0	0	105	Not estimable	1.00 [0.97, 1.00]
Raman 2017	0	0	0	30	Not estimable	1.00 [0.88, 1.00]
Vezzani 2010	4	0	0	107	1.00 [0.40, 1.00]	1.00 [0.97, 1.00]
Weekes 2016	0	0	0	156	Not estimable	1.00 [0.98, 1.00]
Zanobetti 2013	5	0	0	205	1.00 [0.48, 1.00]	1.00 [0.98, 1.00]



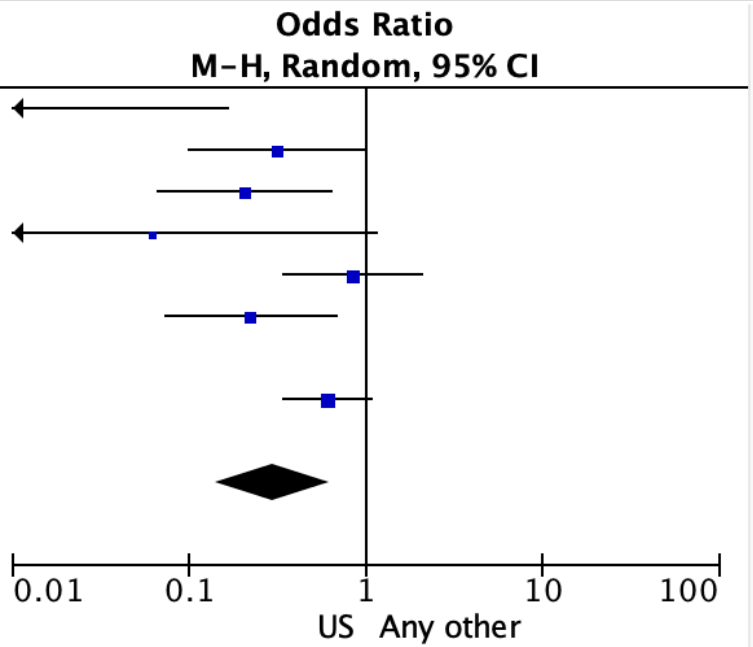
US GUIDED VA IN PEDIATRICS

IJV - Success

Study or Subgroup	US Events	US Total	Any other Events	Any other Total	Weight	Odds Ratio M-H, Random, 95% CI
Al Hamod_2016	0	29	19	29	5.2%	0.01 [0.00, 0.16]
Arai_2005	12	26	19	26	15.8%	0.32 [0.10, 1.01]
Bruzoni_2013	4	66	20	84	16.2%	0.21 [0.07, 0.64]
Chuan_2005	0	31	6	31	5.1%	0.06 [0.00, 1.16]
Froehlich_2009	11	119	10	93	18.8%	0.85 [0.34, 2.09]
Leyvi_2005	4	47	30	102	16.4%	0.22 [0.07, 0.68]
Montes-Tapia_2016	0	0	0	0		Not estimable
Ouleg-Erroz_2018	26	133	38	133	22.6%	0.61 [0.34, 1.07]
Total (95% CI)		**451**		**498**	**100.0%**	**0.30 [0.14, 0.62]**
Total events	57		142			

Heterogeneity: $Tau^2 = 0.53$; $Chi^2 = 16.29$, df = 6 (P = 0.01); $I^2 = 63\%$

Test for overall effect: Z = 3.24 (P = 0.001)

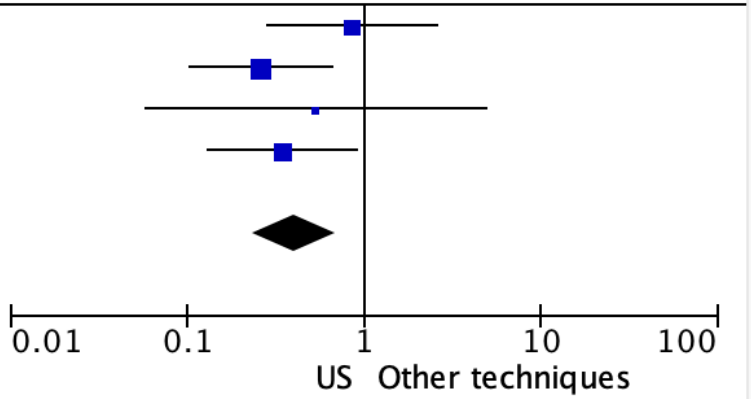


IJV Complications

Study or Subgroup	US Events	US Total	Any other Events	Any other Total	Weight	Odds Ratio M-H, Random, 95% CI
Al Hamod_2016	9	29	10	29	25.4%	0.85 [0.29, 2.56]
Froehlich_2009	7	119	18	93	36.0%	0.26 [0.10, 0.65]
Leyvi_2005	1	47	4	102	6.2%	0.53 [0.06, 4.90]
Ouleg-Erroz_2018	6	133	16	133	32.4%	0.35 [0.13, 0.91]
Total (95% CI)		**328**		**357**	**100.0%**	**0.40 [0.23, 0.70]**
Total events	23		48			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.83$, df = 3 (P = 0.42); $I^2 = 0\%$

Test for overall effect: Z = 3.22 (P = 0.001)



IJV

Recommendation

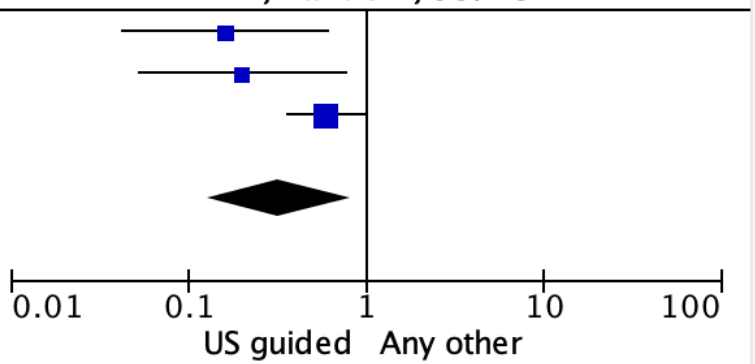
- …
- We recommend the use of USG for IJV in children as it increases the success rate, reduces the time of successful cannulation and occurrence of complications **(1B).**

BCV - Complications

Study or Subgroup	US guided Events	Total	Any other Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Iwashima_2008	3	43	14	44	25.9%	0.16 [0.04, 0.61]
Law_2014	3	48	12	48	25.8%	0.20 [0.05, 0.76]
Ouleg-Erroz_2018	41	323	35	177	48.2%	0.59 [0.36, 0.97]
Total (95% CI)		**414**		**269**	**100.0%**	**0.32 [0.13, 0.81]**
Total events	47		61			

Heterogeneity: $Tau^2 = 0.40$; $Chi^2 = 4.90$, df = 2 (P = 0.09); $I^2 = 59\%$

Test for overall effect: Z = 2.42 (P = 0.02)



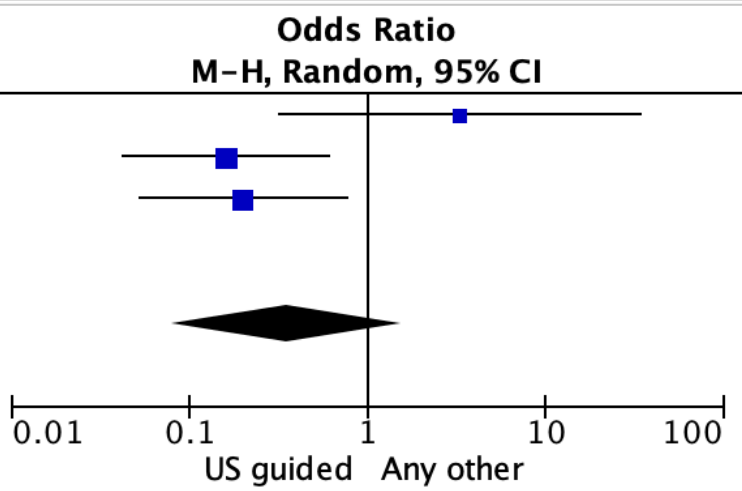
GoR 1C

FV - Complications

Study or Subgroup	US guided Events	Total	Any other Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Aouad_2010	3	24	1	24	23.4%	3.29 [0.32, 34.08]
Iwashima_2008	3	43	14	44	38.3%	0.16 [0.04, 0.61]
Law_2014	3	48	12	48	38.3%	0.20 [0.05, 0.76]
Ouleg-Erroz_2018	41	323	35	177		Not estimable
Total (95% CI)		**115**		**116**	**100.0%**	**0.35 [0.08, 1.57]**
Total events	9		27			

Heterogeneity: $Tau^2 = 1.04$; $Chi^2 = 5.18$, df = 2 (P = 0.08); $I^2 = 61\%$

Test for overall effect: Z = 1.37 (P = 0.17)



FV

Recommendation

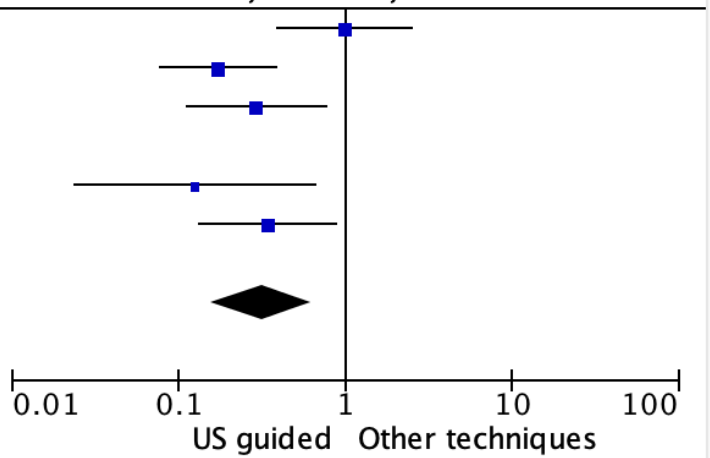
- We recommend the use of USG for FICC in children as it increases the success rate and reduces the risk of complications **(1B)**, even if the time of successful cannulation is not reduced

Arterial Line - Success

Study or Subgroup	US guided Events	Total	Any other technique Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Ganesh_2009	62	72	69	80	21.8%	0.99 [0.39, 2.49]
Ishii_2013	14	59	38	59	24.1%	0.17 [0.08, 0.38]
Min_2018	12	37	23	37	21.2%	0.29 [0.11, 0.76]
Schwemmer_2006	0	0	0	0		Not estimable
Schwemmer_2006	5	15	12	15	11.6%	0.13 [0.02, 0.66]
Ueda_2013	34	52	44	52	21.4%	0.34 [0.13, 0.88]
Total (95% CI)		**235**		**243**	**100.0%**	**0.31 [0.16, 0.62]**
Total events	127		186			

Heterogeneity: $Tau^2 = 0.34$; $Chi^2 = 9.33$, df = 4 (P = 0.05); $I^2 = 57\%$

Test for overall effect: Z = 3.31 (P = 0.0009)



Arterial Lines

Recommendation

- We recommend the use of USG for routine arterial cannulation in children as it increases the success rate **(1B).**

PV

Recommendation

- Due the paucity of well-conducted studies, we cannot recommend the routine use of US for peripheral veins cannulation in paediatric patients. Some evidence suggests the use of USG, in experienced hands, improves the success rate in case of difficult intravenous access (DIVA) in children **(2B)**

TRAINING

- Generic learning/training objectives
- Learning & assessment methods for generic competencies
- Specific learning/training objectives for US guided vascular access
- Training & assessment methods for US guided vascular access
- Performance indicators for US guided vascular access procedures
- Criteria for defining an expert trainer in US guided vascular access

Generic learning/training objectives

- It includes:
  - Procedures to minimise the risks of incorrect-site interventions
  - Procedures to minimise cross-infection from ultrasound equipment

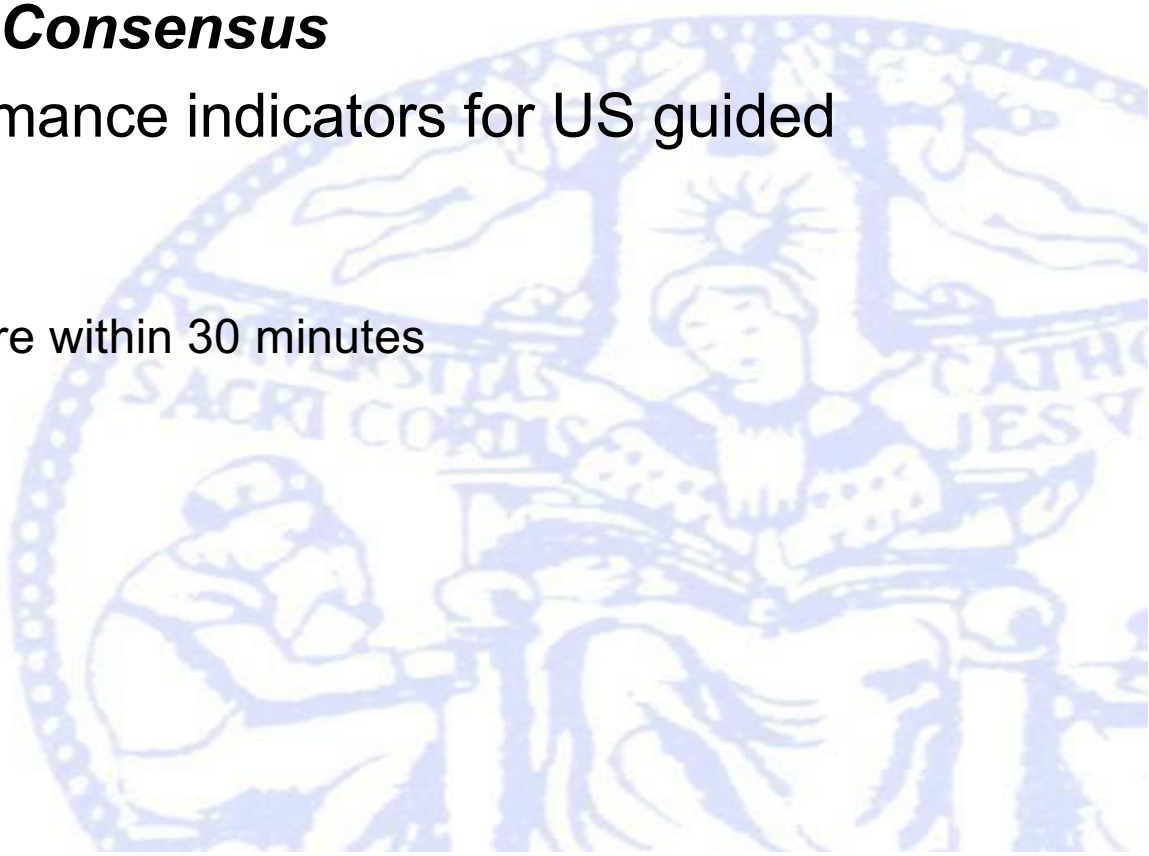
Training & assessment methods

- **Observe 5** ultrasound guided procedures
- **Perform 5** ultrasound scans on patients
- Logbook that documents every procedure
- **5 supervised** ultrasound guided procedures of each type
- For each ultrasound guided vascular access procedure the practitioner should be signed off as competent for that procedure by an expert trainer using a **global rating scale** before they perform the procedure unsupervised.
- To be eligible for completion of competency-based training in both adult and pediatric US guided vascular access the practitioner should have performed **30 US guided vascular access procedures of any type in a 12 months period**

Performance indicators for US guided vascular access procedures

Recommendations with Strong Consensus

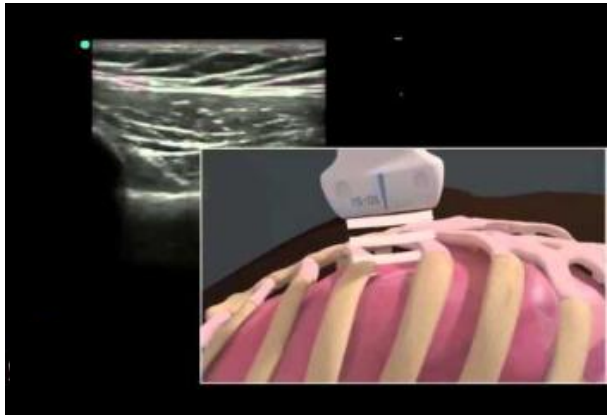
- The following are useful performance indicators for US guided vascular access:
  - First-time puncture rate
  - Successful completion of procedure within 30 minutes
  - Total procedural time
  - Incidence of major complications
  - Incidence of overall complications
  - Patients' satisfaction

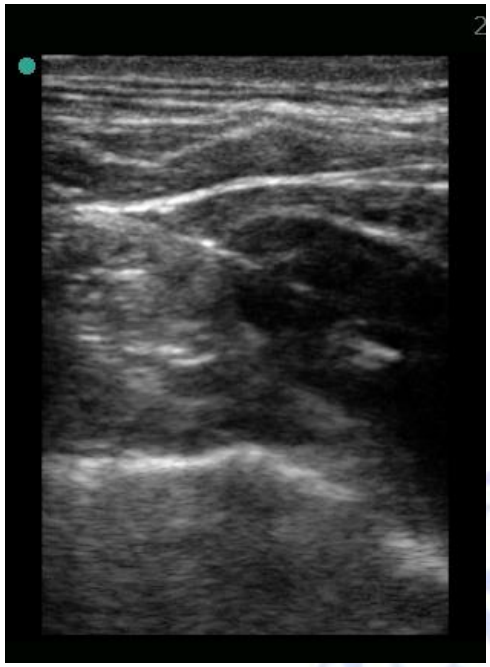


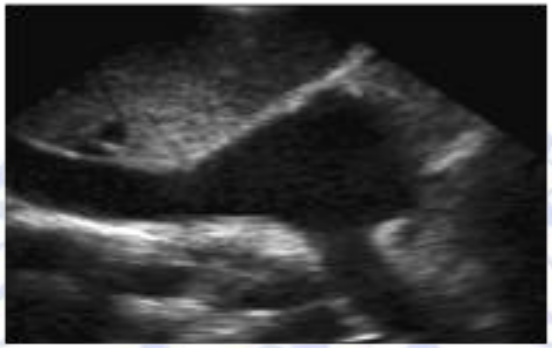
Old technology

has become

disruptive innovation!







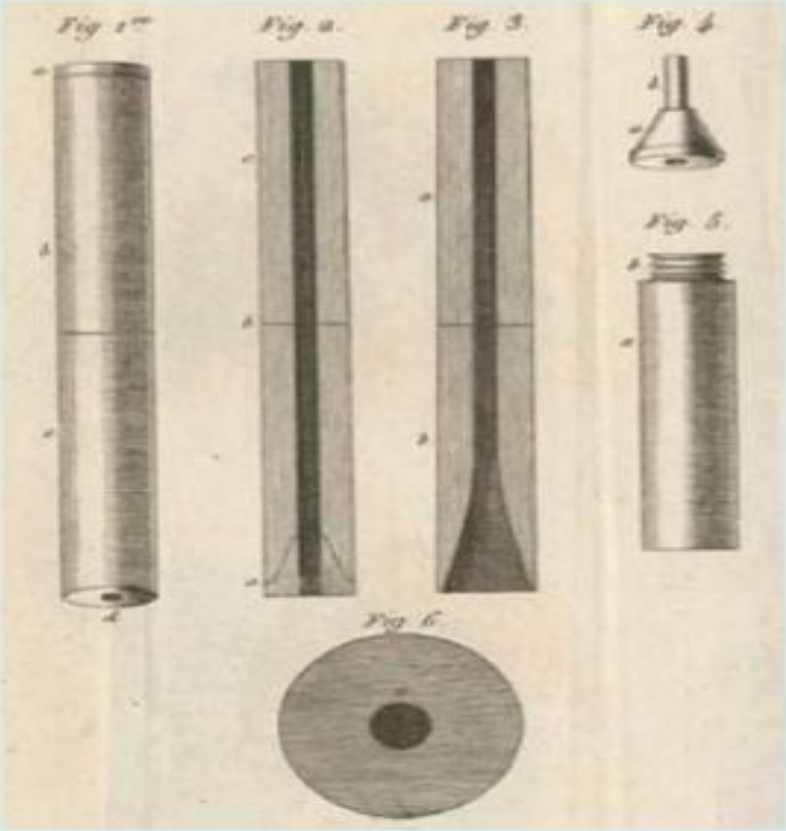
How an old technology has become a discruptive innovation

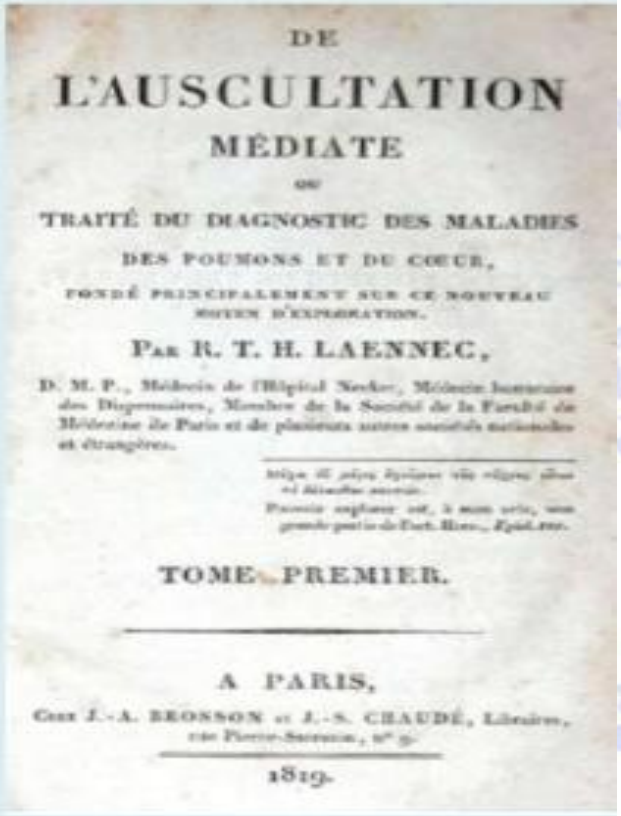
Resa Lewis, TEDMED Talks

Common sense…

Common sense…

1816-1819: René T.H. Laennec




DE

L'AUSCULTATION

MÉDIATE

OU

TRAITÉ DU DIAGNOSTIC DES MALADIES

DES POUMONS ET DU COEUR,

FONDÉ PRINCIPALEMENT SUR CE NOUVEAU MOYEN D'EXPLORATION.

PAR R. T. H. LAENNEC,

D. M. P., Médecin de l'Hôpital Necker, Médecin honoraire des Dispensaires, Membre de la Société de la Faculté de Médecine de Paris et de plusieurs autres sociétés nationales et étrangères.

TOME PREMIER.

A PARIS,

Chez J.-A. BROSSON et J.-S. CHAUDÉ, Libraires, rue Pierre-Sarrazin, n° 9.

1819.

"That it will ever come into general practice, I am extremely doubtful; because its beneficial application requires much time and gives a good bit of trouble both to the patient and the practitioner"

J. Forbes, 1823

Preface to the First English Edition of Laennec's "Treatise"

BLOCKBUSTER

NETFLIX

Prof. Paolo Pelosi, *Sir Robert Macintosh Lecture, Euroanaesthesia 2019*

Thanks a lot