Pose écho-guidée de cathéters vasculaires : Intérêt et réalisation pratique

C. Guervilly et JM Forel

Réanimation

Hôpital Nord - Marseille

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Session 6 // POSE ÉCHO-GUIDÉE DE CATHÉTERS VASCULAIRES : INTÉRÊT ET RÉALISATION PRATIQUE

SonoSite

Christophe Guervilly & Jean-Marie Forel *(Marseille)*

OBJECTIFS :

■ Connaitre les différentes techniques échographiques ■ Que dit la littérature ….et la justice ? ■ Démonstration pratique : à vous de jouer !

Cathéters veineux centraux

VJI : Veine Jugulaire Interne
VSCLAV : Veine Sous Clavière
VFEM : Veine Fémorale

Pourquoi passer à la pose échoguidée ?

Nous avons tous « expérimenté »
les variations anatomiques !

La VJI est en position atypique dans 15-30% des cas

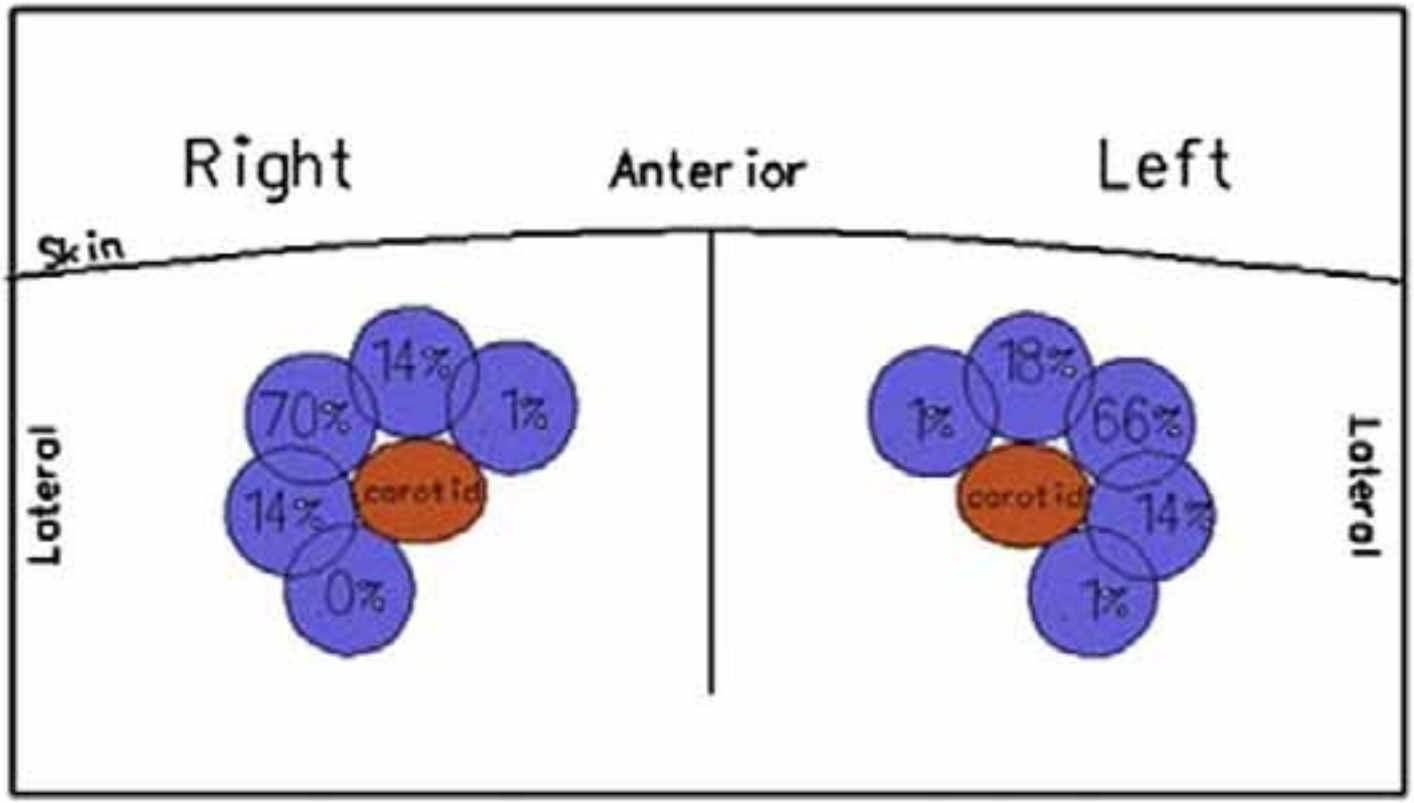


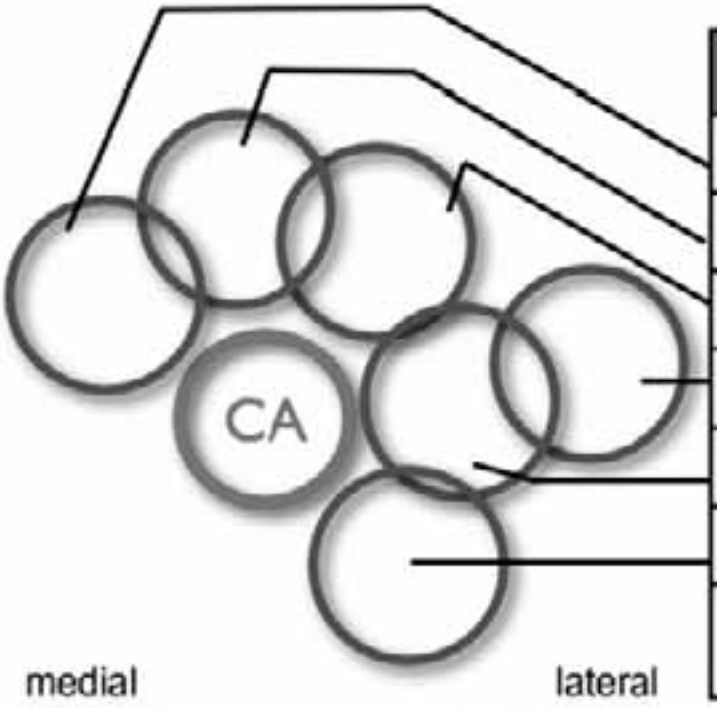
Fig. 2. Possible relations of the internal jugular vein with the carotid artery (left and right).

Gordon AC, Saliken JC, Johns D, Owen R, Gray RR. US-guided puncture of the internal jugular vein: complications and anatomic considerations. *J Vasc Interv Radiol* 1998;**9**:333–8.

Trop de variation anatomique
= 1/3 des cas

Ultrasound imaging in vascular access

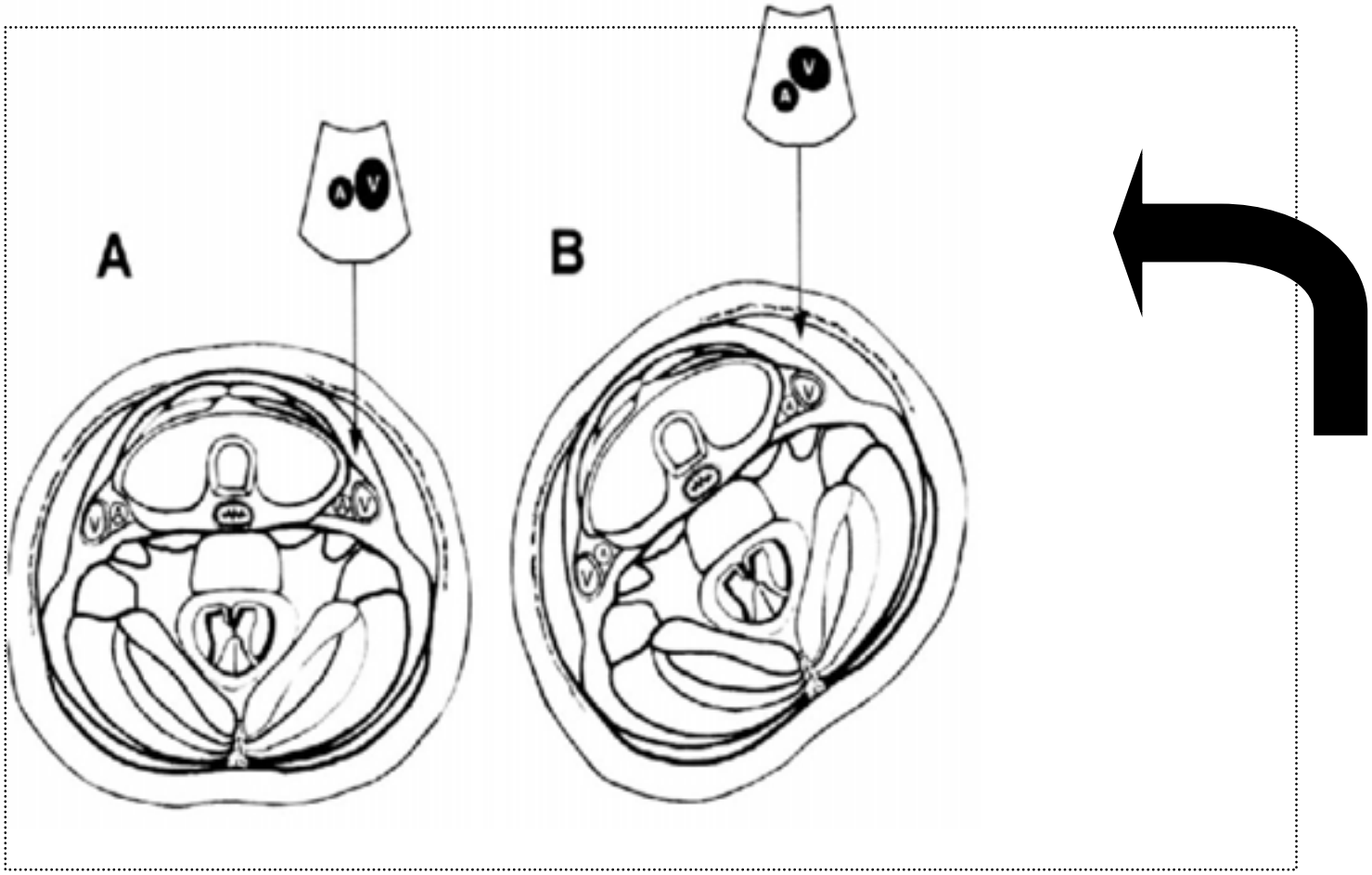
Tim Maecken, MD; Thomas Grau, MD, PhD Crit Care Med 2007 Vol. 35, No. 5 (Suppl.)



Position	range in %
medial	0 - 5.5
anterior	0 - 16 (54*)
anterio-lateral	9 - 92
far lateral	0 - 4
lateral	0 - 84
posterior	0 - 9
not visible/ thrombosed	0 - 18

Figure 2. Prevalence of occurrence of variation in the position of the internal jugular vein in relation to the common carotid artery (*CA*). *Circles* describe reported positions of the internal jugular vein. Data extracted from references 36–40. *jugular vein overlaps ≥75% of the CA. Table 2 provides details and the number of patients in the referenced studies.

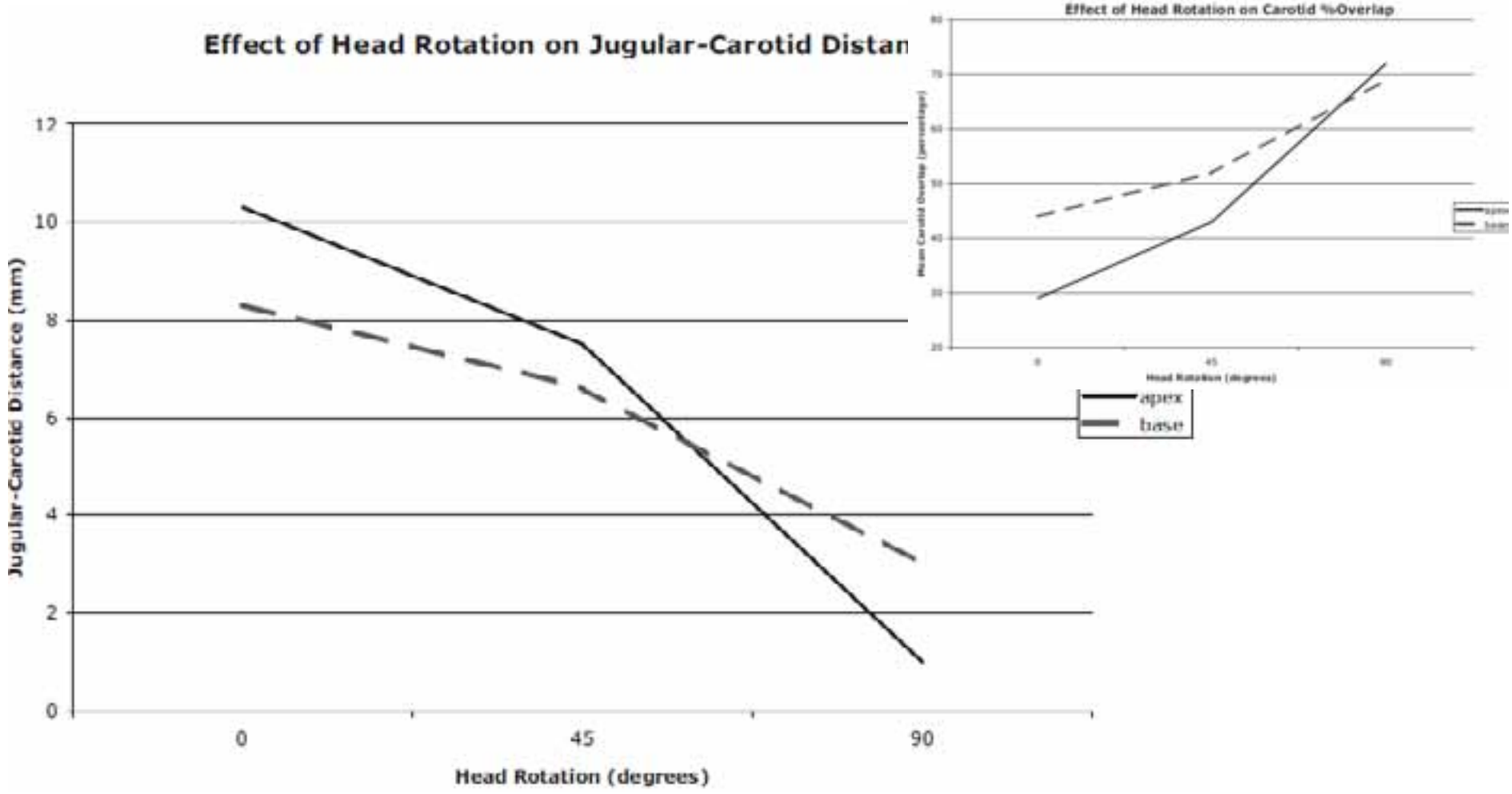
La rotation de la tête accentue la superposition veine / artère



EFFECT OF HEAD ROTATION ON VASCULAR ANATOMY OF THE NECK: AN ULTRASOUND STUDY

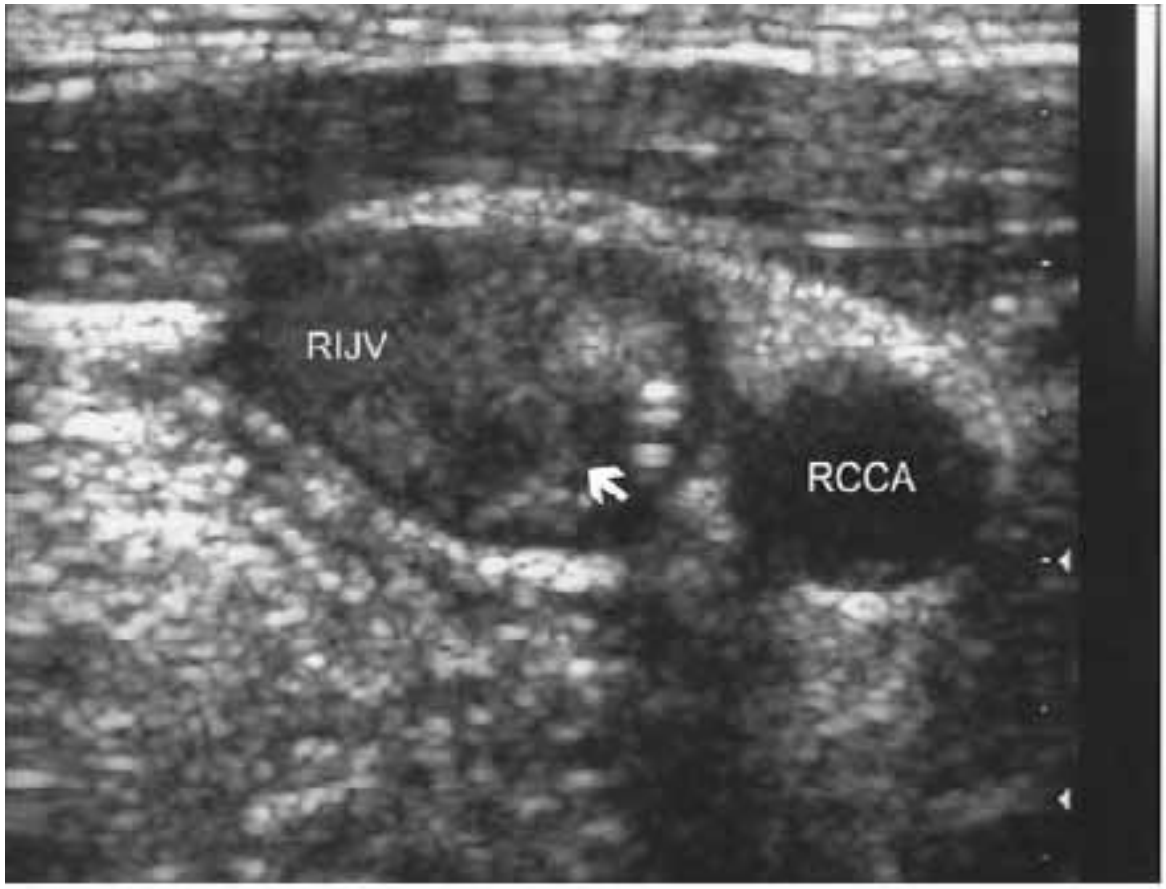
Ralph Wang, MD, Eric R. Snoey, MD, Robert Carter Clements, MD, H. Gene Hern, MD, MS, and Dan Price, MD

The Journal of Emergency Medicine, Vol. 31, No. 3, pp. 283–286, 2006



L’échographie fait seule le diagnostique

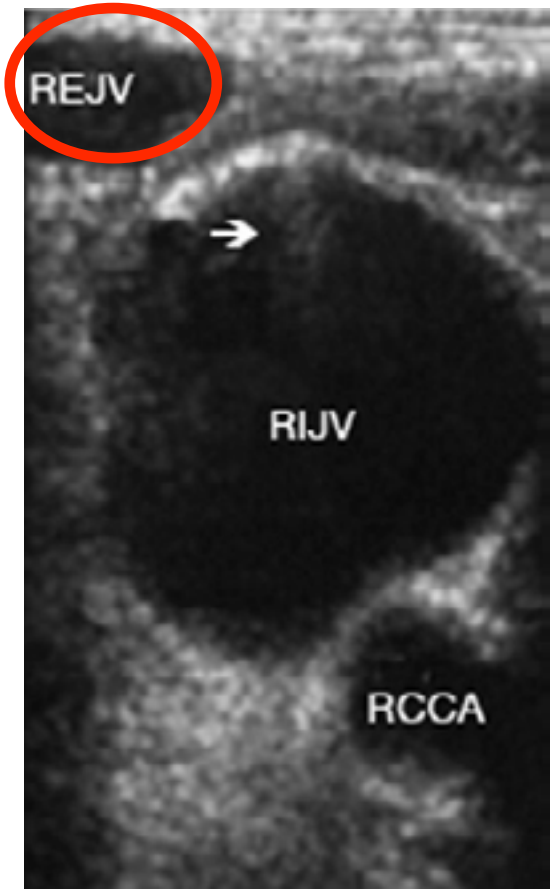
Echec assuré !!!



Thrombus visualised within the right internal jugular vein (RIJV) (arrow). The vessel could not be compressed. RCCA, right common carotid artery.

THROMBUS

Pas loin !!!



Critical Care Vol 10 No 6 Karakitsos *et al.*

Superposition VJE

Pourquoi passer à la pose échoguidée ?

Nous avons tous « expérimenté »
les complications!

Nous avons tous « expérimenté » les complications !

6-20 % de complications selon le site

Table 2. Frequency of Mechanical Complications, According to the Route of Catheterization.*

Complication	Frequency		
	Internal Jugular	Subclavian	Femoral
		percent	
Arterial puncture	6.3–9.4	3.1–4.9	9.0–15.0
Hematoma	<0.1–2.2	1.2–2.1	3.8–4.4
Hemothorax	NA	0.4–0.6	NA
Pneumothorax	<0.1–0.2	1.5–3.1	NA
Total	6.3–11.8	6.2–10.7	12.8–19.4

* Data are from Merrer et al.,[5] Sznajder et al.,[6] Mansfield et al.,[8] Martin et al.,[22] Durbec et al.,[23] and Timsit et al.[24] NA denotes not applicable.

The NEW ENGLAND JOURNAL of MEDICINE

Preventing Complications of Central Venous Catheterization

David C. McGee, M.D., and Michael K. Gould, M.D.

N Engl J Med 2003;348:1123-33.

Pourquoi passer à la pose échoguidée ?

Nous voulons :

1- Réduire les complications

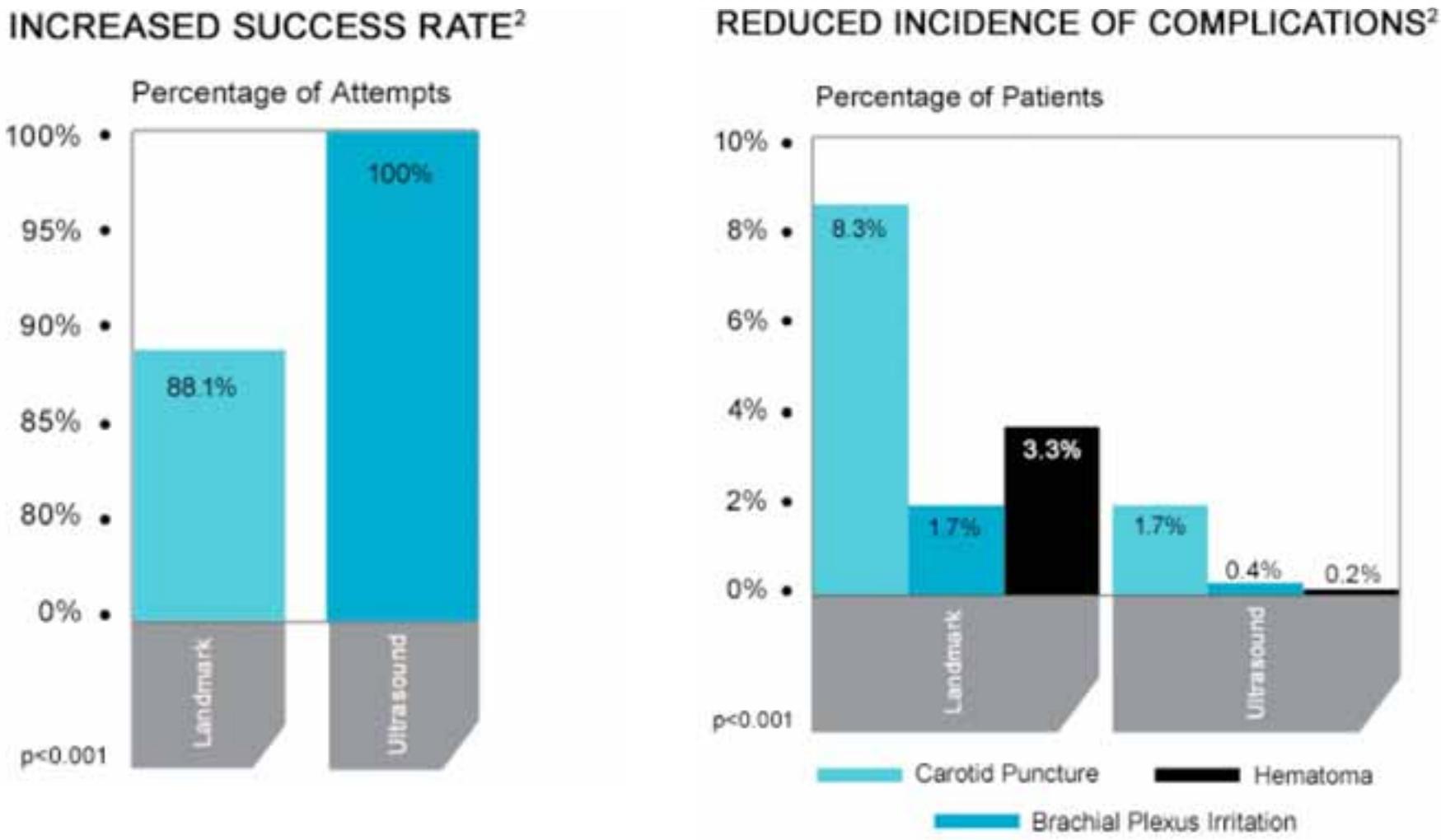
2- Améliorer les pratiques de soins

3- Gagner du temps

4- Au moindre cout

Les évidences

Echoguidage VJI= Plus de réussites … avec moins de complications



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;87:1557-1562.

Ultrasound-Assisted Cannulation of the Internal Jugular Vein

A Prospective Comparison to the External Landmark-Guided Technique

Bart G. Denys, MD; Barry F. Uretsky, MD; and P. Sudhakar Reddy, MD

Circulation *Vol 87, No 5 May 1993*

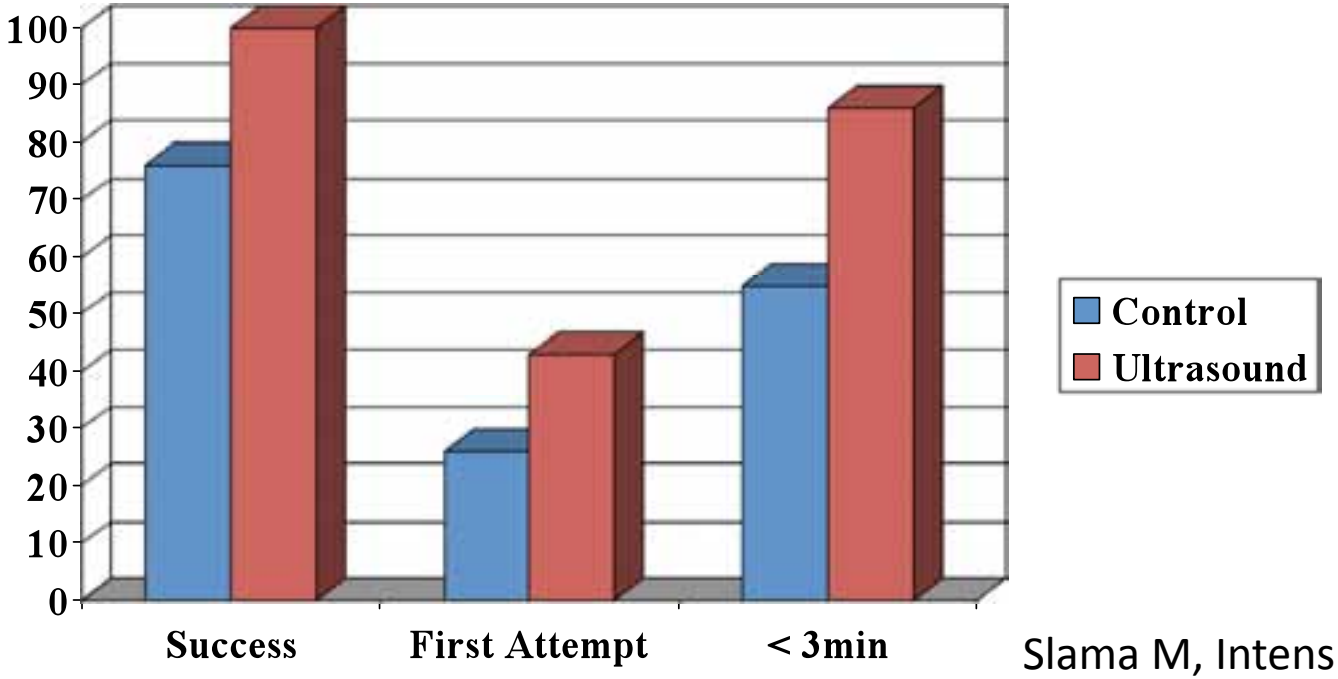
Techniques/ No. patients	Landmark 302	Ultrasound 1 302	Ultrasound 2 626
			* p≤0.001
Succès total (%)	88	100*	100*
Temps d'accès (sec)	44.5	10.3*	9.7*
Ponction carotide (%)	8	2.6*	1.3*
Hématome	1.7	0.3*	0.5*
Irritation plexus brachial	3.3	0*	0.3*
No. tentatives	2.5	1.2*	1.4*
Succès après 1 ponction (%)	38.4	82*	75.6*

Echoguidage VJI = Plus de réussites

Table 2 Comparison of ultrasound and external landmark techniques in internal jugular vein cannulation

	Control group	Ultrasound group
Number of patients	42	37
Initial technique successful	32 (76%)	37 (100%)[b]
Access time (s)	235 ± 408	95 ± 174[a]
First needle pass successful	11 (26%)	16 (43%)
Access time < 3 min	23 (55%)	32 (86%)[b]
Carotid artery puncture	5 (12%)	5 (14%)

Values in parentheses are percentages
[a] $p = 0.06$ and [b] $p < 0.01$ vs control group



Slama M, Intens Care Med 1997;23:916-9

Echoguidage SCLAV= Plus de réussites … avec moins de complications

Subclavian Venous Cannulation by inexperienced operators using ultrasound technique

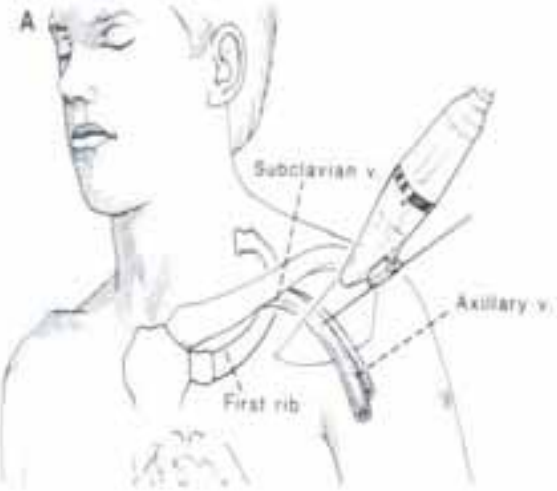
Gualtieri E Crit Care Med 1995;23:692-7

Table 1. Summary of study results

	Landmark (n = 27)		Ultrasound (n = 25)		*p* Value
Success rate	12	(44)	23	(92)	.0003[a]
Minor complications	11	(41)	1	(4)	.002[a]
Venipunctures required	2.5		1.4		.0007[b]
Insertion kits required	1.4		1.0		.0003[b]

[a] *p* values were obtained using the chi-square test; [b] *p* values were obtained using the Mann-Whitney test.

Values in parentheses are percentages.



Echoguidage veineux = Plus de réussites … avec moins de complications

Variable	Internal jugular vein: No of placements: 2-D ultrasound guidance	Internal jugular vein: No of placements: Landmark method	Effect size (95% CI)	P value
Adults				
Relative risk:				
Failed catheter placement	296	312	0.14 (0.06 to 0.33)	<0.0001
Complication with placement	284	295	0.43 (0.22 to 0.87)	0.02
Failure on first attempt	162	179	0.59 (0.39 to 0.88)	0.009
Mean No:				
Attempts to successful catheterisation	131	136	−1.50 (−2.53 to −0.47)	0.004
Seconds to successful catheterisation	180	192	−69.33 (−92.36 to −46.31)	<0.0001

Hind BMJ 2003;327:361.

BMJ

Ultrasonic locating devices for central venous cannulation: meta-analysis

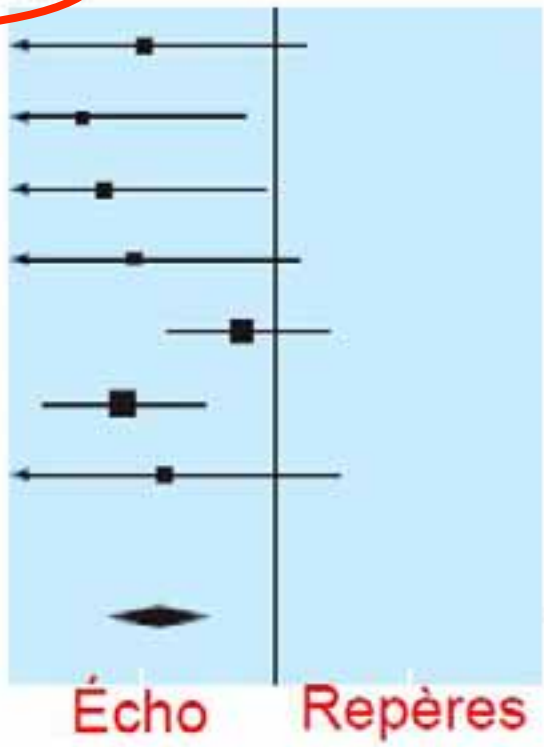
Daniel Hind, Neill Calvert, Richard McWilliams, Andrew Davidson, Suzy Paisley, Catherine Beverley and Steven Thomas

BMJ 2003;327;361
doi:10.1136/bmj.327.7411.361

Study	Two dimensional ultrasonography (n/N)	Landmark method (n/N)	Relative risk (95% CI random)	Weight (%)	Relative risk (95% CI random)
Failed catheter placement (adults, internal jugular vein)					
Mallory et al 1990[w9]	0/12	6/17		8.8	0.11(0.01 to 1.73)
Nadig et al 1998[w10]	0/36	13/37		8.8	0.04(0.00 to 0.62)
Slama et al 1997[w11]	0/37	10/42		8.7	0.05(0.00 to 0.89)
Soyer et al 1993[w12]	0/24	5/23		8.5	0.09(0.01 to 1.49)
Sulek et al 2000[w13]	3/60	5/60		28.6	0.60(0.15 to 2.40)
Teichgräber et al 1997[w14]	2/50	26/50		28.7	0.08(0.02 to 0.31)
Troianos et al 1991[w15]	0/77	3/83		7.9	0.15(0.01 to 2.93)
Total (95% CI)	5/296	68/312		100.0	0.14(0.06 to 0.33)

Test for heterogeneity: χ^2=6.86, df=6, P=0.33

Test for overall effect: z=-4.50, P=0.0001



Failed catheter placement (adults, subclavian vein)

Gualtieri et al 1995[W6]	2/25	15/27	100.0	0.14(0.04 to 0.57)
Total (95% CI)	2/25	15/27	100.0	0.14(0.04 to 0.57)

Test for heterogeneity: χ^2=0.0, df=0

Test for overall effect: z=-2.77, P=0.006

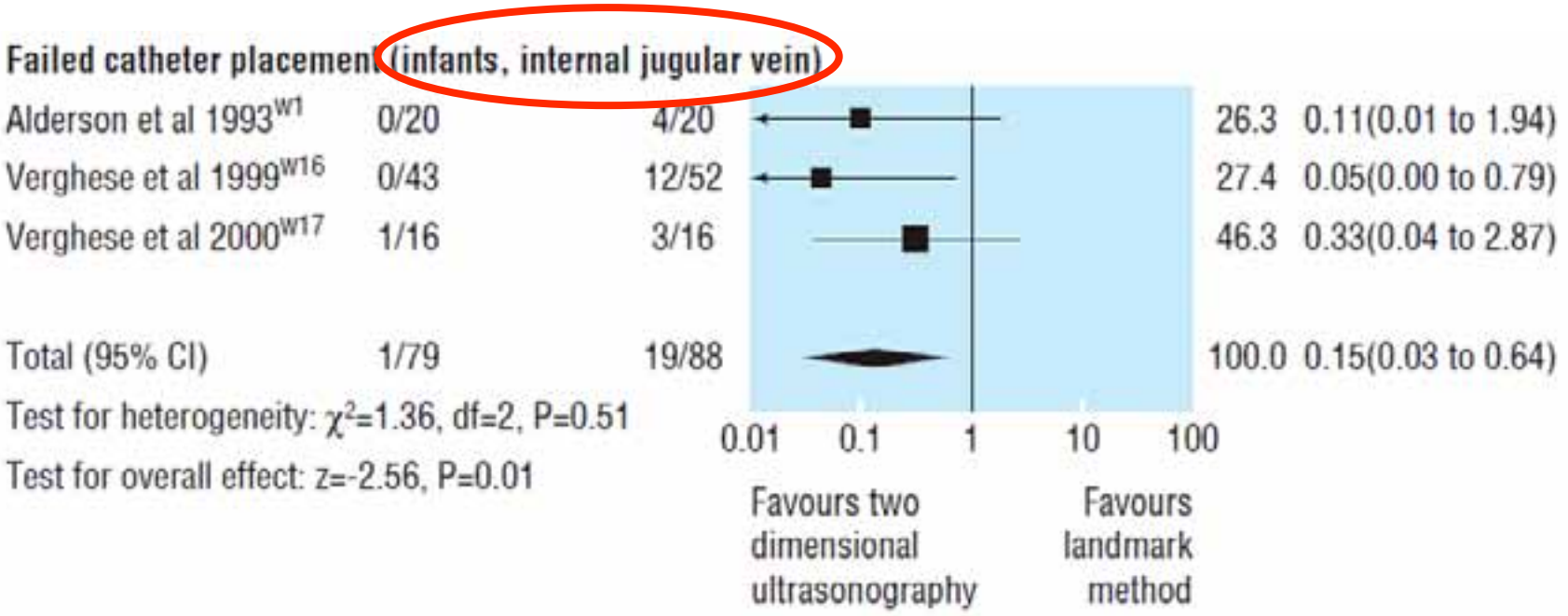
Failed catheter placement (adults, femoral vein)

Hilty et al 1997[W7]	2/20	7/20	100.0	0.29(0.07 to 1.21)
Total (95% CI)	2/20	7/20	100.0	0.29(0.07 to 1.21)

Test for heterogeneity: χ^2=0.0, df=0

Test for overall effect: z=-1.70, P=0.09

Chez les enfants aussi



Echoguidage VJI= Plus de réussites avec …

moins de complications mécaniques et infectieuses

Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients

Dimitrios Karakitsos[1], Nicolaos Labropoulos[2], Eric De Groot[3], Alexandros P Patrianakos[4],

Critical Care 2006, 10:R162

Table 2

Outcome measures in the ultrasound group versus the landmark group of patients

Outcome measures	Ultrasound group ($n = 450$)	Landmark group ($n = 450$)
Access time (seconds)	17.1 ± 16.5 (11.5 to 41.4)[a]	44 ± 95.4 (33.2 to 77.5)
Success rate	450 (100%)[a]	425 (94.4%)
Carotid puncture	5 (1.1%)[a]	48 (10.6%)
Haematoma	2 (0.4%)[a]	38 (8.4%)
Haemothorax	0 (0%)[a]	8 (1.7%)
Pneumothorax	0 (0%)[a]	11 (2.4%)
Average number of attempts	1.1 ± 0.6 (1.1 to 1.9)[a]	2.6 ± 2.9 (1.5 to 6.3)
CVC-BSI	47 (10.4%)[a]	72 (16%)

[a]Comparison of the outcome measures between the ultrasound group and the landmark group of patients ($p < 0.001$). Access time and average number of attempts are expressed as mean ± standard deviation (95% confidence interval). Success rate, carotid puncture, haematoma, haemothorax, pneumothorax, and CVC-BSI are expressed as the absolute number of patients and percentage of their group. CVC-BSI, central venous catheter-associated blood stream infection.

Echoguidage VJI= Plus de réussites avec …
plus de rapidité moins de complications mécaniques

Ultrasound-guided catheterization of the internal jugular vein in oncologic patients; Comparison with the classical anatomic landmark technique: A prospective study

Konstantinos Serafimidis, George H. Sakorafas*, George Konstantoudakis, Konstantina Petropoulou,

International Journal of Surgery 7 (2009) 526–528

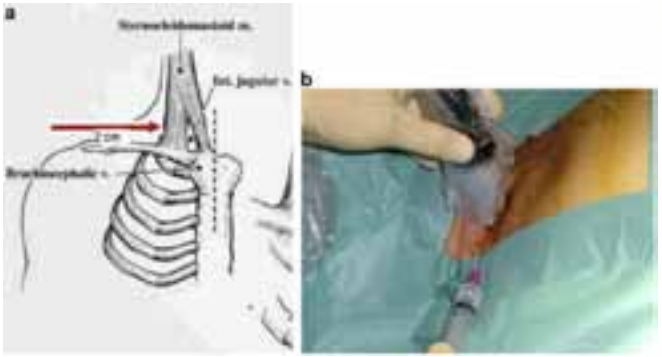


Table 1
Comparison between the anatomic landmark and the US-guided technique.

	Group A[a] (n = 347)	Group B[b] (n = 204)	p value
Operating time (min)	20.02 ± 4.4	9.83 ± 3.1	< 0.001
Pneumothorax	2	0	< 0.05
Carotid injury-hematoma	16	1	< 0.05
Failure to achieve central venous access	18	0	< 0.05
Number of attempts			
1–3	283	204	< 0.01
> 3	64	0	

[a] Group A. The anatomic landmark technique.
[b] Group B. US-guided technique.

Echoguidage VSCLAV= Plus de réussites avec …

plus de rapidité, moins de complications mécaniques

Real-time ultrasound-guided subclavian vein cannulation versus the landmark method in critical care patients: A prospective randomized study* **(Crit Care Med 2011; 39:1607–1612)**

Marlantina Fragou, MD; Andreas Gravvanis, MD, PhD; Vasilios Dimitriou, MD, PhD;

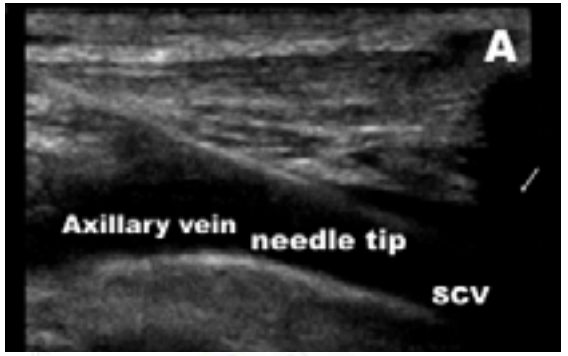


Table 2. Outcome measures in the ultrasound group vs. the landmark group of patients

Outcome Measures	Ultrasound Group (n = 200)	Landmark Group (n = 201)[b]
Access time (sec)	26.8 ± 12.5 (16.4–39.2)	44.8 ± 54.9 (30.1–70.4)
Success rate	200 (100%)[a]	176 (87.5%)
Average number of attempts	1.1 ± 0.3 (1.1–1.5)[a]	1.9 ± 0.7 (1.5–2.7)
Artery puncture	1 (0.5%)[a]	11 (5.4%)
Hematoma	3 (1.5%)[a]	11 (5.4%)
Pneumothorax	0 (0%)[a]	10 (4.9%)
Hemothorax	0 (0%)[a]	9 (4.4%)
Catheter misplacement	19 (9.5%)	22 (11%)
Injury of the brachial plexus	0 (0%)[a]	6 (2.9%)
Phrenic nerve injury	0 (0%)[a]	3 (1.5%)
Cardiac tamponade	0 (0%)	1 (0.5%)

Cathéter de dialyse échoguidé

Rabindranath KS, Kumar E, Shail R, Vaux EC

THE COCHRANE COLLABORATION®

Ultrasound use for the placement of haemodialysis catheters

Review: Ultrasound use for the placement of haemodialysis catheters

Comparison: 1 Ultrasound guided versus "blind" haemodialysis catheter insertion

Outcome: 1 Failed catheter placement (overall)

Study or subgroup	Real-time USS guidance n/N	Landmark method n/N	Risk Ratio M-H,Random,95% CI	Risk Ratio M-H,Random,95% CI
Bansal 2005	0/30	2/30		0.20 [0.01, 4.00]
Ibrik 2000	0/139	0/73		0.0 [0.0, 0.0]
Korogolu 2006	0/40	1/40		0.33 [0.01, 7.95]
Kumwenda 2003	0/125	0/125		0.0 [0.0, 0.0]
Nadig 1998	0/36	13/37		0.04 [0.00, 0.62]
Prabhu 2010	1/55	11/55		0.09 [0.01, 0.68]
Zafar-Khan 1995	0/25	4/20		0.09 [0.01, 1.57]
Total (95% CI)	**450**	**380**		**0.11 [0.03, 0.35]**

Review: Ultrasound use for the placement of haemodialysis catheters

Comparison: 1 Ultrasound guided versus "blind" haemodialysis catheter insertion

Outcome: 5 Arterial puncture

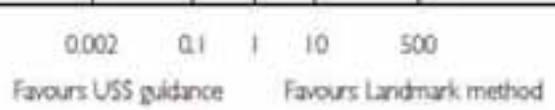
Study or subgroup	Real-time USS guidance n/N	Landmark method n/N	Risk Ratio M-H,Random,95% CI	Risk Ratio M-H,Random,95% CI
Bansal 2005	0/30	4/30		0.11 [0.01, 1.98]
Ibrik 2000	2/139	6/73		0.18 [0.04, 0.85]
Korogolu 2006	0/40	14/40		0.03 [0.00, 0.56]
Kumwenda 2003	4/125	3/125		1.33 [0.30, 5.84]
Nadig 1998	0/36	0/37		0.0 [0.0, 0.0]
Prabhu 2010	1/55	6/55		0.17 [0.02, 1.34]
Total (95% CI)	**425**	**360**		**0.22 [0.06, 0.81]**

Total events: 7 (Real-time USS guidance), 33 (Landmark method)

Heterogeneity: $Tau^2 = 1.04$; $Chi^2 = 7.99$, df = 4 (P = 0.09); $I^2 = 50\%$

Test for overall effect: Z = 2.28 (P = 0.023)

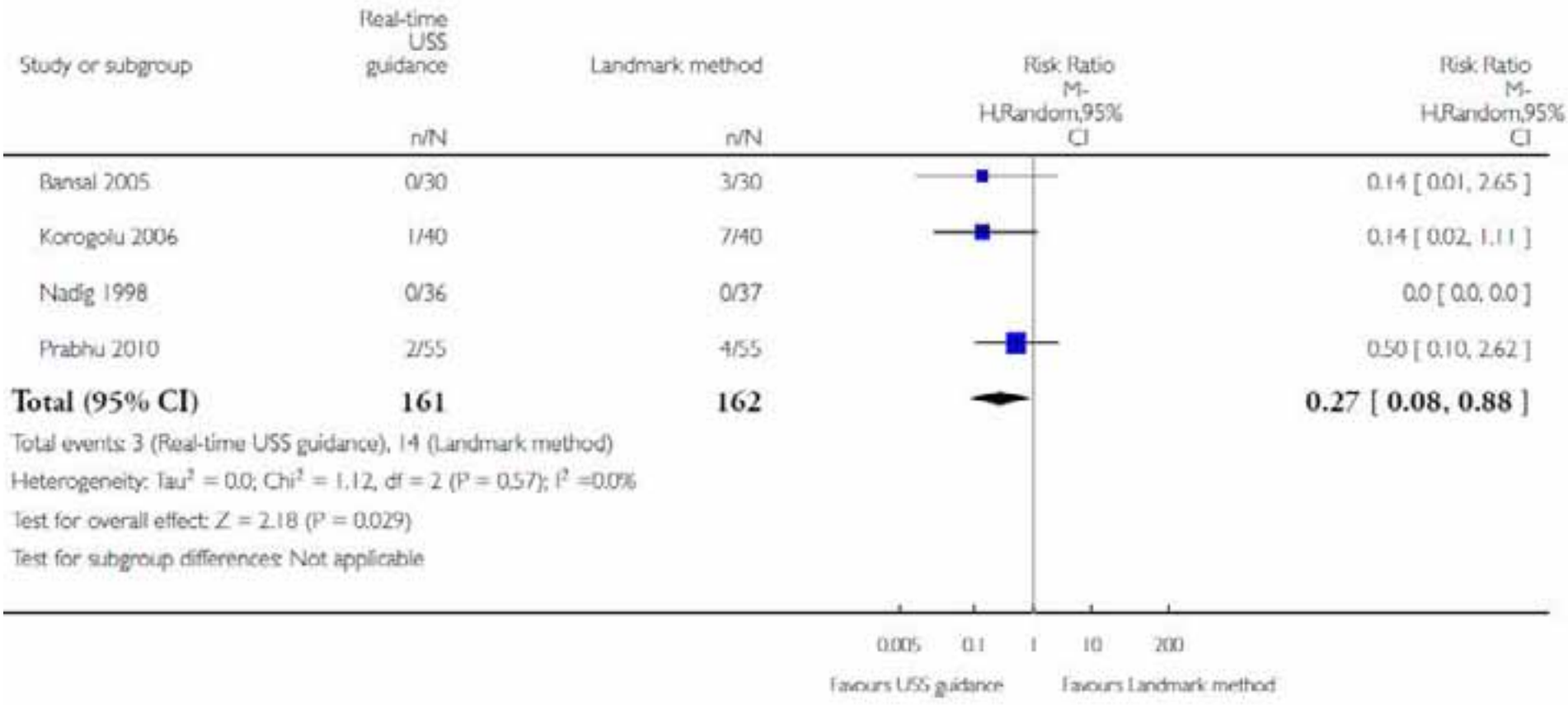
Test for subgroup differences: Not applicable



Review: Ultrasound use for the placement of haemodialysis catheters

Comparison: 1 Ultrasound guided versus "blind" haemodialysis catheter insertion

Outcome: 1 Haematoma



Review: Ultrasound use for the placement of haemodialysis catheters

Comparison: 1 Ultrasound guided versus "blind" haemodialysis catheter insertion

Outcome: 7 Pneumothorax or haemothorax

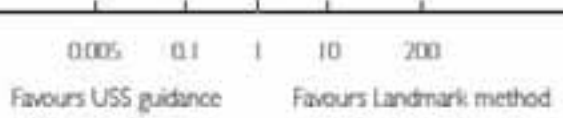
Study or subgroup	Real-time USS guidance n/N	Landmark method n/N	Risk Ratio M-H,Random,95% CI	Risk Ratio M-H,Random,95% CI
Bansal 2005	0/30	0/30		0.0 [0.0, 0.0]
Ibrik 2000	0/139	1/73		0.18 [0.01, 4.27]
Korogolu 2006	0/40	1/40		0.33 [0.01, 7.95]
Kumwenda 2003	0/125	2/125		0.20 [0.01, 4.12]
Nadig 1998	0/36	0/37		0.0 [0.0, 0.0]
Total (95% CI)	**370**	**305**		**0.23 [0.04, 1.38]**

Total events: 0 (Real-time USS guidance), 4 (Landmark method)

Heterogeneity: $Tau^2 = 0.0$; $Chi^2 = 0.09$, df = 2 (P = 0.96); $I^2 = 0.0\%$

Test for overall effect: Z = 1.61 (P = 0.11)

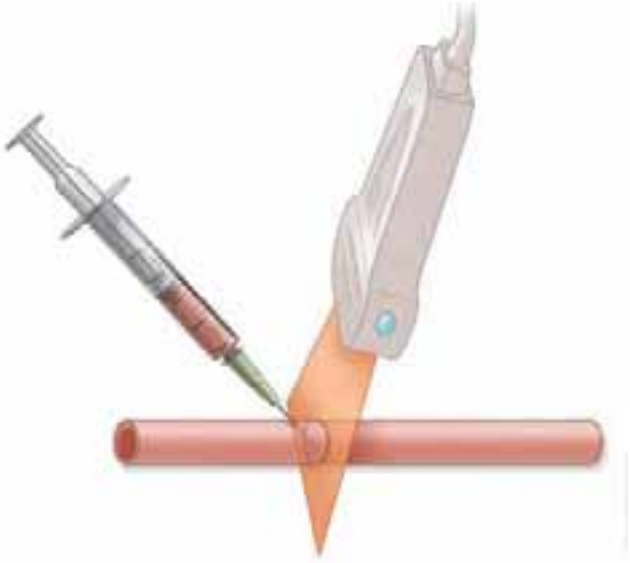
Test for subgroup differences: Not applicable



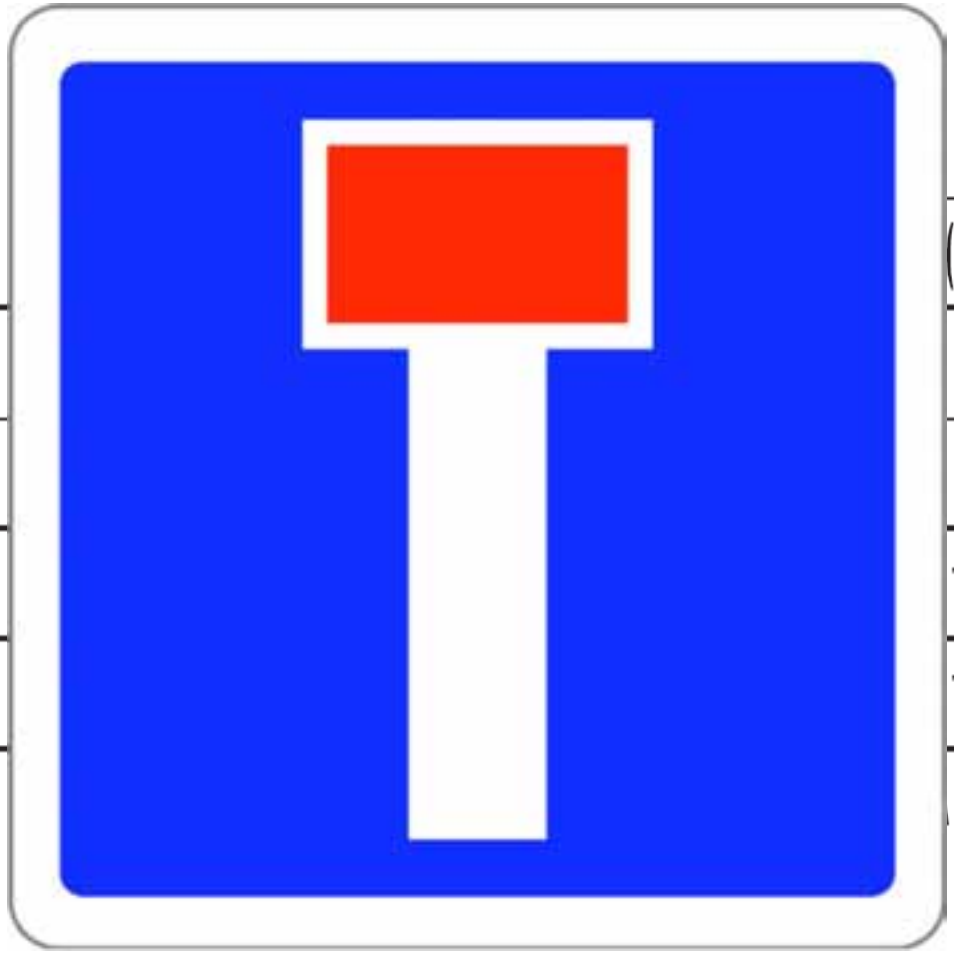
Comparison 1. Ultrasound guided versus "blind" haemodialysis catheter insertion

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Failed catheter placement (overall)	7	830	Risk Ratio (M-H, Random, 95% CI)	0.11 [0.03, 0.35]
2 Failed catheter placement (first attempt)	5	705	Risk Ratio (M-H, Random, 95% CI)	0.40 [0.30, 0.52]
5 Arterial puncture	6	785	Risk Ratio (M-H, Random, 95% CI)	0.22 [0.06, 0.81]
6 Haematoma	4	323	Risk Ratio (M-H, Random, 95% CI)	0.27 [0.08, 0.88]
7 Pneumothorax or haemothorax	5	675	Risk Ratio (M-H, Random, 95% CI)	0.23 [0.04, 1.38]

Les techniques



Méta-analyse Doppler



Variable	Subclavian vein (95% CI)	P value
Adults		
Relative risk:		
Failed catheter placement	to 0.38)	0.0008
Complication with placement	to 2.57)	0.2
Failure on first attempt		NA

Hind BMJ 2003;327:361.

Echo de Repérage préalable

Does Ultrasound Imaging Before Puncture Facilitate Internal Jugular Vein Cannulation? Prospective Randomized Comparison With Landmark-Guided Puncture in Ventilated Patients

Hayashi H, Amano M. J Cardiothorac Vasc Anesth. 2002;16:572-5.

	Landmark		Ultrasound	
	Visible	Invisible	Visible	Invisible
Total	81/97 (83.5)	7/23 (30.4)	78/91 (85.7)	25/29 (86.2)*

NOTE. Values are the frequency of cases, as tabulated by groups and the visibility of respiratory jugular venodilation, with percentage in parentheses.

*$p < 0.01$ *v* venodilation-invisible in landmark group.

Dynamique (écho) ou statique (répérage)

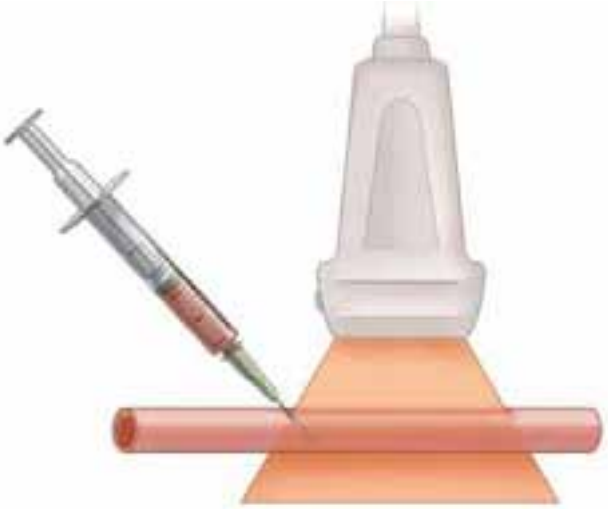
Randomized, controlled clinical trial of point-of-care limited ultrasonography assistance of central venous cannulation: The Third Sonography Outcomes Assessment Program (SOAP-3) Trial*

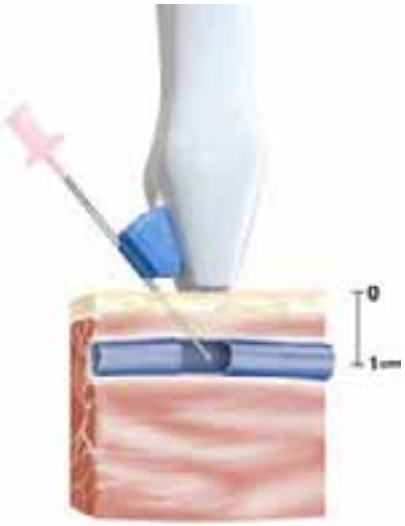
Crit Care Med 2005 Vol. 33, No. 8

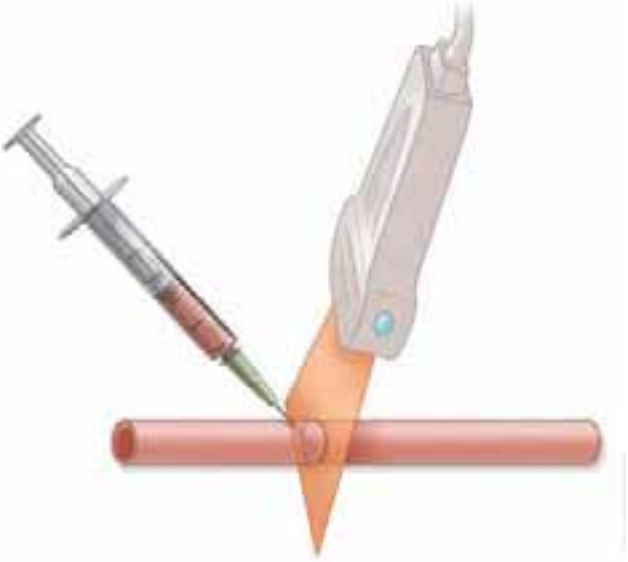
Truman J. Milling, Jr, MD; John Rose, MD; William M. Briggs, PhD; Robert Birkhahn, MD, MS;

	Dynamic (100)	Static (72)	Landmarks (69)
Cannulation success odd ratios	53.5	3.0	-
Overall success (%)	98	82	64
First-attempts odd ratios	5.8	3.4	-
First-attempts success(%)	62	50	23
Mean number of attempts	2.3	2.9	5.2
Mean time to cannulation (sec)	109	126	250

Avec ou sans guide (Porte aiguille)





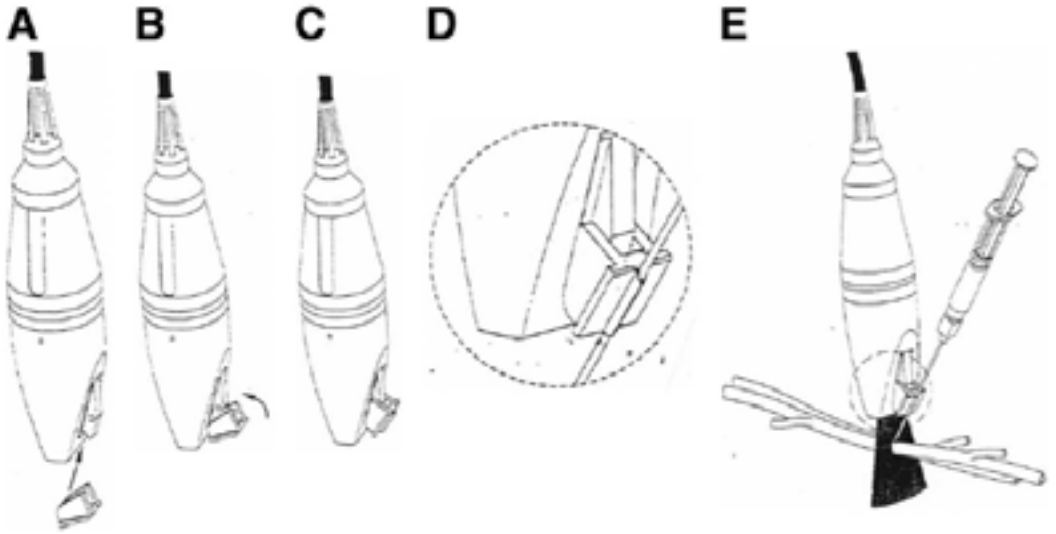


A Randomized Controlled Clinical Trial of Real-Time Needle-Guided Ultrasound for Internal Jugular Venous Cannulation in a Large University Anesthesia Department

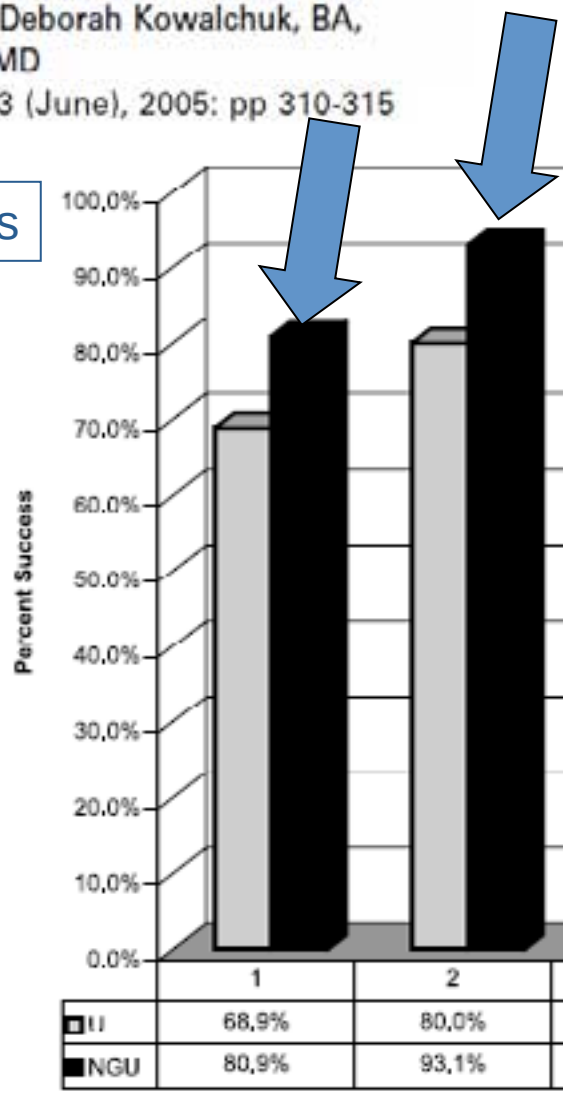
John G. Augoustides, MD, Jiri Horak, MD, Andrew E. Ochroch, MD, William J. Vernick, MD, Andrew J. Gambone, BA, Justin Weiner, BA, Dawn Pinchasik, BA, Deborah Kowalchuk, BA, Joseph S. Savino, MD, and David R. Jobes, MD

Journal of Cardiothoracic and Vascular Anesthesia, Vol 19, No 3 (June), 2005: pp 310-315

Plus de succès



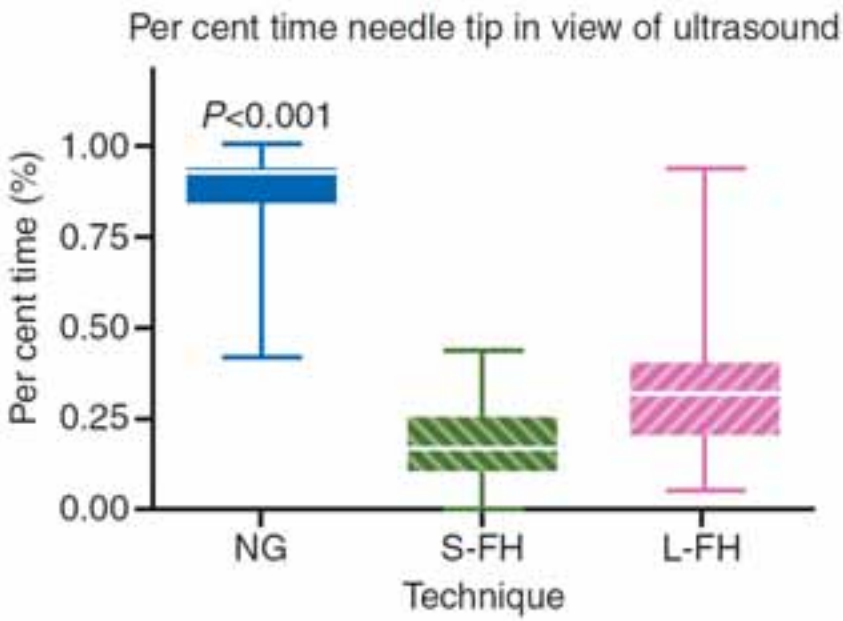
lation success after first (68.9%-80.9%, $p = 0.0054$) and second (80.0%-93.1%, $p = 0.0001$) needle passes. Cumulative

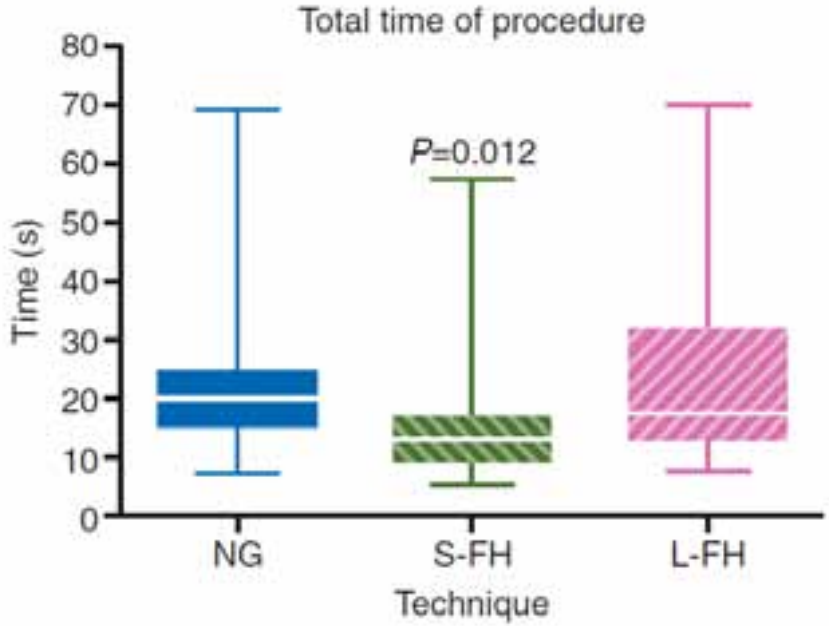


Randomized, prospective, observational simulation study comparing residents' needle-guided *vs* free-hand ultrasound techniques for central venous catheter access†

R. D. Ball[1‡], N. E. Scouras[1,2‡], S. Orebaugh[1,3], J. Wilde[4] and T. Sakai[1,5*]

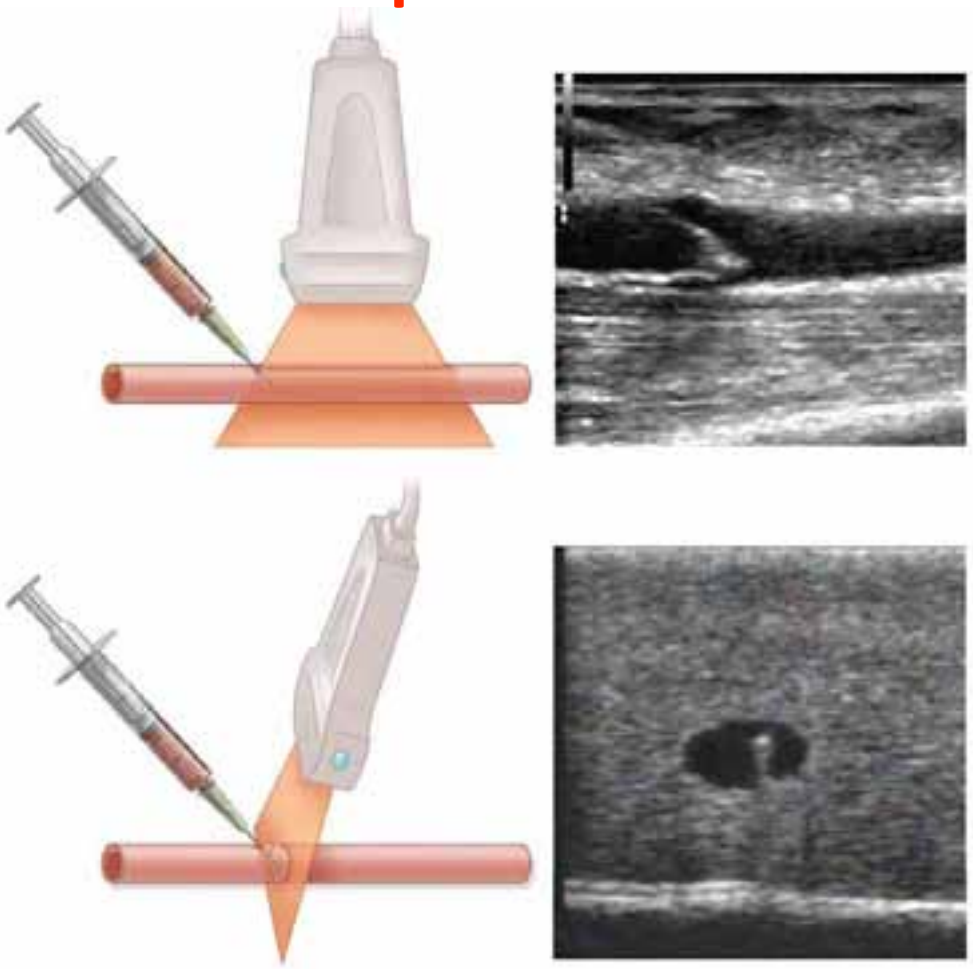
British Journal of Anaesthesia **108** (1): 72–9 (2012)





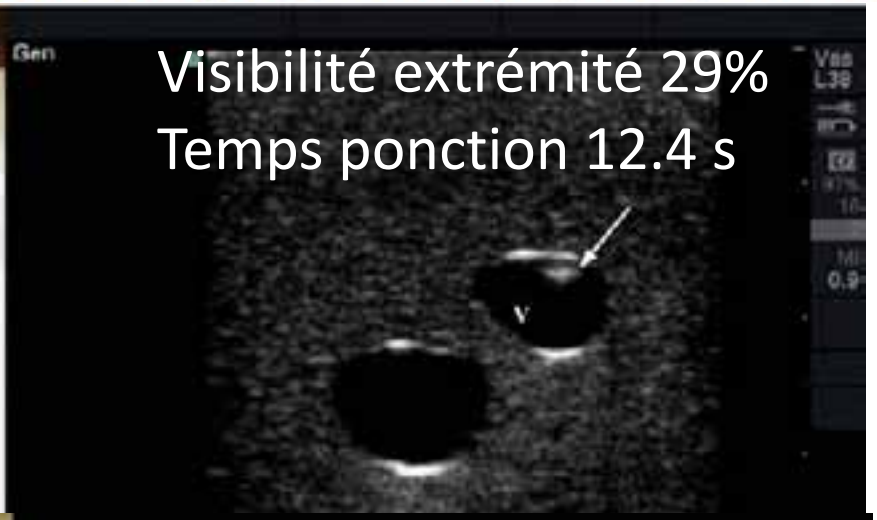
Choix de l’axe de coupe écho

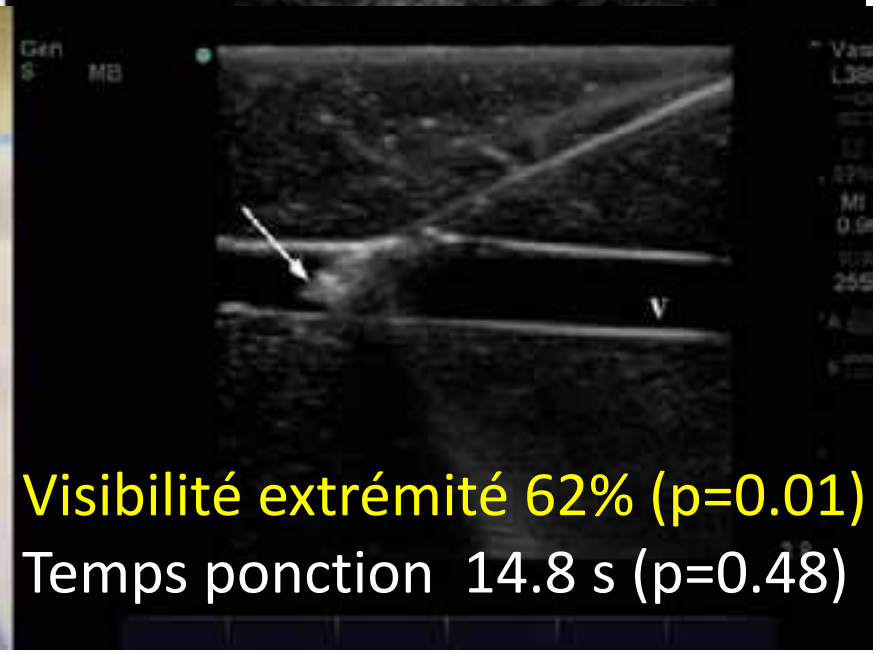
Axe
Long (parallèle)
ou Court
(transverse) ?



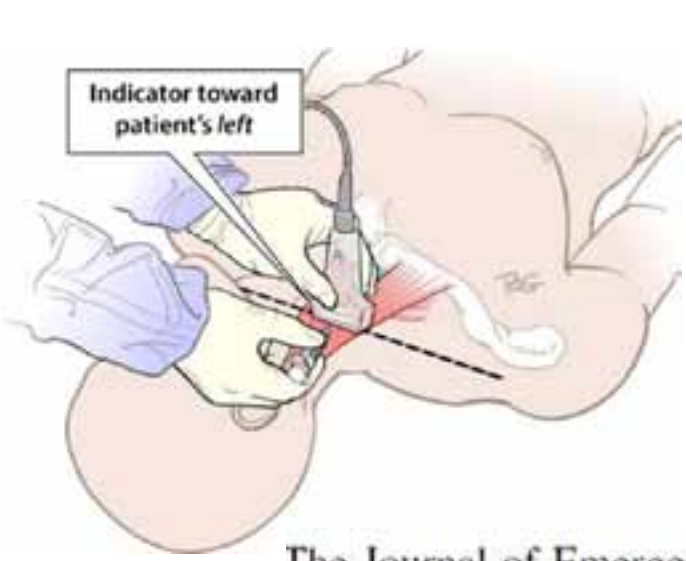
Needle tip visualization during ultrasound-guided vascular access: short-axis vs long-axis approach

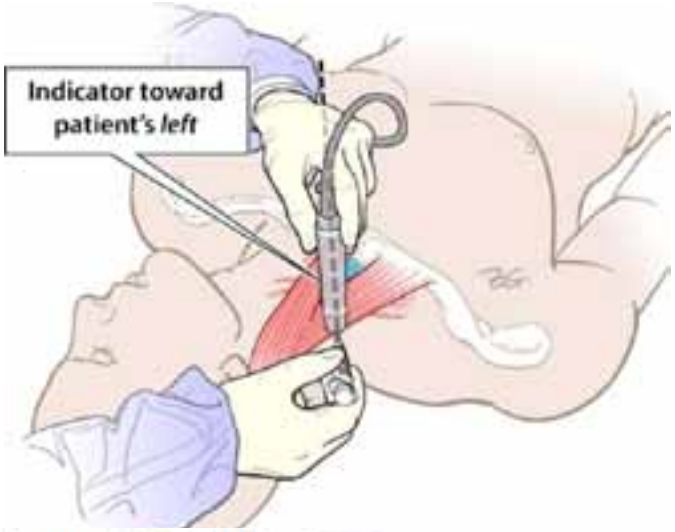
Michael B. Stone MD[a,*], American Journal of Emergency Medicine (2010) **28**, 343–347





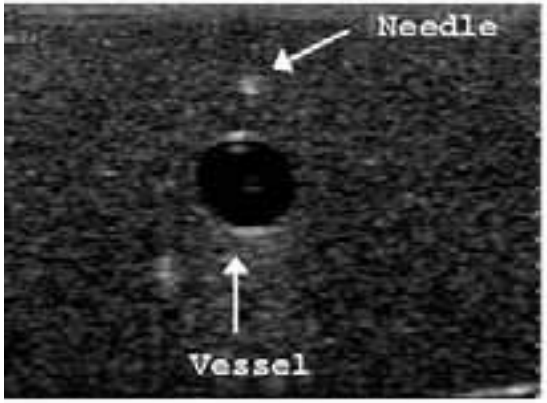
Oblique



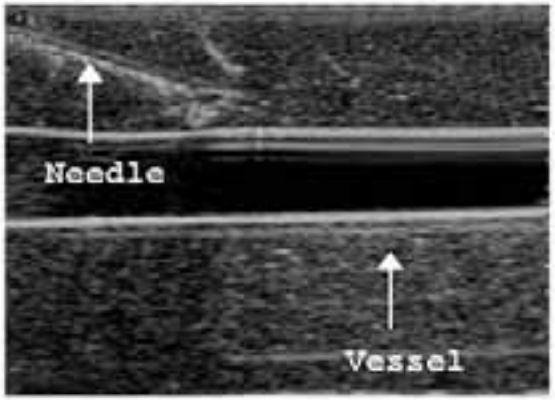


Phelan

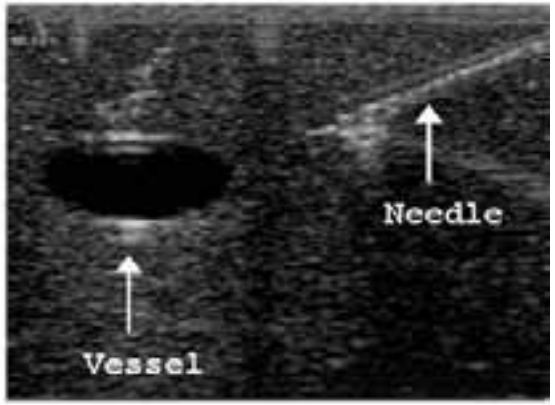
The Journal of Emergency Medicine, Vol. 37, No. 4, pp. 403–408, 2009



Short Axis



Longitudinal



Oblique

Approche transversale

THE MEDIAL-TRANSVERSE APPROACH FOR INTERNAL JUGULAR VEIN CANNULATION: AN EXAMPLE OF LATERAL THINKING

Anthony M.-H. Ho, MD,* Christopher J. Ricci, MD,† Calvin S. H. Ng, MD,‡ Lester A. H. Critchley, MD,*

The Journal of Emergency Medicine, Vol. 42, No. 2, pp. 174–177, 2012

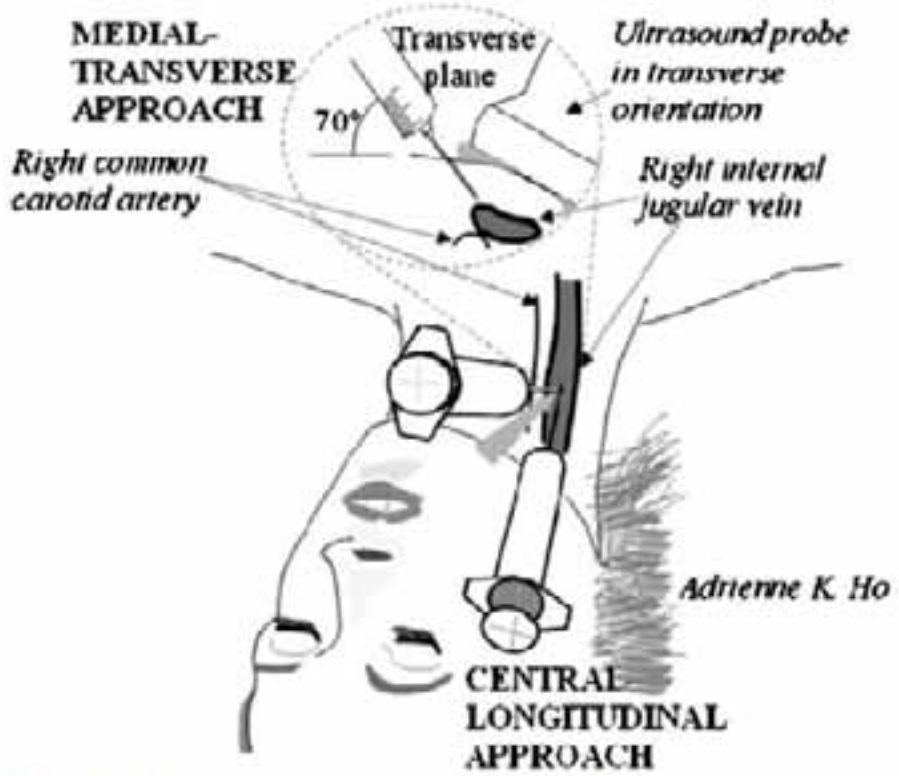
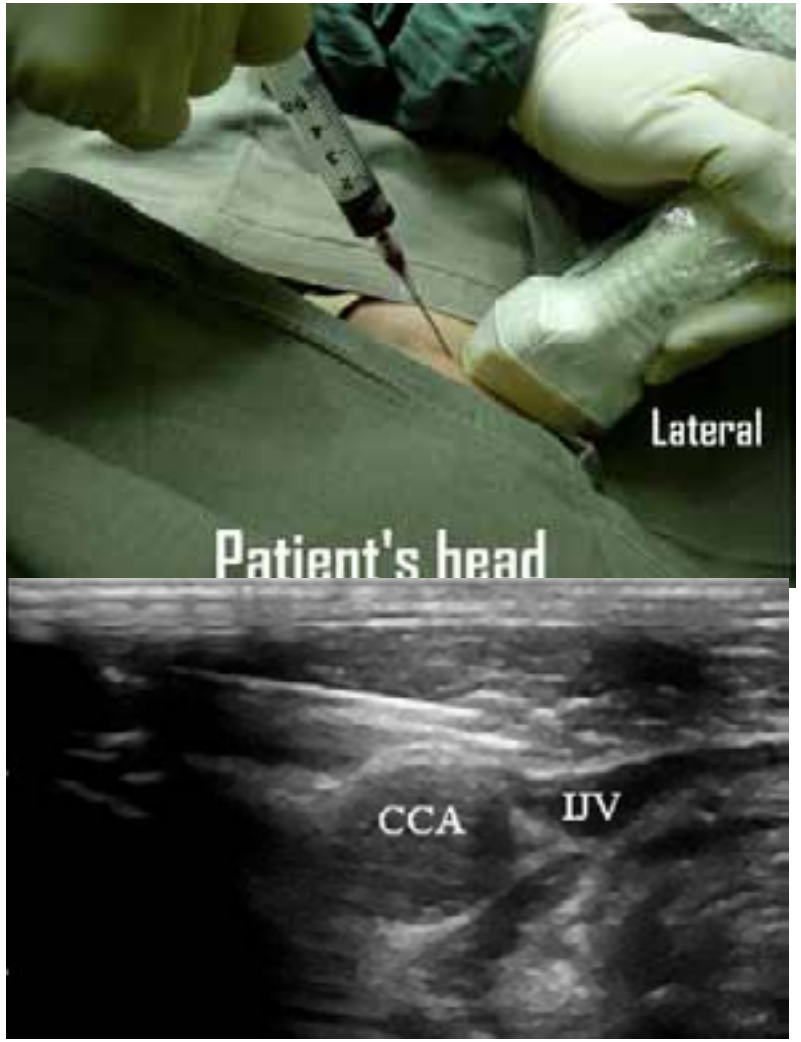


Figure 1. The central-longitudinal and medial-transverse



Echo pour les VVC: la sécurité totale ?

Continuing Medical Education Article

An unseen danger: Frequency of posterior vessel wall penetration by needles during attempts to place internal jugular vein central catheters using ultrasound guidance*

Michael Blaivas, MD, RDMS; Srikar Adhikari, MD, RDMS

Crit Care Med 2009 Vol. 37, No. 8

Objectif: évaluer la fréquence d'effraction de la paroie post de la VJI lors de la pose échoguidée sur mannequin d'une VVC

Méthode: n=25 Résidents après formation pratique de 3h de l'écho .

Utilisation de l'approche en petit axe.

Contrôle avec transducteur endo-cavitaire

par 2 investigateurs expérimentés

Transducteur endocavitaire

An unseen danger: Frequency of posterior vessel wall penetration by needles during attempts to place internal jugular vein central catheters using ultrasound guidance*

Michael Blaivas, MD, RDMS; Srikar Adhikari, MD, RDMS

Table 2. Descriptive statistics of count data and Likert scale

	Median (Interquartile Range)
Ultrasound-guided catheters placed prior to study	8 (2, 15)
Blind central catheters placed prior to study	20 (15, 40)
Posterior wall penetration	1 (0, 2)
Confidence in needle placement	8 (7, 9)

	Frequency, n (%)
Training year	
1	7 (28)
2	8 (32)
3	10 (40)
Ended through posterior wall	
No	19 (76)
Yes	6 (24)
Posterior wall penetration	
No	9 (36)
Yes	16 (64)
Ended in carotid	
No	20 (80)
Yes	5 (20)

Table 3. Spearman correlation coefficients and p values

	Training Year	Ultrasound-Guided Catheters
Posterior wall penetration	–.41 ($p = .04$)	–.54 ($p = .01$)

An unseen danger: Frequency of posterior vessel wall penetration by needles during attempts to place internal jugular vein central catheters using ultrasound guidance*

Michael Blaivas, MD, RDMS; Srikar Adhikari, MD, RDMS

These results suggest that care must be taken even with ultrasound-guided central catheter placement and that alternative ultrasound guidance techniques, such as visualization of the vein and needle in longitudinal axis, should be considered.

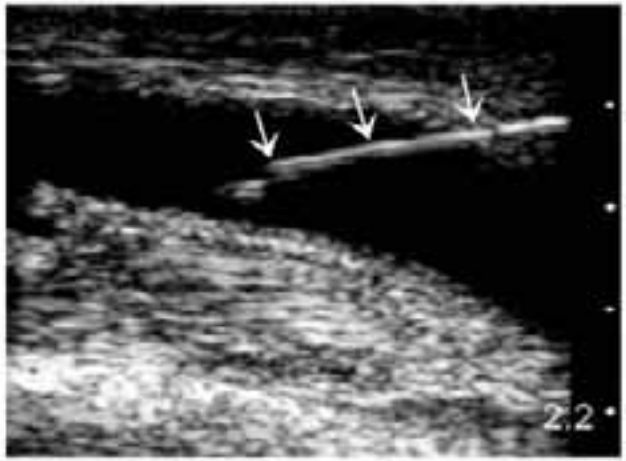


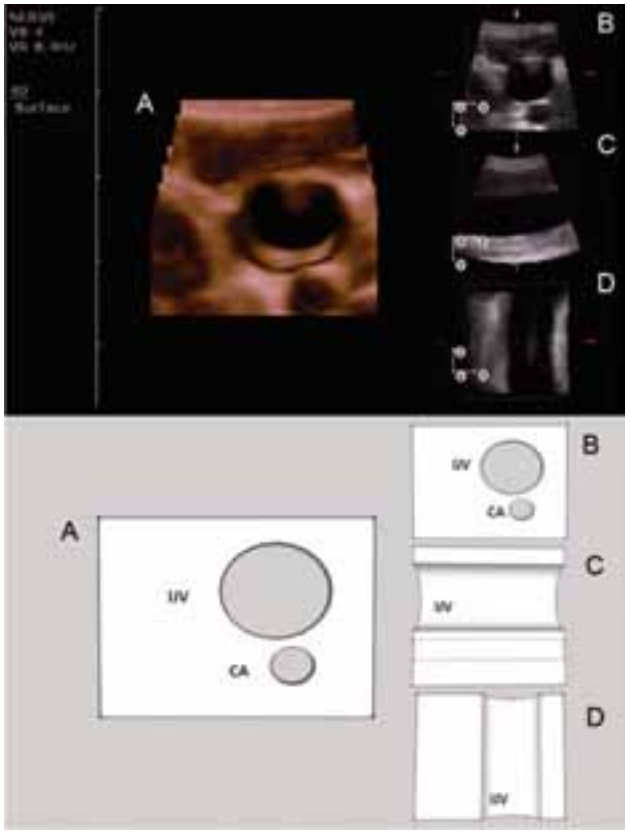
Figure 4. A needle is visualized in its length (*arrows*) entering a vessel, also visualized in its length or long axis.

Video Analysis of Accidental Arterial Cannulation With Dynamic Ultrasound Guidance for Central Venous Access

J Ultrasound Med 2009; 28:1239–1244

Michael Blaivas, MD

3D = L’avenir ?



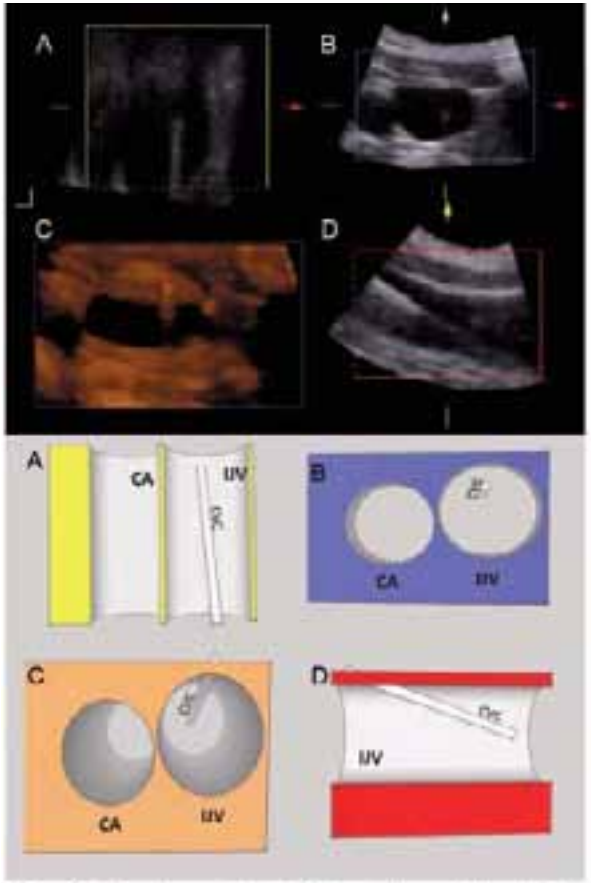


Figure 2. Three-dimensional multiplanar ultrasound showing the catheter within the lumen of the internal jugular vein (IJV) with a diagrammatic illustration. A. Plan view. B. Transverse view. C. volume-rendered view. D. Longitudinal view. CA = carotid artery. CVC = central venous catheter.

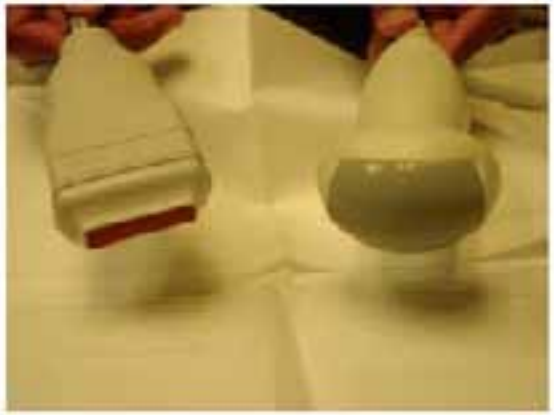


Figure 3. Philips V8-4 transducer compared with a standard linear probe.

standard 2D ultrasound technique. Limitations include poor image resolution, slow screen refresh rate, large transducer size, and increased time to perform the procedure. In the current form, 3D will not replace 2D ultrasound for CVC insertion, but as the technology evolves, we look forward to a reduction in these limitations and improved clinical applicability.

CASE REPORT

Real-Time Three-Dimensional Ultrasound-Guided Central Venous Catheter Placement

Myles Dowling, BM, BS,* Hatem A. Jlala, MBBCh, PhD,† Jonathan G. Hardman, BMedSci, BM BS, DM,† and Nigel M. Bedforth, BMedSci, BM BS*

Les recommandations

NHS

National Institute for Clinical Excellence

Technology Appraisal No. 49

Guidance on the use of ultrasound locating devices for placing central venous catheters

Issue date: September 2002
Review date: August 2005

1.1 Two-dimensional (2-D) imaging ultrasound guidance is recommended as the preferred method for insertion of central venous catheters (CVCs) into the internal jugular vein (IJV) in adults and children in elective situations.

1.2 The use of two-dimensional (2-D) imaging ultrasound guidance should be considered in most clinical circumstances where CVC insertion is necessary either electively or in an emergency situation.

Making Health Care Safer: A Critical Analysis of Patient Safety Practices

Use of real-time ultrasound guidance during central line insertion to prevent complications;

TECHNICAL REPORT INTERNATIONAL JOURNAL OF LABORATORY HEMATOLOGY
Int. Jnl. Lab. Hem. 2007, **29**, 261–278

Guidelines on the insertion and management of central venous access devices in adults

L. BISHOP*, L. DOUGHERTY†, A. BODENHAM‡, J. MANSI*, P. CROWE§, C. KIBBLER¶, M. SHANNON**, J. TRELEAVEN†

- Ultrasound guided insertion is recommended for all routes of central venous catheterization. The use of ultrasound is also recommended for the insertion of PICC when the peripheral veins are not visible or palpable.

Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011

7. Use ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance should only be used by those fully trained in its technique. [60–64].

   Category 1B

Practice Guidelines for Central Venous Access

A Report by the American Society of Anesthesiologists Task Force on Central Venous Access

Anesthesiology 2012; 116:539–73

- Use static ultrasound imaging before prepping and draping for prepuncture identification of anatomy to determine vessel localization and patency when the internal jugular vein is selected for cannulation. Static ultrasound may be used when the subclavian or femoral vein is selected.
- Use real time ultrasound guidance for vessel localization and venipuncture when the internal jugular vein is selected for cannulation (see fig. 1). Real-time ultrasound may be used when the subclavian or femoral vein is selected. The Task Force recognizes that this approach may not be feasible in emergency circumstances or in the presence of other clinical constraints.

La vraie vie….

Pratiques en 2010

Ultrasound guidance for central venous catheter placement: results from the Central Line Emergency Access Registry Database

Adam Balls MD, Frank LoVecchio DO, MPH*, Amy Kroeger MD, RN,

American Journal of Emergency Medicine (2010) **28**, 561–567

Table 5 U/S usage by anatomic location

Location	Cases using U/S	Total cases	%
Left IJ vein	73	74	99
Right IJ vein	326	350	93
Left FV	22	96	23
Right FV	64	314	20
Left subclavian vein	1	157	1
Right subclavian vein	1	210	0
Overall	487	1202	41

Ultrasound guidance for central venous catheter placement in Australasian emergency departments: Potential barriers to more widespread use

Emergency Medicine Australasia (2010) 22, 514–523

Jakub T Matera,[1] Diana Egerton-Warburton[2] and Robert Meek[3]

Access to US at the place of principal employment	
Yes	430 (88.5)
No	56 (11.5)

Table 2. Self-reported frequency of ultrasound use for CVC ($n = 486$)

	Responders *n* (%)
Never	97 (20.0)
Rarely	76 (15.6)
Sometimes	94 (19.3)
Usually	113 (23.3)
Always	67 (13.8)
No CVC insertion	39 (8.0)

Les raisons de la sous utilisation

American Journal of Emergency Medicine (2010) **28**, 561–567

Table 6 Reasons for not using U/S

Reason	No.	%
Insufficient time for setup/use of U/S machine	275	37
No access to U/S in hospital setting where lines were placed	95	13
Not trained in U/S placement of central lines	37	5
Not mentioned	28	4
All other	304	41
Total	739	100

A Survey of the Use of Ultrasound During Central Venous Catheterization

ANESTHESIA & ANALGESIA Vol. 104, No. 3, March 2007

Reasons for not using US	
Cost	18 (1.4)
Time delay to obtain US	95 (7.2)
Time delay to perform CVS with US	113 (8.5)
Lack of availability of US	234 (17.7)
No need to use US to perform CVC	605 (45.7)
Other	19 (1.3)
Missing	235 (17.8)

Est-ce économiquement rentable ?

Rentabilité de moins en moins discutée

Volume 12 • Number 1 • 2009
VALUE IN HEALTH

Ultrasound-Guided Central Line Placement as Compared with Standard Landmark Technique: Some Unpleasant Arithmetic for the Economics of Medical Innovation

Stephen Kinsella, PhD,[1] Nicholas Young, MD[2]

Results: The initial "cost" of placing central lines was found to be 390,780,000 to 651,300,000 dollars per year by the landmark technique, as compared with 494,820,000 to 824,700,000 dollars per year by ultrasound guidance.

Conclusions: The cost of ultrasound guidance was not mitigated by its reduction in the cost of treating pneumothoraces.

Keywords: cardiovascular disease prevention, clinical research, cost analysis, cost savings.

C'est rentable !!!

Ultrasound for central venous cannulation: economic evaluation of cost-effectiveness

Anaesthesia, 2004, **59**, pages 1116–1120

N. Calvert,[1] D. Hind,[1] R. McWilliams,[2] A. Davidson,[3] C. A. Beverley[4]

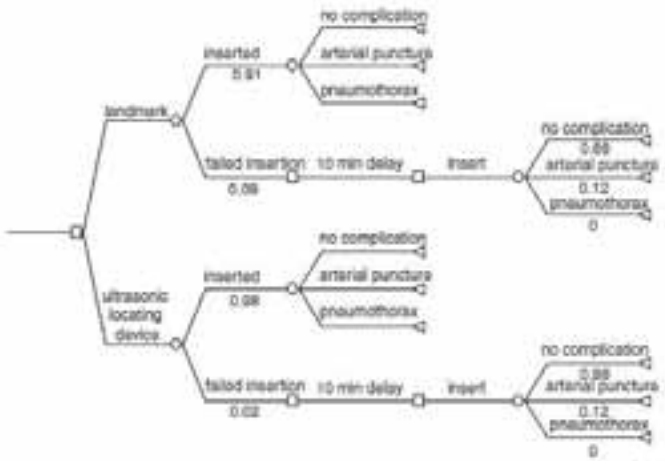


Table 4 Costs and consequences per 1000 central venous cannulations performed using the landmark and ultrasound methods.

	Landmark	Ultrasound	Incremental change
Cost; £	11 379	9305	−2092
Arterial punctures; *n*	120	30	−90
Pneumothorax; *n*	0	0	0

Table 5 Univariate threshold sensitivity analysis for central venous cannulation.

	Baseline	Threshold*
Failure rate		
Landmark	9%	6%
Ultrasound	2%	5%
Arterial puncture rate		
Landmark	12%	7%
Ultrasound	3%	8%
Cost per ultrasound procedure; £	6.64	8.72
Cost of ultrasound machine; £	11 000	15 584
Training cost per operator; £	1090	3360
Operator procedures per week; *n*	2	0.65
Ultrasound procedures per week; *n*	15	10.6
Cost of failure delays; £	73	No solution†
Cost of arterial puncture; £	40	No solution†

*The point at which the saving arising from use of ultrasound becomes neutral so that the two techniques are deemed to cost

2535 €

- 2.5 €/cathé

Cathéters artériels

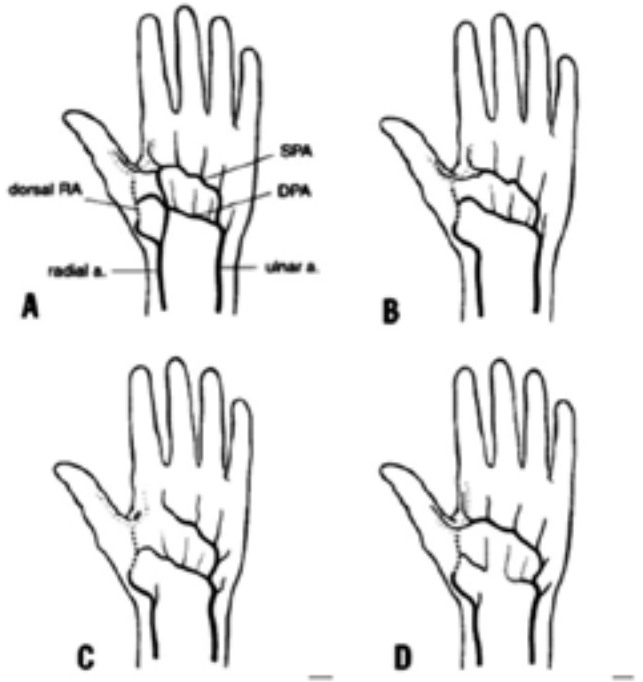
Cathétérisme artériel radial
pourquoi utiliser l'échographie ?

- 8. 10^6 KTA /an aux EU, 2.5 . 10^6 en Europe
- Risks: bleeding, hematoma, pseudoaneurysm, infection, nerve damage, and distal limb ischemia
- Ø ulnaire > Ø radiale
- <u>Variations anatomiques</u>

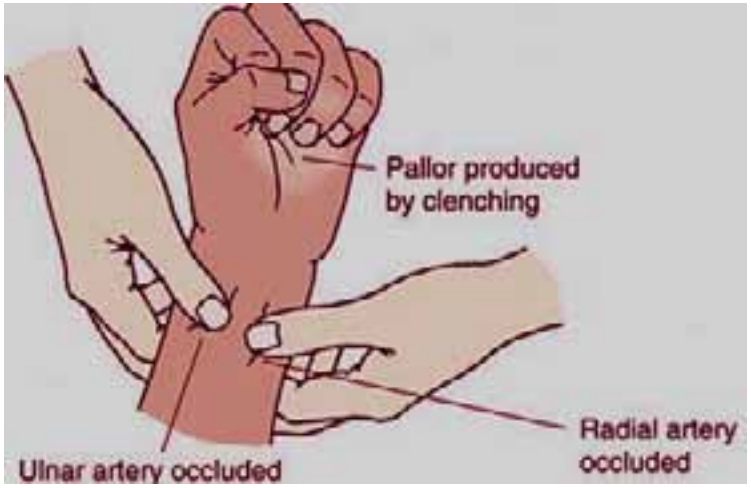
Arcade palmaire superficielle

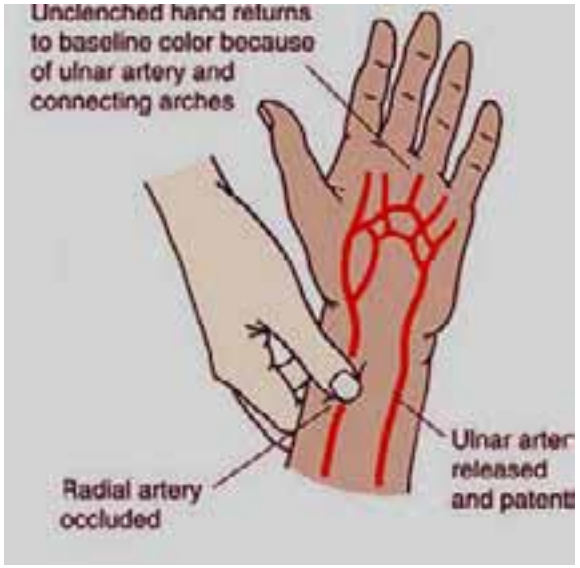
complète chez seulement 90%

Brzezinski M, Anesth & Analgesia, 2009



Cathétérisme artériel radial pourquoi utiliser l'échographie ?





Le Test d'Allen modifié ne prédit

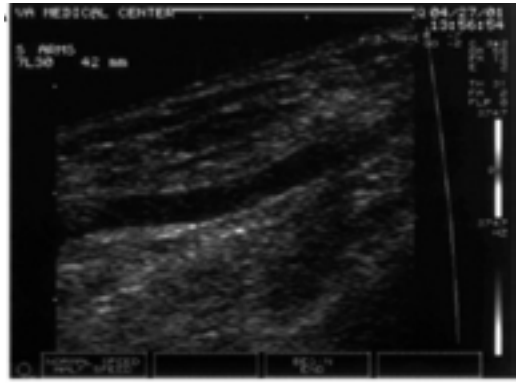
l'ischémie de la main après

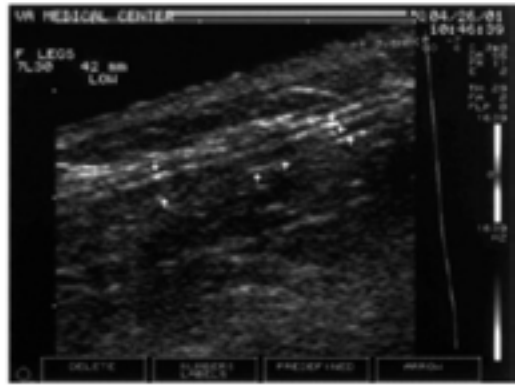
cathétérisme radial (FP et FN)

Brzezinski M, Anesth & Analgesia, 2009

Cathétérisme artériel radial
pourquoi utiliser l'échographie ?

- <u>Athérosclérose et calcifications radiales:</u> 10-20 % des patients cardiaques (80% des diabétiques)



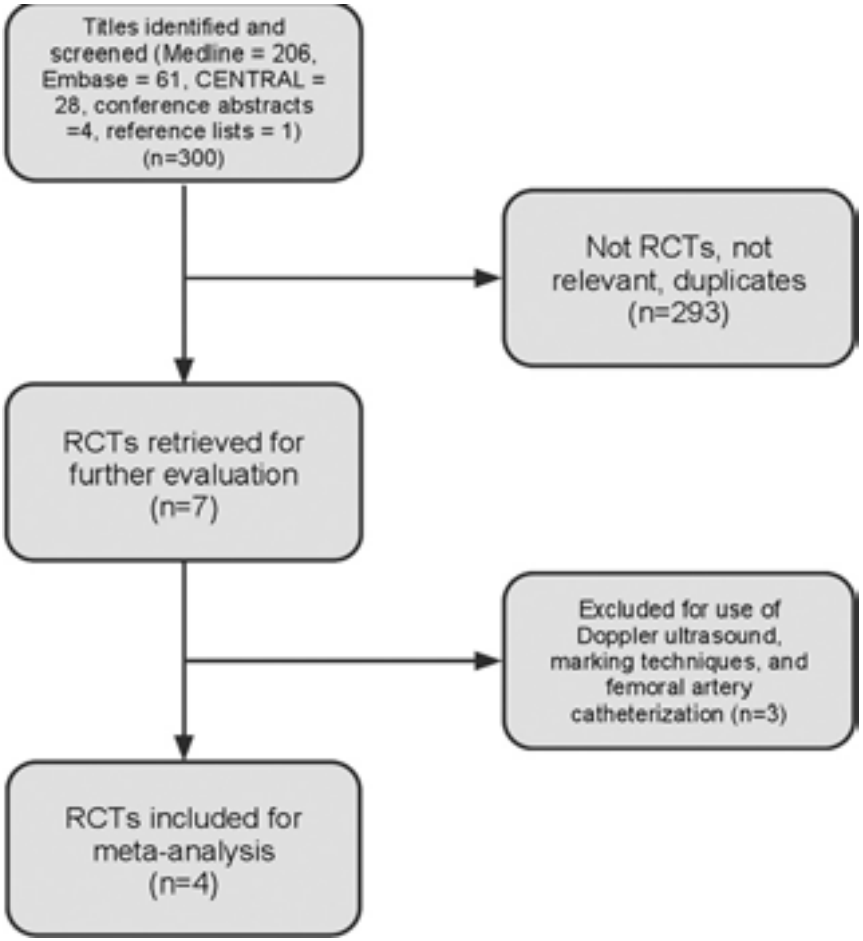


CHEST Original Research
CRITICAL CARE

Ultrasound-Guided Catheterization of the Radial Artery

A Systematic Review and Meta-analysis of Randomized Controlled Trials

Ariel L. Shiloh, MD; Richard H. Savel, MD; Laura M. Paulin, MD, MHS; and Lewis A. Eisen, MD, FCCP



CHEST Original Research
CRITICAL CARE

Ultrasound-Guided Catheterization of the Radial Artery

A Systematic Review and Meta-analysis of Randomized Controlled Trials

Ariel L. Shiloh, MD; Richard H. Savel, MD; Laura M. Paulin, MD, MHS; and Lewis A. Eisen, MD, FCCP

Table 2—*Summary of RCTs of Ultrasound-Guided Arterial Catheterization*

Author	Sample Size	Population	Operator	First-Attempt Success[a]		Jadad Score	*P* Value
				USG	Palpation		
Levin et al[14]	69	Adult cardiothoracic, abdominal, neuro-, and vascular surgery	Anesthesia attending physicians and residents with USG CVC placement experience but with minimal USG arterial catheterization experience	62% (21/34)	34% (12/35)	3	.03
Schwemmer et al[15]	30	Infant neurosurgery	Anesthesiologists with experience in > 20 pediatric arterial catheterizations in both palpation and USG	67% (10/15)	20% (3/15)	3	< .05
Shiver et al[16]	60	Adult ED	Attending emergency physicians without USG arterial catheterization experience; all had extensive USG CVC and peripheral venous catheterization experience	87% (26/30)	50% (15/30)	3	.005
Ganesh et al[17]	152	Pediatric abdominal, craniofacial, neuro-, orthopedic, and thoracic surgery	Pediatric trainee and consultant anesthesiologists, 94% with < 5 USG arterial catheterization experience	13.5% (11/80)	13.9% (10/72)	3	1

CVC = central venous catheter; RCT = randomized controlled trial; USG = ultrasound guidance.
[a]For all studies, the intervention was real-time two-dimensional ultrasound guidance to visualize the radial artery and direct arterial catheterization, and the control was palpation of the radial artery.

CHEST Original Research
CRITICAL CARE

Ultrasound-Guided Catheterization of the Radial Artery

A Systematic Review and Meta-analysis of Randomized Controlled Trials

CHEST / 139 / 3 / MARCH, 2011

Ariel L. Shiloh, MD; Richard H. Savel, MD; Laura M. Paulin, MD, MHS; and Lewis A. Eisen, MD, FCCP

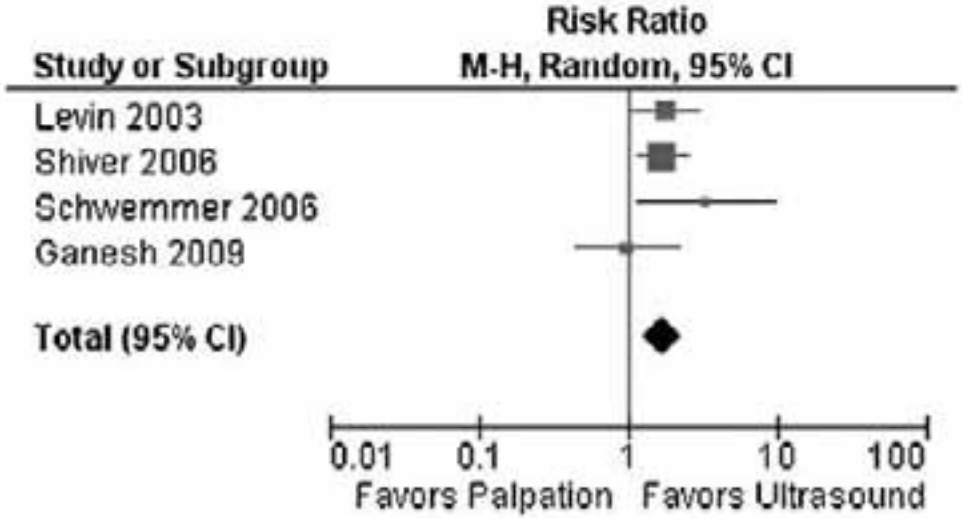


FIGURE 2. Effect of ultrasound-guided catheterization on first-attempt success. M-H = Mantel-Haenszel test.

Cathétérisme Artériel Ulnaire ?

- Alternative au KT radial en Réa/Bloc

Karacalar et al. J.Clin Anesth 2007

- Succès du cathétérisme variable (100% si poul, < 60 % en l'absence de poul)
- Taux élevé d'ischémie digitale après échec en radial
- Risque théorique de complication neuro
- Alternative en coronarographie , taux succès et de complications = abord radial
- Absence de données sur la pose échoguidée à ce jour….

Voies veineuses périphériques

CHEST ONLINE

Ultrasound-Guided Peripheral Venous Access in Severely Ill Patients With Suspected Difficult Vascular Puncture

Thomas Kerforne, Franck Petitpas, Denis Frasca, Véronique Goudet, René Robert and Olivier Mimoz

Chest 2012;141;279-280

Table 1—*Patients' Characteristics and Main Results by Insertion Technique*

	Traditional Approach (n = 30)	Ultrasound Guided (n = 30)	*P* Value
Male sex	15 (50)	19 (63)	> .20
Age, y	56 ± 15	61 ± 17	> .20
Simplified Acute Physiology Score II	41 ± 15	38 ± 16	> .20
Presence of edema	23 (77)	24 (80)	> .20
History of diabetes	10 (30)	8 (27)	> .20
Corticosteroids therapy	4 (13)	1(3)	> .20
IV drug use	1 (3)	0 (0)	> .20
Successful cannulation, n[a] (No.[b] [%])			
Before group switched	11 (30 [37])	21 (30 [70])	.02
After group switched	2 (9 [22])	15 (19 [79])	NA
Overall	13 (39 [33])	36 (49 [73])	NA
Time for cannulation, s	400 ± 195	435 ± 304	> .20

Data are provided as No. (%) or Mean ± SD unless otherwise indicated. NA = not applicable.

[a]Number of patients with successful cannulation in each study group.

[b]Total number of patients in each study group.

PREDICTORS OF SUCCESS IN NURSE-PERFORMED ULTRASOUND-GUIDED CANNULATION

Brian Chinnock, MD, Stephen Thornton, MD, and Gregory W. Hendey, MD

- But: définir les facteurs associés au succès de KTV périphérique sous US / choix du site de canulation / facteurs liés au patient / technique (2/4 mains)
- Méthode: étude prospective monocentrique, SAU, sur 1 an. Opérateur (nurse) après > 2 échecs de pose, et aucune autre veine visible.

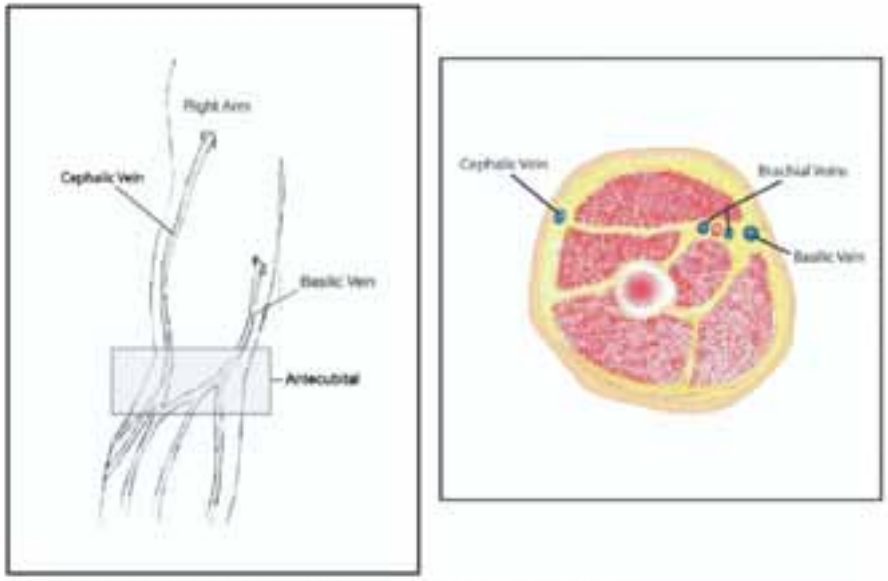


Figure 1. Surface and cross-sectional anatomy of arm veins used for cannulation.

The Journal of Emergency Medicine, Vol. 33, No. 4, pp. 401–405, 2007

PREDICTORS OF SUCCESS IN NURSE-PERFORMED ULTRASOUND-GUIDED CANNULATION

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Résultats:

100 patients inclus

Taux de succès 63%, 53 % à la première tentative

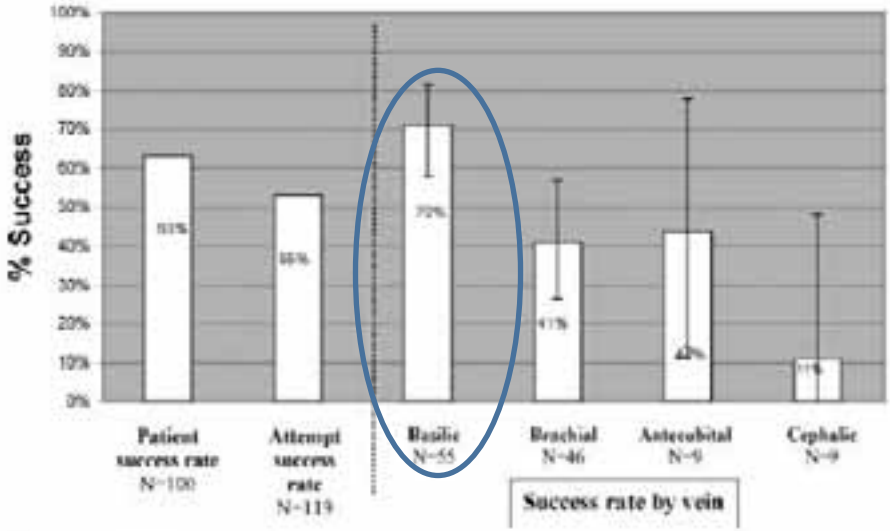


Figure 2. Cannulation success rates.

Table 1. Characteristics of Study Subjects and Cannulation Procedure (100 Patients)

Mean age (years)	48 (range 22–104)
Female	59%
Reason for difficult venous access (%)	
IV drug abuse	48
Obesity	18
Medical condition	52
> 1 of above reasons	17
Need for past central venous access (%)*	
Definite past need	69
Sonographic visualization achieved (%)	
Brachial	99
Basilic	74
Antecubital	17
Cephalic	22
Initial vein chosen for cannulation attempt (%)†	
Basilic	52
Brachial	34
Antecubital	9
Cephalic	5
One- or two-person technique used for cannulation attempt (%)	
One-person	81%

* This question was added to the study data form later, and only the 74 final patients in study were asked this question.
† 6 patients had no adequate vein for cannulation and were not attempted.

PREDICTORS OF SUCCESS IN NURSE-PERFORMED ULTRASOUND-GUIDED CANNULATION

Brian Chinnock, MD, Stephen Thornton, MD, and Gregory W. Hendey, MD

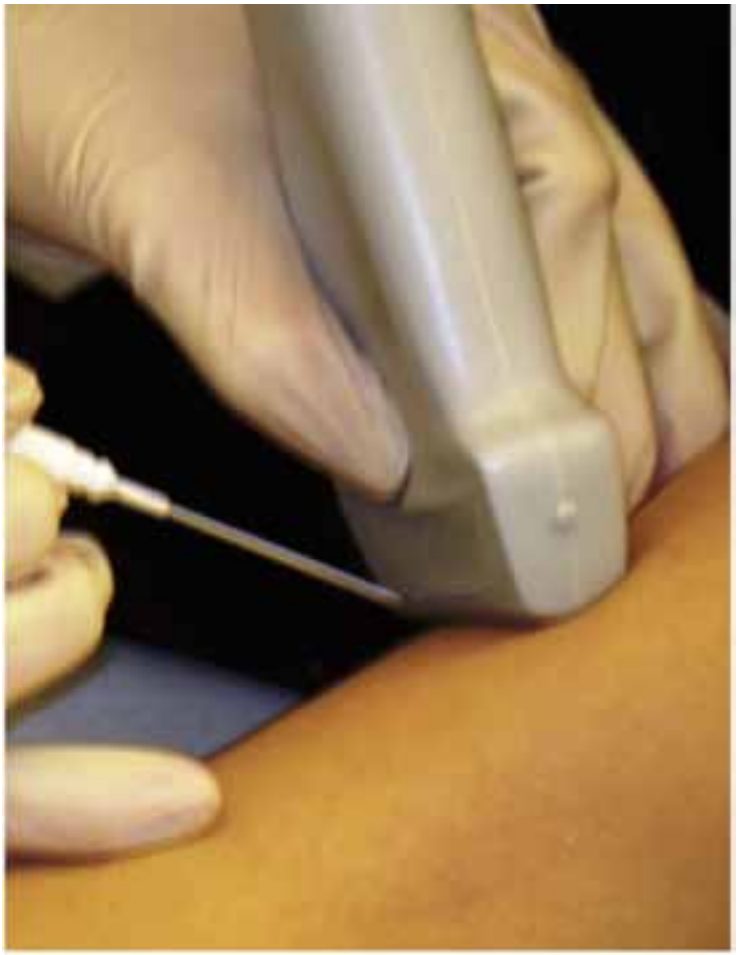
- Complications: 5% ponction artérielle (V brachiale (4))- douleurs 8%
- Pas d'influence de la technique 2 vs 4 mains
- V. basilique > V.brachiale

Brief Report

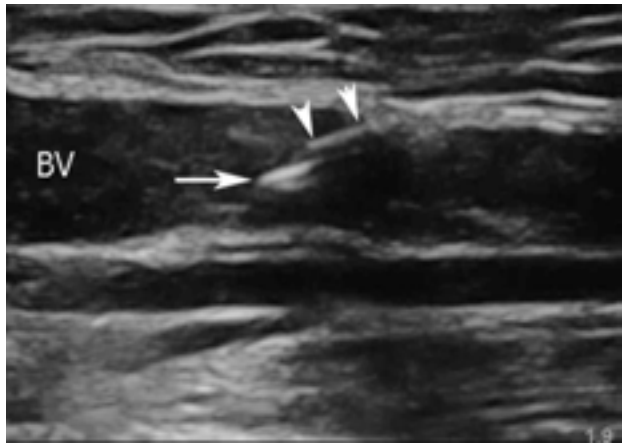
Short- vs long-axis approach to ultrasound-guided peripheral intravenous access: a prospective randomized study☆

Simon A. Mahler MD*, Hao Wang MD, PhD, Chadwick Lester RN, Janice Skinner RN, Thomas C. Arnold MD, Steven A. Conrad MD, PhD

Department of Emergency Medicine, Louisiana State University Health Sciences Center; Shreveport, LA 71130, USA



American Journal of Emergency Medicine (2011) **29**, 1194–1197



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- Objectifs: comparer les approches en petit et grand axes de pose VVP (après > 2 échecs technique “landmark”), site v. basilique
- Résultats: 20 patients ds chaque groupe
- Petit axe:19/20 Grand axe: 17/20
- Tous les échecs en coupe longitudinale
- Corrigées en coupe transversale
- inverse:non

Table 2 Comparison of end points for short- and long-axis techniques

	Short axis	Long axis	*P* value
Median insertion time (IQR)	34s (35s)	96s (59s)	.02
Median total procedure time (IQR)	201s (331s)	236s (378s)	.68
Mean needle sticks ± SD	1.5 ± 0.7	1.4 ± 0.7	.82
Success rate (%)	19/20 (95)	17/20 (85)	.61
Complication rate (%)	3/20 (15)	3/20 (15)	1.00
Mean satisfaction score ± SD	9.7 ± 0.7	9.5 ± 1.0	.79

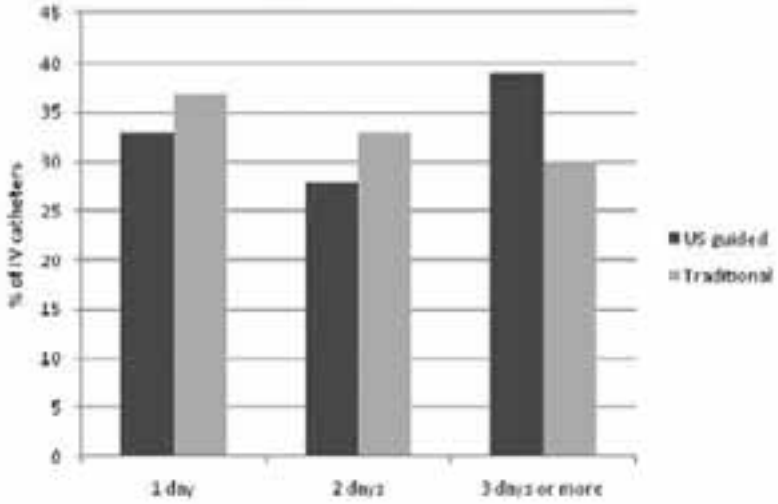
Comparison of Infection Rates Among Ultrasound-Guided Versus Traditionally Placed Peripheral Intravenous Lines

J Ultrasound Med 2010; 29:741–747

Srikar Adhikari, MD, RDMS, Michael Blaivas, MD, Daniel Morrison, MD, RDMS, Lina Lander, ScD

- 25% de “lymphangites”, faible % de bactériémies reliées
- Étude rétrospective, 402 VVP sous US vs 402 VVP “landmark”
- 7 IDE formées aux US (> 1an, après formation sur mannequin + théorie + video…)
- 5.2 p1000 groupe US vs 7.8 p 1000 groupe standard bactériémies, p=ns

Figure 2. Duration of IV catheters in situ before removal.



conclusions

- Échoguidage = Formation
- Echoguidage systématique VJI
- Patients à risques (obésité- cou court-ATCD ponction)
- Repérage= VF- SC
- A déterminer= KTA-VVP difficile