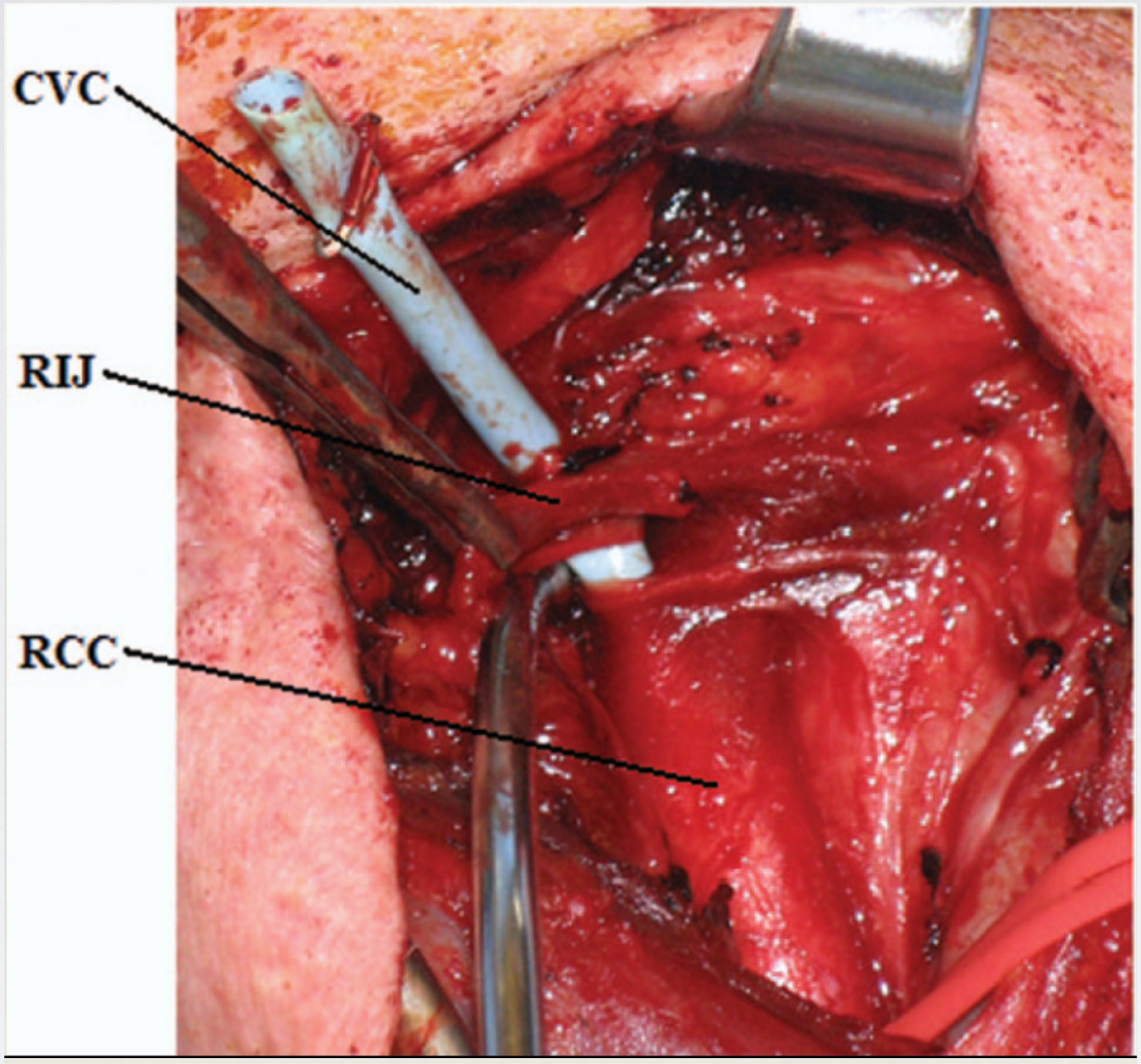
DANGER OF INADVERTENT ARTERIAL CANNULATION

IS THIS A REAL PROBLEM?

How to avoid this….and **ultrasound is not the answer!**



Open surgical repair following arterial cannulation reveals a catheter traversing through the right internal jugular vein into the carotid artery…**despite the use of ultrasound**

Anesth Analg 2009 109: 135-136

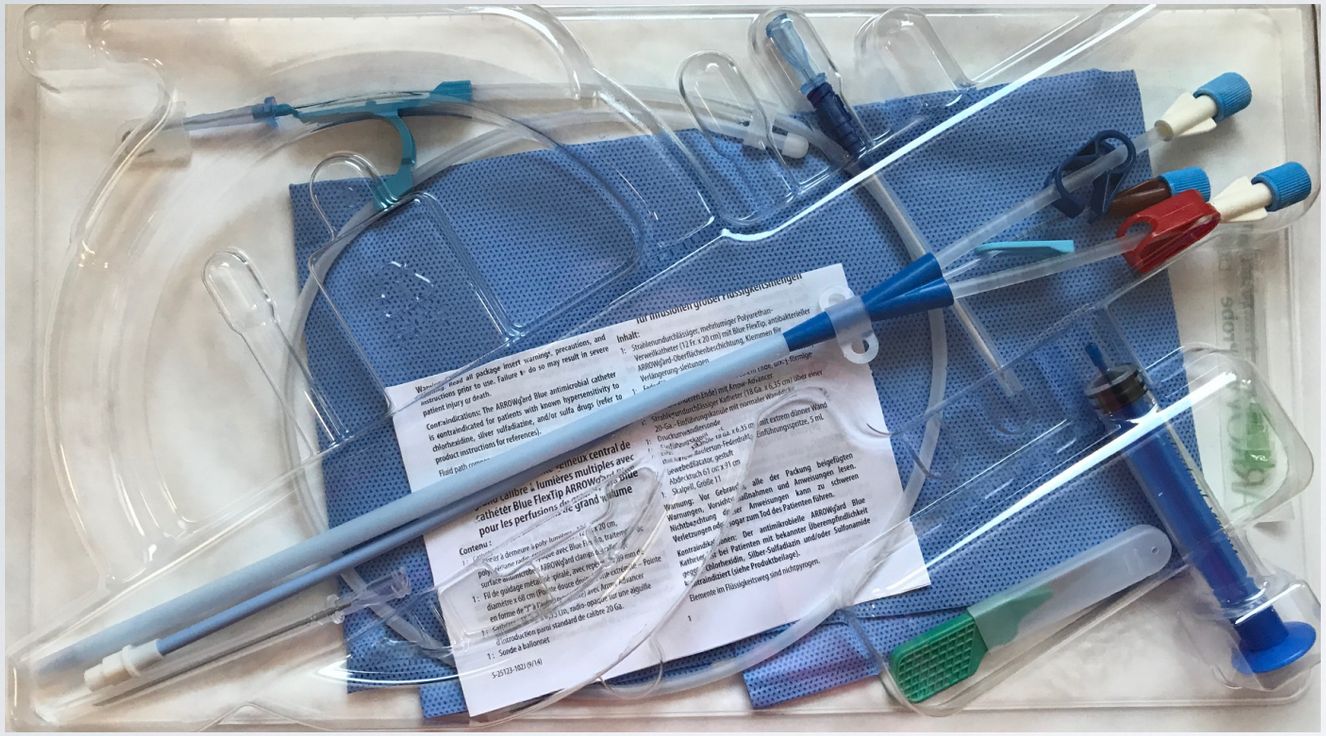
Be careful !

Ultrasound has **not** removed the risk of unintended arterial cannulation.

2 out of **6** died

3 out of **6** required emergency surgery

…and remember we use BIG catheters!



VasCath ~ 12 - 13.5 Fr

"At 15.5 Fr diameter, the Hemolung Catheter is the smallest ECC0$_2$R catheter available."

French (Fr)
increases from zero in
increments of 0.33 mm O.D.
(a size 5 Fr = 16 SWG)

Estimated risks :

- **"Can't intubate and can't ventilate"**

"an **entire industry** devoted to performing ventilation and tracheal intubation in just those few patients."

- **Intraoperative awareness**

"…industry that … sells **expensive monitors** that at best is marginally effective."

- **Malignant hyperthermia**

"tens of thousands of dantrolene carts …"

- **Arterial cannulation with a 7F or larger catheter**

"if manometry is only half as effective as reported, then major morbidity or death, will be avoided"

Relative to many other rare events the payback of pressure measurement here is tremendous.

Anesth Analg Vol. 109, No. 1, July 2009

Does ultrasound eliminate this risk?

Carotid arterial cannulation: removing the risk with ultrasound?

Can J Anesth (2009) 56:471–472

"The use of an **US** technique does **not remove all risk inherent with CVC insertion**"

Inadvertent Great Vessel Arterial Catheterization During Ultrasound-Guided Central Venous Line Placement: A Potentially Fatal Event

JOURNAL OF VASCULAR SURGERY June Supplement 2011

In 8 patients there was inadvertent/**unrecognized carotid artery catheterization**. All were **done under "ultrasound guidance"**

inadvertent great vessel catheterization …is a **fatal event in 38%**.

"**ultrasound…** imparted a **false sense of security**."

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

J Ultrasound Med 2009; 28:1239–1244

This series describes 6 **accidental arterial cannulations** in critically ill patients that **occurred with dynamic ultrasound** guidance.

Carotid Dissection: A Complication of Internal Jugular Vein Cannulation with the Use of Ultrasound

Anesthesia and Analgesia Vol. 109, No. 1, July 2009

"…serious complications with **potentially fatal outcomes** can occur … **despite ultrasound guidance**"

Pressure Waveform Monitoring During Central Venous Catheterization

Anesthesia and Analgesia Vol. 109, No. 6, December 2009

"**color** and **pulsatility** are **not reliable** for detecting intra-arterial puncture"

"..**always measure a pressure waveform** … **inadvertent arterial cannulation** …**despite the use of ultrasound** "

"….. this largely **life-threatening complication** seems to **occur far too often**."

Does ultrasound eliminate this risk?

Ultrasound Identification of the Guidewire in the Brachiocephalic Vein for the Prevention of Inadvertent Arterial Catheterization During Internal Jugular Central Venous Catheter Placement

"There are numerous reports of **inadvertent arterial catheterisation** **despite** the use of **ultrasound** guidance"

"One solution for avoiding this problem is to place a catheter over needle into the internal jugular vein and **measure the pressure** from the catheter"

Anesth Analg 2016 123:896-900

The Faculty of Intensive Care Medicine

Learning from Patient Safety Incidents

STROKE COMPLICATING CENTRAL VENOUS LINE

S

- A patient with community acquired pneumonia and septic shock had an inadvertent right carotid artery placement of a multi-lumen central venous line.
- The patient subsequently developed a large right sided cerebral infarct.

B

- The line was inserted under ultrasound guidance
- On connection to pressure transducer, a waveform could not be obtained and chest X-ray was performed. This was interpreted as showing correct placement and noradrenaline infusion commenced.
- 2 hours later a pressure waveform was obtained by changing the monitor scale (from maximum of 20 mmHg to 200 mmHg) which revealed an arterial trace.
- The line was promptly removed and local pressure applied until bleeding controlled.

A

- Technical error with inadvertent passage of guide-wire through vein into artery with failure to identify malposition before proceeding to dilatation and large gauge line insertion.
- Misinterpretation of cause of failure to obtain venous waveform (incorrect scale)
- Removal of large gauge line without referral to vascular surgery or interventional radiology.

R

- Venous placement of guidewire must be confirmed before dilatation.
- Consider routinely transducing BEFORE dilatation.
- Highlight potential for misinterpreting a flat CVC trace
- Ensure all clinical members of team are trained in troubleshooting invasive pressure transducers
- Do not ‘remove and press’ following Inadvertent arterial cannulation with a large bore line but get urgent vascular surgery/interventional radiology advice.

https://www.ficm.ac.uk/safety-and-clinical-quality/learning-patient-safety-incidents

Pressure measurement to the rescue?

Arterial Cannulation During Central Line Placement:
Mechanisms of Injury, Prevention, and Treatment

T. Andrew Bowdle MD, PhD

Professor of Anesthesiology and Pharmaceutics

Chief of the Division of Cardiothoracic Anesthesiology

Department of Anesthesiology

University of Washington

"the Closed Claims Database confirmed the hazards associated with central line…had an increased proportion of death (36%)

Type of complication	No.	Deaths (%)
Carotid artery injury	14	36
Miscellaneous vessel injury	7	29

"…the IHI added a Central Line Insertion Checklist from Johns Hopkins University…the **checklist includes mandatory pressure transduction**"

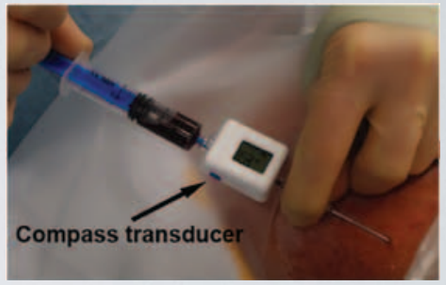


Figure 3: Tube manometer used in the Ezaru et al. study demonstrating that pressure measurement can prevent arterial cannulation[10]

Out of 1795 catheterizations, **0.8%** arterial cannulations were prevented by pressure measurement.
Estimated **48,000 prevented by pressure measurement /yr**
(which would not be discovered by colour or pulsatility)

Practice guidelines

"While ultrasound has been recommended, it is only recently that professional organisations have begun to appreciate the importance of including pressure measurement."
"the ASA published central line insertion recommendations that include pressure transduction..to to prevent inadvertent arterial cannulation."

So if it ain't broke, why fix it?

British Journal of Anaesthesia **110** (3): 368–73 (2013)
Advance Access publication 6 November 2012 · doi:10.1093/bja/aes381

BJA

CARDIOVASCULAR

Three-step method for ultrasound-guided central vein catheterization

J. Tokumine[1]*, A. T. Lefor[4], A. Yonei[5], A. Kagaya[2], K. Iwasaki[2] and Y. Fukuda[3]

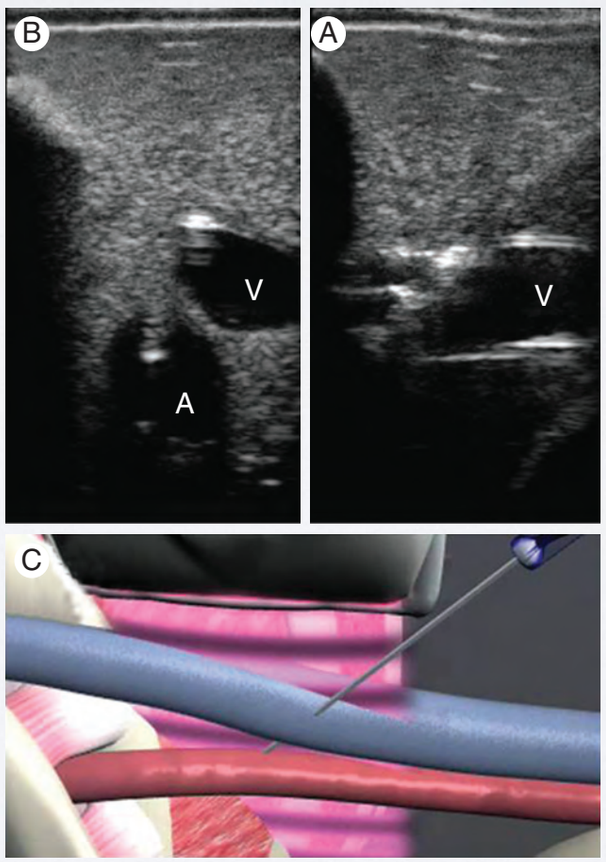


Fig 1 Pitfalls of the LAX-IP technique. Pitfalls associated with the LAX-IP are demonstrated using a simulator. V, vein; A, artery. (A) The longitudinal view shows what appears to be a correct orientation. (B) Actually, the tip of the needle is in the artery. (C) The three-dimensional graphic illustrates that the needle went through the vein into the artery.

Clinical case

- 73 yr old man
- Haematological malignancy - post chemotherapy
- Temperature 40 degrees ; 0 neutrophils; 5 platelets
- Marked sequel of rt arm cellulitis post- PICC line
- BP ~80/35 requires urgent Noradrenaline
- Platelets will arrive in 2 hrs

What do you suggest?

EXTERNAL JUGULAR VEIN

External jugular vein cannulation works!

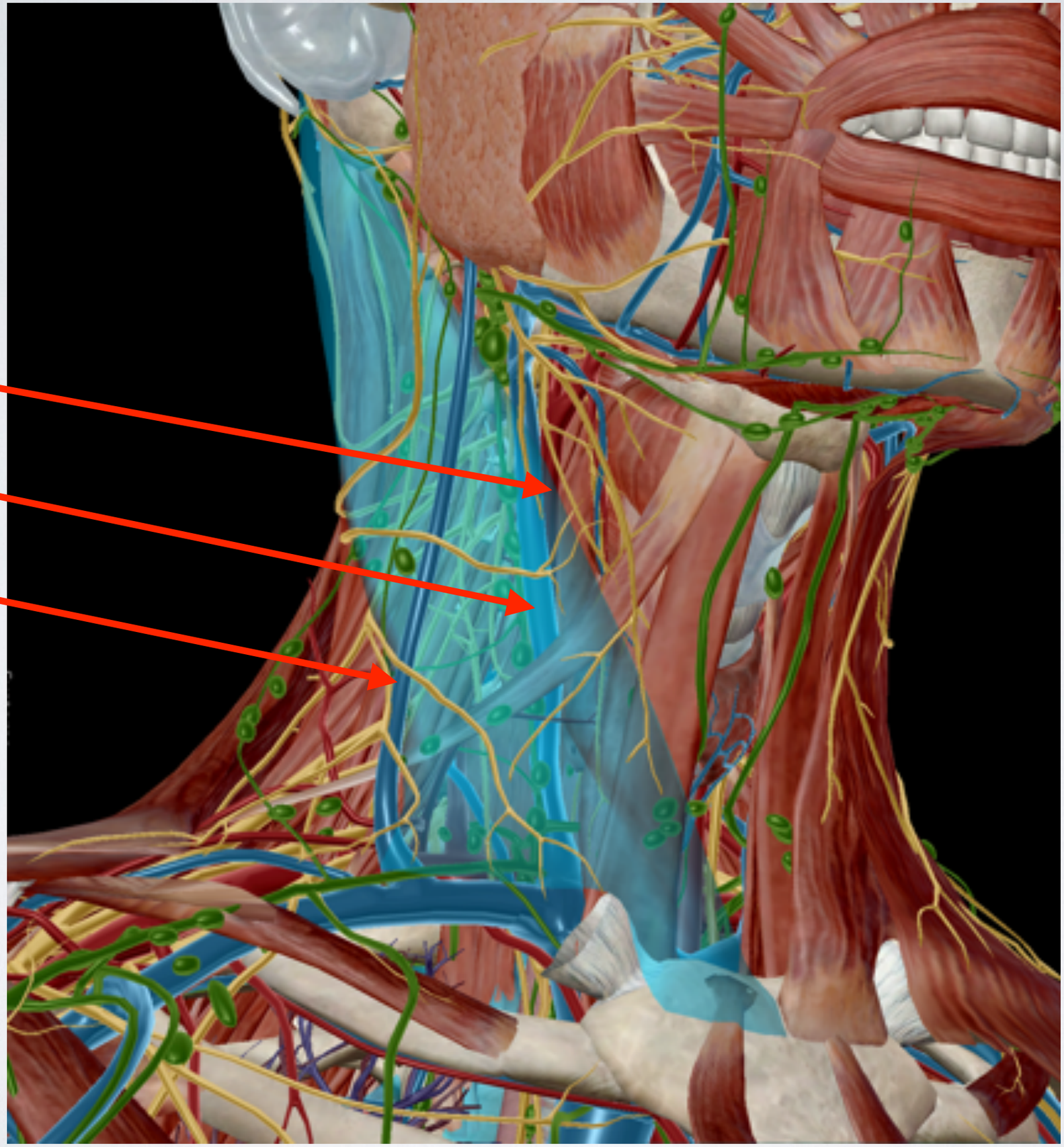
J-Wire versus Straight Wire for Central Venous System Cannulation via the External Jugular Vein

Casey D. Blitt, MD,*
George L. Carlson, MD,†
Will A. Wright, MD,† and
Charles W. Otto, MD‡

ANESTHESIA AND ANALGESIA
Vol 61, No 6, June 1982

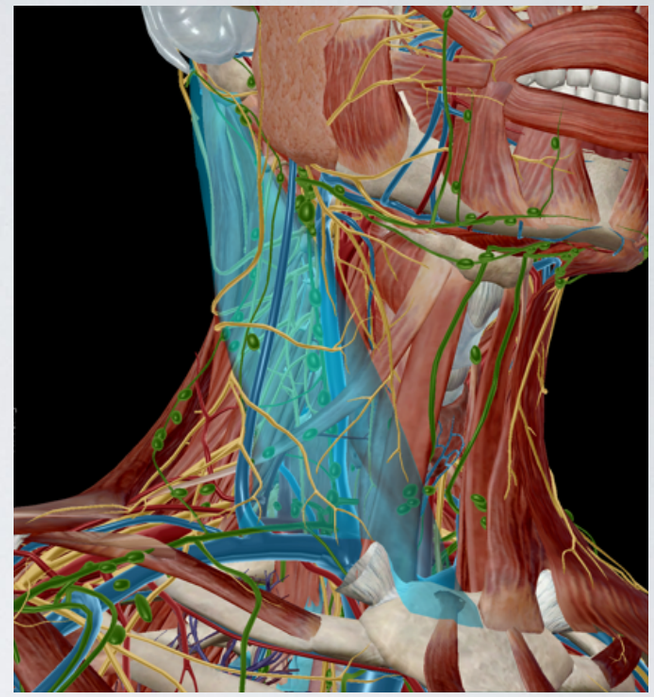
"..more than 100,000 cannulations of the **central venous** system and pulmonary artery **via the external jugular vein** have been performed with a **success rate of 80-95%**"

Anatomy of external jugular vein



Surg Radiol Anat 1994; 16:173-7 Deslaugiers B, Vaysse P, Combes et al

Anatomy of external jugular vein



The EJV generally has **two bicuspid valves**, one at the junction of the subclavian and the other approximately 4 cm upstream.

Dissection of 100 external jugular veins, the external jugular vein flowed into:

60% into the **jugulo-subclavian** venous confluence

36% into the **subclavian vein**

4% into the internal jugular vein

Surg Radiol Anat 1994; 16:173-7 Deslaugiers B, Vaysse P, Combes et al

Central Venous Access Via External Jugular Vein

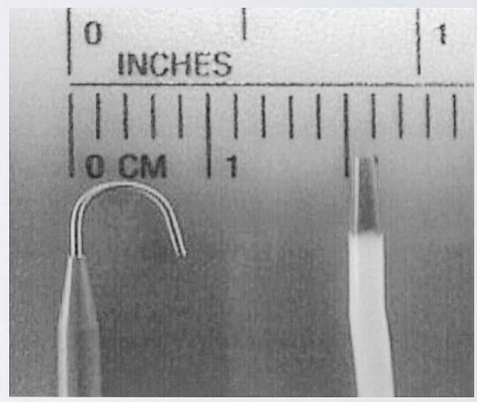
- Author: Rick McPheeters, DO, FAAEM; Chief Editor: Vincent Lopez Rowe, MD more...

Updated: Feb 26, 2015

http://emedicine.medscape.com/article/2116323-overview

Tips

- Valsalva manoeuvre
- If wire does not pass :
  - withdraw it a few mm and rotate 90-180°
  - head tilt to the opposite side and shoulder manipulation
  - **pass the catheter over the wire after withdrawing a few mm**



"In **11 of 68** EJV cannulation attempts, the J-wire could **not transverse** the EJV-SVC junction…"

"…this rescue technique facilitated central vein cannulation through the EJV in **10 of 11** attempts."

ANESTH ANALG 1999;88:691–6

INFECTION RISK FROM FEMORAL CATHETER

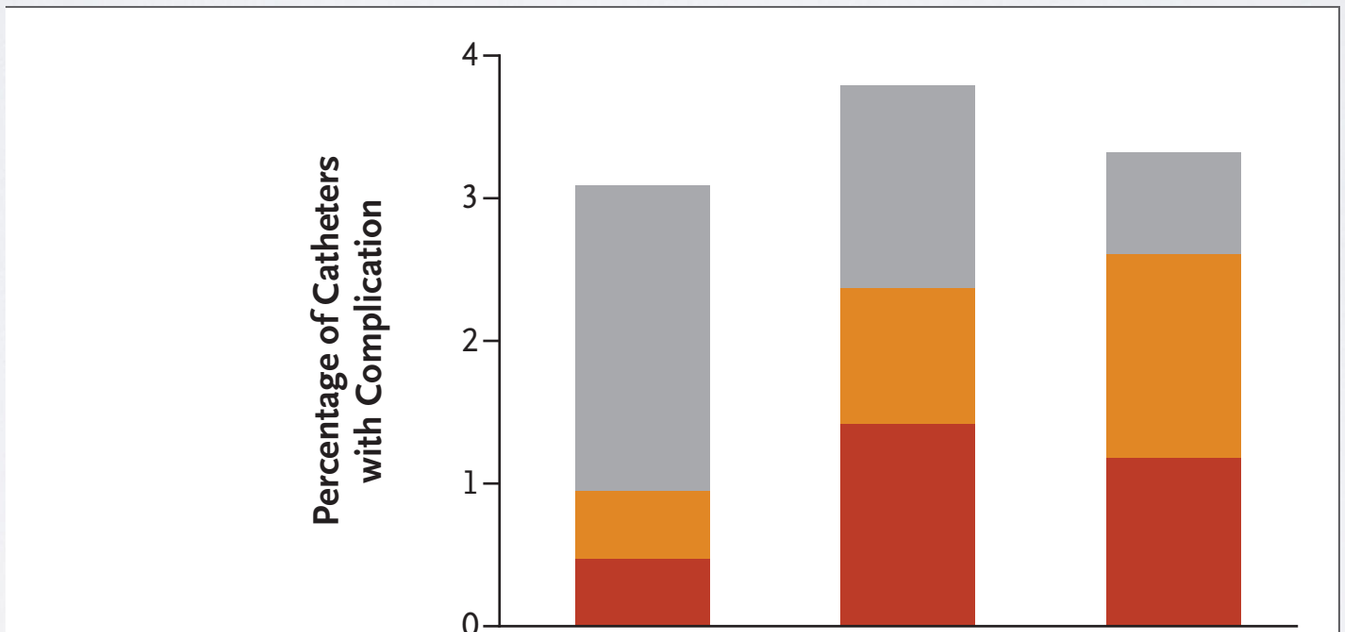
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Intravascular Complications of Central Venous Catheterization by Insertion Site

Conclusions

"In this trial, **subclavian**-vein catheterisation was associated with a **lower risk of bloodstream infection** and symptomatic thrombosis and a higher risk of pneumothorax than **jugular**-vein or **femoral**-vein catherization."



	Subclavian (N=843)	Jugular (N=845)	Femoral (N=844)
Mechanical (grade ≥3)	18 (2.1%)	12 (1.4%)	6 (0.7%)
Symptomatic deep-vein thrombosis	4 (0.5%)	8 (0.9%)	12 (1.4%)
Bloodstream infection	4 (0.5%)	12 (1.4%)	10 (1.2%)

N Engl J Med 2015;373:1220-9.

Femoral vs Jugular Venous Catheterization and Risk of Nosocomial Events in Adults Requiring Acute Renal Replacement Therapy

A Randomized Controlled Trial

JAMA, May 28, 2008—Vol 299, No. 20

In terms of **infection**,

Jugular = Femoral venous catheterization

Complications of Femoral and Subclavian Venous Catheterization in Critically Ill Patients

A Randomized Controlled Trial

In terms of infection/thrombosis,

Femoral > Subclavian venous catheterization

JAMA 2001;286:700

But for how long?

Jugular versus Femoral Short-Term Catheterization and Risk of Infection in Intensive Care Unit Patients

Causal Analysis of Two Randomized Trials

Jean-François Timsit[1,2,3], Lila Bouadma[3], Olivier Mimoz[4], Jean-Jacques Parienti[5], Maïté Garrouste-Orgeas[1,6], Serge Alfandari[7], Gaétan Plantefeve[8], Régis Bronchard[9], Gilles Troche[10], Remy Gauzit[11], Marion Antona[12], Emmanuel Canet[13], Julien Bohe[14], Marie-Christine Herrault[15], Carole Schwebel[2], Stéphane Ruckly[1], Bertrand Souweine[16], and Jean-Christophe Lucet[17]

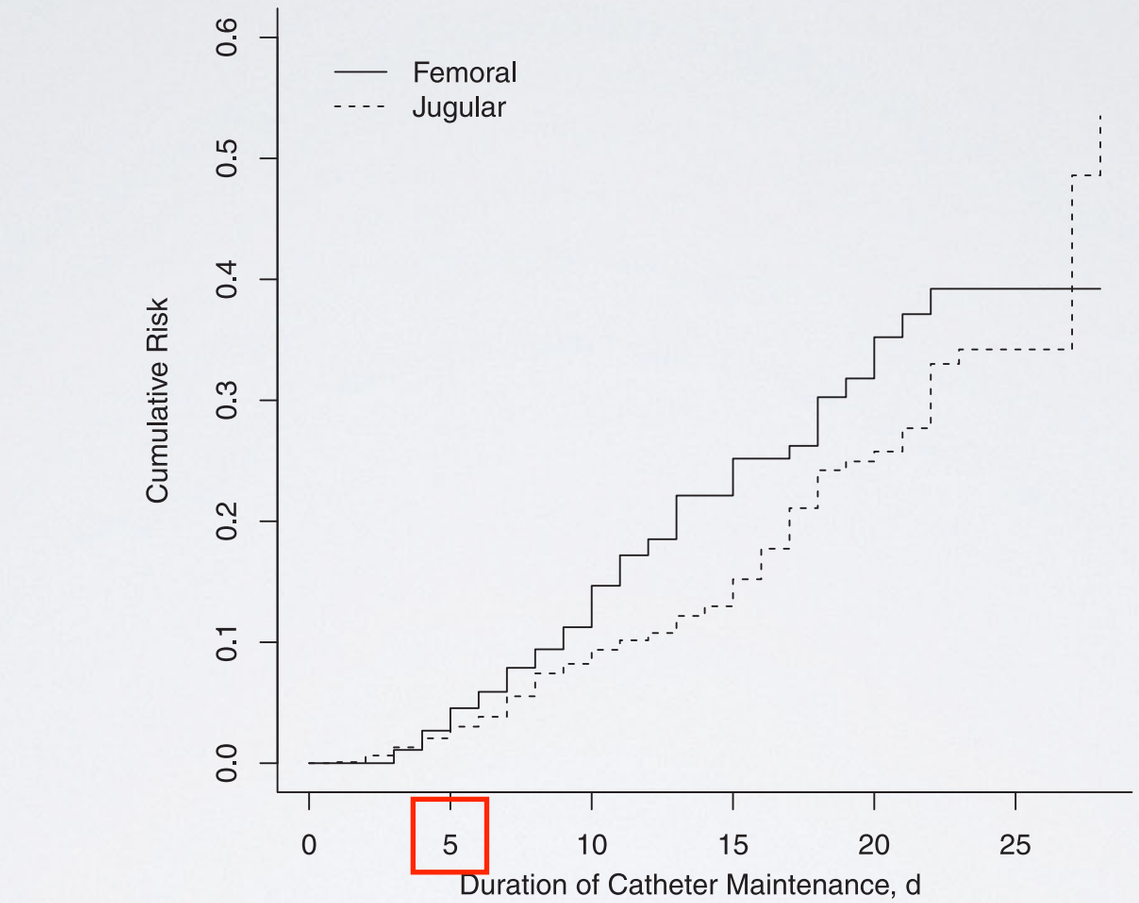


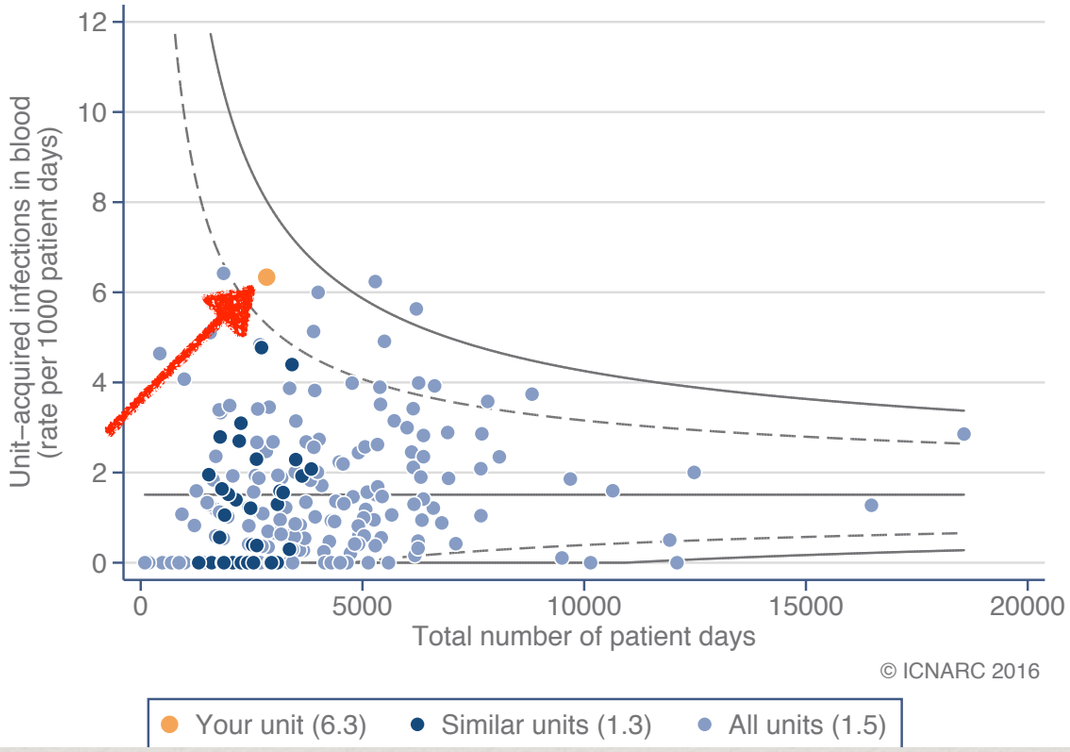
Figure 2. Cumulative incidence curve of colonization

"the risk of catheter-tip colonisation is higher with **femoral catheters** when **left in place more than 4 days**…"

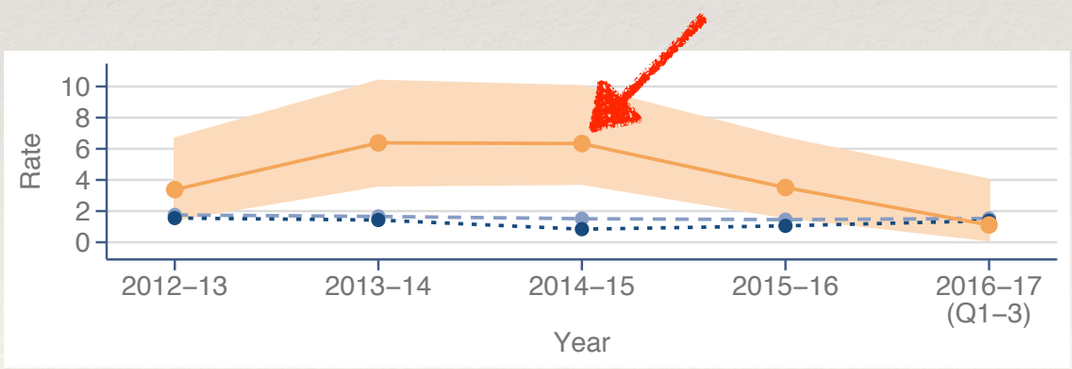
Am J Respir Crit Care Med Vol 188, Iss. 10, pp 1232–1239, Nov 15, 2013

Unit-acquired infections in blood

Ealing's ICNARC results
2014 - 2015

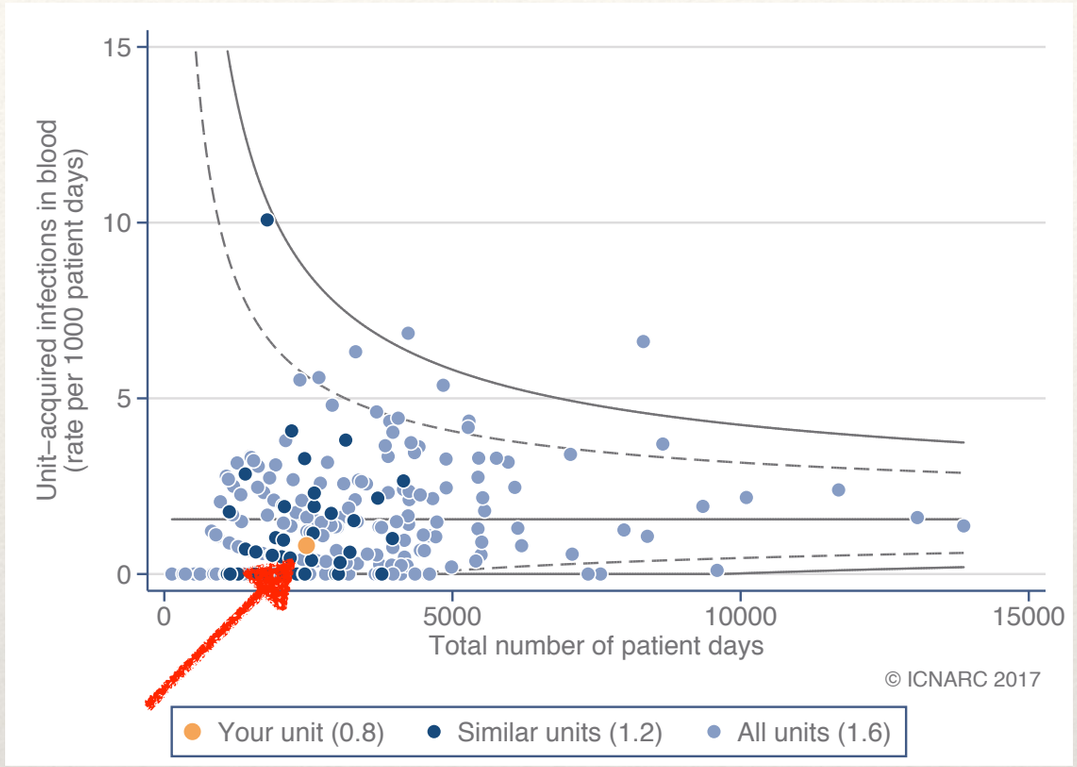


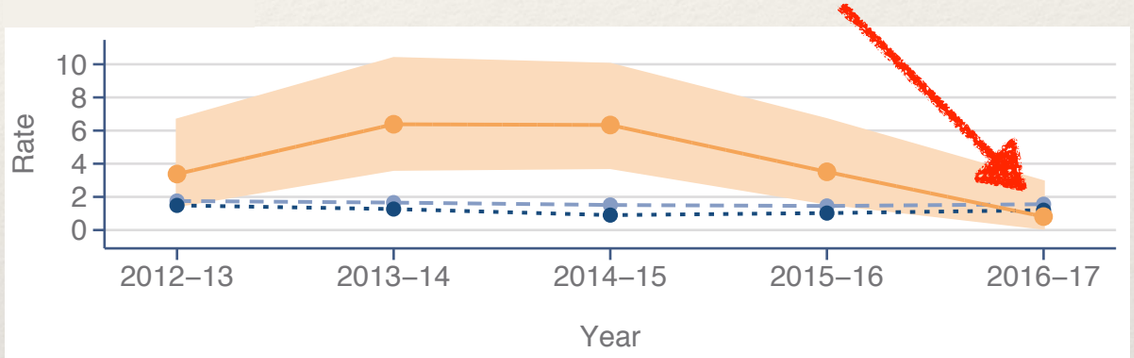
	Eligible	Numerator	Denominator	Result	
Quarter 1 [N=117]	73	4	785	5.1	
Quarter 2 [N=99]	56	3	511	5.9	
Quarter 3 [N=110]	66	9	751	12.0	
Quarter 4 [N=117]	68	2	794	2.5	
Full year [N=443]	263	18	2841	6.3	



Unit-acquired infections in blood

Ealing's ICNARC results
April 2016 - March 2017





	Eligible	Numerator	Denominator	Result	
Quarter 1 [N=107]	68	1	558	1.8	
Quarter 2 [N=116]	62	0	478	0.0	
Quarter 3 [N=131]	87	1	764	1.3	
Quarter 4 [N=93]	64	0	667	0.0	
Full year [N=447]	281	2	2467	0.8	

Worth auditing duration of femoral CVCs?

We have **dramatically improved** by acting on our audited poor results

Still required?

ICU Checklist

Patient

	Date						
General What needs to be done for the patient to be discharged? What are the greatest safety needs?							
Haemodynamics Tissue perfusion adequate? Fluids optimised? BP/HR optimised? Inotropic/pressor support							
Pulmonary Vt 6ml/kg IBW *P/F ratio* Type of vent support Weanable ?							
Renal *Fluid balance* UO							
Infectious disease Temperature Inflammatory markers-PCT CRP WBC Antibiotics Relevant?/Duration/Levels Lines/drains/trache site Duration /Clean/Needed? Wounds							
Prophylaxis DVT/Stress ulcer 30/45 degree head up							
Labs Hb/platelets Coags							

RECAP

- Beware of inadvertent arterial cannulation
  - These will **not always prevent** this potentially deadly complication :
    - Ultrasound
    - Colour of blood
    - Pulsation
    - ABG
    - Always measure **pressure before** placing guide wire
- In coagulopathic patients (? all ?) consider the **external jugular** approach to the central venous circulation
- If you must place a femoral line, keep for a **maximum of 4 days**
- Future audits:
  - Duration of femoral CVCs
  - Method of arterial/venous detection

For years we didn't use ETCO2 to verify ETT placement!

A fool with a tool is still a fool

Stay safe……transduce that catheter

???

Download at

http://www.jvsmedicscorner.com

Mallory / Everest2013