

6th WINFOCUS WORLD CONGRESS ON **ULTRASOUND** in Emergency & Critical Care

October 4 - 9, 2010
4th WINFOCUS Italy
Università Cattolica del Sacro Cuore
Policlinico Universitario "Agostino Gemelli"
"Europa" Congress Center - Rome (Italy)
GAVeCeLT 2010

**INTRACAVITARY EKG +
ULTRASOUND GUIDANCE:
MINIMIZING CVC INSERTION
RELATED COMPLICATIONS**

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Risk reduction strategies in central venous cannulation

US guidance
Puncture-related complications

- Wrong target
 - Accidental arterial puncture
 - Accidental pleural damage
 - Other wrong targets
- Missed target



EKG guidance
Position-related complications:

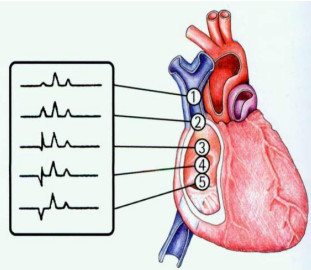
- Arrhythmias
- Malpositions
 - Need for reposition procedure
 - Persistent malposition:
 - Catheter malfunction
 - Venous thrombosis
 - Fibrous sleeve
 - Tricuspid valve damage
 - Arrhythmias



**US guided CVC insertion:
pitfalls, limits and open questions**

- Residual incidence of insertional complications**
 - Training / experience (tips to avoid wrong targets) ?
 - Inability to shift to different approach/technique if requested ?
 - Hazards due to attempts at limiting malpositions ?
- Limited tip control in the mediastinum**
 - "Long" and "short" catheters
 - Malposition in Azygos, internal mammary, intercostal and other tributary veins

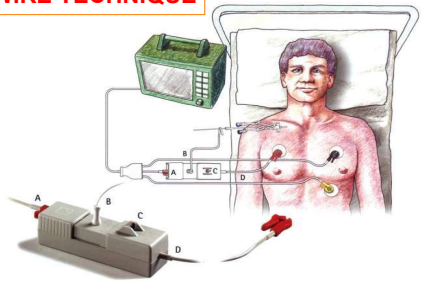
The intracavitary EKG method



- It's an intracavitary EKG
- The P wave modifies as the intracavitary electrode enters the right atrium
- Maximal P wave = proximity of the atrial node (upper right atrium)
- Cavo-atrial junction: when the P wave starts to rise or when the P wave reaches 1/2 - 2/3 height of the maximal "nodal" P wave

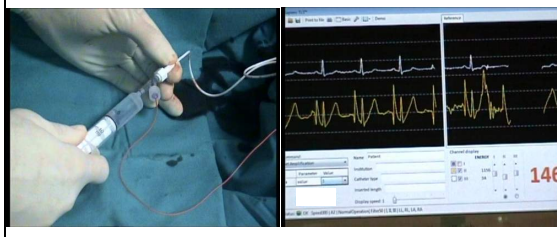
The intracavitary EKG method

**Intracavitary electrode:
GUIDE WIRE TECHNIQUE**



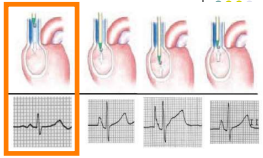
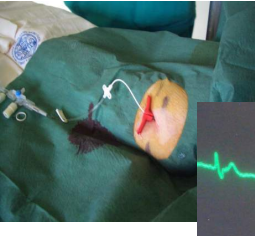
The intracavitary EKG method

**Intracavitary electrode:
COLUMN OF SALINE TECHNIQUE**



P wave shapes

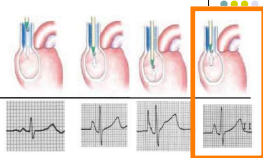
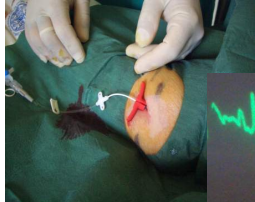
Tip in SVC

Intracavitary P wave similar to that detected from the skin

P wave shapes

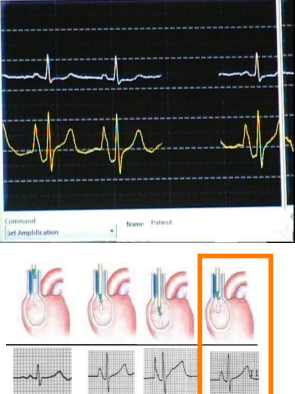
Tip in distal segment of SVC

Intracavitary P wave is increasing in amplitude (1/3 - 1/2 of the maximal amplitude)

P wave shapes

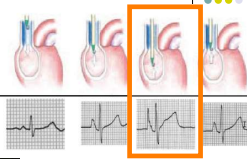
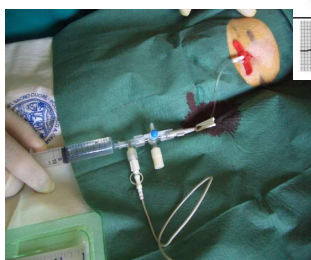
Tip at the cavo-atrial junction




Intracavitary p wave is 2/3 of the maximal recorded amplitude

P wave shapes

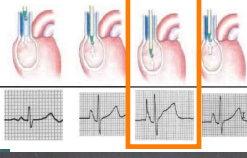
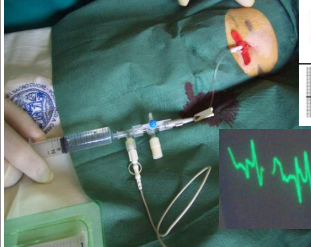
Tip in right atrium

Maximal amplitude p wave

P wave shapes

Tip deep in right atrium (crista terminalis / seno-atrial node)

Biphasic intracavitary P wave

Results of EKG method

Italian Multicenter study on ECG method (2009 – 2010)

- 8 hospitals – 1444 patients
- three subgroups of patients (no children, no emergency)
 - short term non-tunnelled CVCs
 - PICCs
 - totally implanted ports
- ECG method and postop xray in all patients
- goal: gain clinical evidence that postop xray can be avoided

	N	%
P – PERFECT MATCH	1199	83 %
C – CORRECT MATCH	179	12,4 %
S - MISMATCH	55	3,8 %
NA – NOT APPLICABLE	11	0,7 %

Results of EKG method

- Avoid chest X-Ray and fluoroscopy
- Avoid primary malpositions
- Better cost-efficacy of LT devices insertion
- Better cost efficacy of bedside procedures (PICCs)

EKG guided CVC insertion: pitfalls, limits and open questions

- Difficult interpretation of the EKG trace in arrhythmic patients
- Exclusion of patients with atrial fibrillation ?
- Exclusion of patients with pace-makers
- INABILITY TO LOCATE THE CATHETER TIP IF ANY P WAVE VARIATION CANNOT BE DETECTED

Powering risk reduction strategies

- **Versatility of each single method**
- **Methods integration**

Otpimizing ultrasound results: VERSATILITY

• Operator versatility

- US: shift to a different access/technique if first choice not suitable
- EKG: ability to use different equipments and to detect para-physiologic P wave shapes

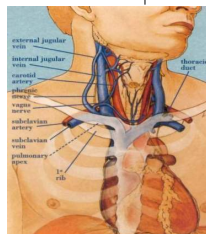
• Method versatility

- US = pre-operative evaluation to choose the best approach for any single patient
 real time guidance during venipuncture
 intraop. detection of wrong guidewire/catheter direction
 post-op. detection of cervical/pleural complications

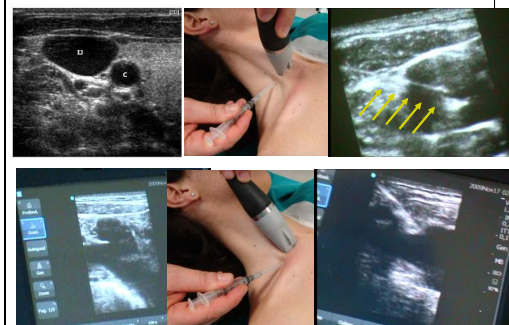
EKG = application to different vascular devices

US: operator versatility APPROACH SHIFT

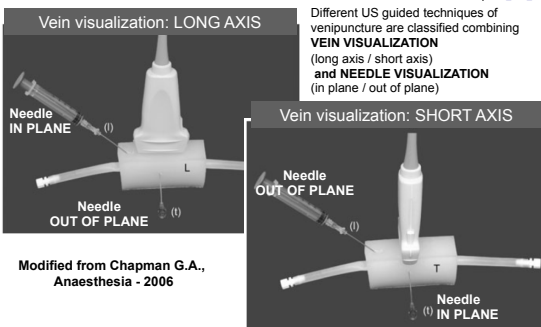
- Internal jugular vein (IJV)
 - Jernigan (in plane)
 - Axial (out of plane)
- Brachiocephalic vein (BCV)
 - in plane
- Subclavian vein (SCV)
 - Supra-clavicular (in plane)
 - Infra-clavicular ?
- Axillary vein (AV) – thoracic tract
 - in plane and out of plane
- Cephalic vein (CV) – thoracic tract
 - in plane
 - out of plane
- External jugular vein (EJV) - deep neck



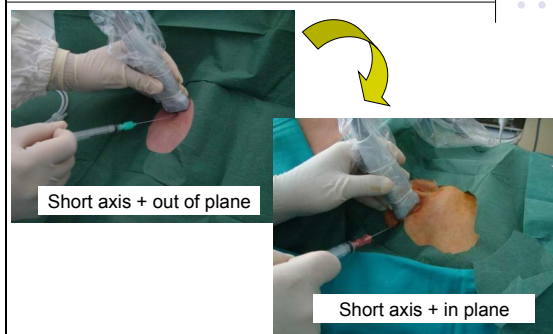
US: operator versatility APPROACH SHIFT



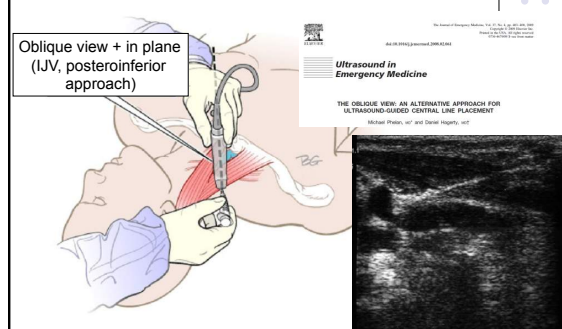
US: operator versatility TECHNIQUE SHIFT



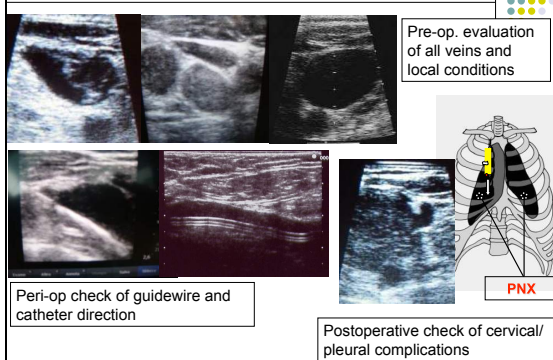
US: operator versatility TECHNIQUE SHIFT



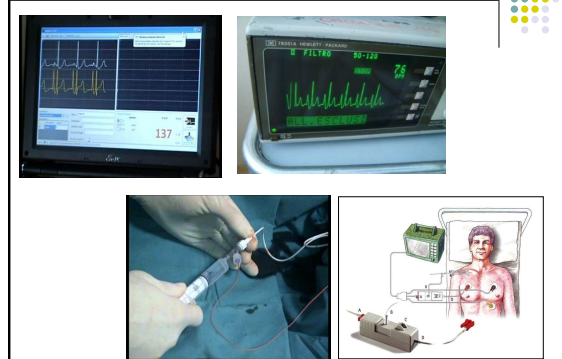
US: operator versatility TECHNIQUE SHIFT



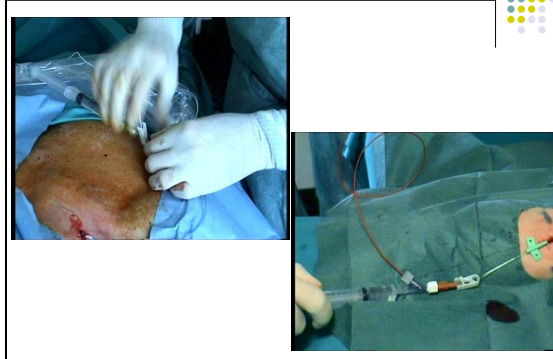
US: method versatility



EKG: operator versatility



EKG: method versatility



Powering risk reduction strategies: METHODS INTEGRATION

Integrating US and EKG may give better results than simply adding the expected results of the two methods.

INDEED

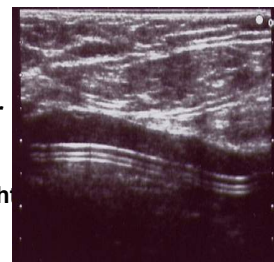
Integration may cancel some of the dark holes of the two methods

US may enhance EKG performance

If a p wave variation cannot be detected, there's no way to locate the catheter (you can only say that it's not near the cavo-atrial junction)

BUT

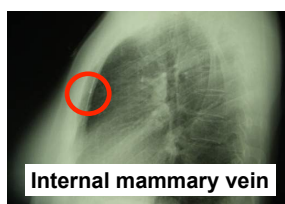
Identifying the catheter in a tributary vein can help the operator to manipulate it in the right direction



EKG may enhance US performance (1)

EKG covers the US "black holes"

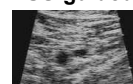
- "short" and "long" catheters
- malposition into mediastinal tributary veins



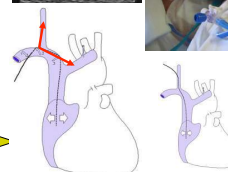
EKG may enhance US performance (2)

EKG aids in choosing an US-guided approach

- Unsuitable IJV ?



- Fear of primary malposition if an infraclavicular approach is chosen as an alternative ?



With EKG, a more convenient infraclavicular approach, if needed, can be chosen without any increased risk of primary malposition and avoiding a higher risk "preferred" approach

EKG + US: from state of the art to standard of care

Can Electrocardiogram-Controlled Central Line Placement Decrease the Need for Routine Chest Radiographs After Central Venous Cannulation?

Vol. 104, No. 6, June 2007

ANESTHESIA & ANALGESIA

with ECG guidance. Furthermore, we clearly state in our last paragraph that recommendations regarding completely replacing CXR verification of CVC placement with ECG guidance should be left to a multidisciplinary panel of experts, reviewing all available data and discussing potential benefits and risks.

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A BUNDLE ?

Letter to the Editor

The Journal of TRAUMA® Injury, Infection, and Critical Care
April 2008

Procedural and Clinical Data plus Electrocardiographic Guidance Greatly Reduce the Need for Routine Chest Radiograph Following Central Line Placement

Vittorio Antonelli, MD
Giuseppe Bistagno, MD
Giorgio Berlot, MD
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Trieste, Italy

correct placement of the central line. We, therefore, truly encourage the development of a decision model based on the association of procedural and clinical data and ECG guidance, which may greatly decrease the need for routine chest radiographs. We believe this procedural approach to be appropriate for a number of reasons. As well as being reliable, cost-effective, and timesaving, it may allow for a reduction in radiation exposure and an increase in hospital efficiency without decreasing patient safety.

YES, A BUNDLE !!!

An “X-ray free” insertion bundle

Target: zero malposition !

“X-Ray free” insertion bundle (GAVeCeLT, 2009-2010)

- 1) US guided venipuncture
- 2) Estimated length of the catheter by anatomical landmarks
- 3) US check of guidewire direction and absence of the catheter in abnormal explorable sites
- 4) ECG method for confirming the final position
- 5) Rule out of pleural complications by US



A comprehensive safety and cost-efficacy bundle (1)

GAVeCeLT



SILTA: Safe Implantation of Long Term Venous Access
(totally implantable ports and tunneled cuffed catheters)

1. maximal barrier precautions;
2. **ultrasound guided venipuncture**
3. **Intra-operative assessment of the position of the tip of the catheter**
4. careful handling of the guide wire
5. appropriate stabilization of tunnelled catheters
6. proper choice of the site of implantation of the reservoir.

SILTA details: ultrasound

GAVeCeLT



- After US evaluation of supraclavicular (internal jugular, brachiocephalic, subclavian) and infraclavicular (axillary) veins, the most appropriate vein is chosen, possibly the vein which appears larger and easier to access
- US guided venipuncture is carried out preferably 'in plane' + short axis, so to have a better control of the needle together with a better control of the nerveo-vascular bundle structures
- Soon after cannulation, the direction of the guidewire is checked by US; US control of explorable tributary veins is also suggested
- If not contraindicated by local conditions, the right side is preferred (lower risk of malposition and lower risk of catheter related venous thrombosis)

SILTA details: EKG

GAVeCeLT



- Prefer column of saline technique
- Prefer battery-powered machines
- Follow the entire pattern of P wave modifications before judging which is the “maximal” amplitude
- Always check tip position intra-operatively as well as postoperatively

Conclusions

- Integration of US-guided cannulation with EKG tip control may enhance the performance of both methods
- US machines with integrated EKG monitor/software: a desirable technology ?



1-11-2010



www.gavecelt.org
(Official website GAVeCeLT - Gruppo di studio per gli Accessi Venosi Centrali a Lungo Termine)

www.evanetwork.info
(Official website EVAN - European Vascular Access Network)

To have a copy of this presentation and/or for further information on vascular access, please contact me:
antonio.lagreca@rm.unicatt.it

