"The primary objective of this review was to evaluate the effectiveness and safety of two-dimensional (imaging ultrasound (US) or ultrasound Doppler (USD)) guided puncture techniques for insertion of central venous catheters via the internal jugular vein in adults and children" Brass et al (2015).

Reference:

Brass, P., Hellmich, M., Kolodziej, L., Schick, G. and Smith, A.F. (2015) Ultrasound guidance versus anatomical landmarks for internal jugular vein catheterization. The Cochrane Database of Systematic Reviews. CD006962. .

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Abstract:

BACKGROUND: Central venous catheters (CVCs) can help with diagnosis and treatment of the critically ill. The catheter may be placed in a large vein in the neck (internal jugular vein), upper chest (subclavian vein) or groin (femoral vein). Whilst this is beneficial overall, inserting the catheter risks arterial puncture and other complications and should be performed with as few attempts as possible. Traditionally, anatomical 'landmarks' on the body surface were used to find the correct place in which to insert catheters, but ultrasound

imaging is now available. A Doppler mode is sometimes used to supplement plain 'two-dimensional' ultrasound.

OBJECTIVES: The primary objective of this review was to evaluate the effectiveness and safety of two-dimensional (imaging ultrasound (US) or ultrasound Doppler (USD)) guided puncture techniques for insertion of central venous catheters via the internal jugular vein in adults and children. We assessed whether there was a difference in complication rates between traditional landmark-guided and any ultrasound-guided central vein puncture.Our secondary objectives were to assess whether the effect differs between US and USD; whether the effect differs between ultrasound used throughout the puncture ('direct') and ultrasound used only to identify and mark the vein before the start of the puncture procedure (indirect'); and whether the effect differs between different groups of patients or between different levels of experience among those inserting the catheters.

SEARCH METHODS: We searched the Central Register of Controlled Trials (CENTRAL) (2013, Issue 1), MEDLINE (1966 to 15 January 2013), EMBASE (1966 to 15 January 2013), the Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1982 to 15 January 2013), reference lists of articles, 'grey literature' and dissertations. An additional handsearch focused on intensive care and anaesthesia journals and abstracts and proceedings of scientific meetings. We attempted to identify unpublished or ongoing studies by contacting companies and experts in the field, and we searched trial registers. We reran the search in August 2014. We will deal with identified studies of interest when we update the review.

SELECTION CRITERIA: We included randomized and quasi-randomized controlled trials comparing two-dimensional ultrasound or Doppler ultrasound with an anatomical 'landmark' technique during insertion of internal jugular venous catheters in both adults and children.

DATA COLLECTION AND ANALYSIS: Three review authors independently extracted data on methodological quality, participants, interventions and outcomes of interest using a standardized form. A priori, we aimed to perform subgroup analyses, when possible, for adults and children, and for experienced operators and inexperienced operators.

MAIN RESULTS: Of 735 identified citations, 35 studies enrolling 5108 participants fulfilled the inclusion criteria. The quality of evidence was very low for most of the outcomes and was

moderate at best for four of the outcomes. Most trials had an unclear risk of bias across the six domains, and heterogeneity among the studies was significant.Use of two-dimensional ultrasound reduced the rate of total complications overall by 71% (14 trials, 2406 participants, risk ratio (RR) 0.29, 95% confidence interval (CI) 0.17 to 0.52; P value < 0.0001, I^2 = 57%), and the number of participants with an inadvertent arterial puncture by 72% (22 trials, 4388 participants, RR 0.28, 95% CI 0.18 to 0.44; P value < 0.00001, I^2 = 35%). Overall success rates were modestly increased in all groups combined at 12% (23 trials, 4340 participants, RR 1.12, 95% CI 1.08 to 1.17; P value < 0.00001, I^2 = 85%), and similar benefit was noted across all subgroups. The number of attempts needed for successful cannulation was decreased overall (16 trials, 3302 participants, mean difference (MD) -1.19 attempts, 95% CI -1.45 to -0.92; P value < 0.00001, I^2 = 96%) and in all subgroups. Use of two-dimensional ultrasound increased the chance of success at the first attempt by 57% (18 trials, 2681 participants, RR 1.57, 95% CI 1.36 to 1.82; P value < 0.00001, I^2 = 82%) and reduced the chance of haematoma formation (overall reduction 73%, 13 trials, 3233 participants, RR 0.27, 95% CI 0.13 to 0.55; P value 0.0004, I^2 = 54%). Use of two-dimensional ultrasound decreased the time to successful cannulation by 30.52 seconds (MD -30.52 seconds, 95% CI -55.21 to -5.82; P value 0.02, I^2 = 97%). Additional data are available to support use of ultrasound during, not simply before, line insertion.Use of Doppler ultrasound increased the chance of success at the first attempt by 58% (four trials, 199 participants, RR 1.58, 95% CI 1.02 to 2.43; P value 0.04, I^2 = 57%). No evidence showed a difference for the total numbers of perioperative and postoperative complications/adverse events (three trials, 93 participants, RR 0.52, 95% CI 0.16 to 1.71; P value 0.28), the overall success rate (seven trials, 289 participants, RR 1.09, 95% CI 0.95 to 1.25; P value 0.20), the total number of attempts until success (two trials, 69 participants, MD -0.63, 95% CI -1.92 to 0.66; P value 0.34), the overall number of participants with an arterial puncture (six trials, 213 participants, RR 0.61, 95% CI 0.21 to 1.73; P value 0.35) and time to successful cannulation (five trials, 214 participants, each using a different definition for this outcome; MD 62.04 seconds, 95% CI -13.47 to 137.55; P value 0.11) when Doppler ultrasound was used. It was not possible to perform analyses for the other outcomes because they were reported in only one trial.

AUTHORS' CONCLUSIONS: Based on available data, we conclude that two-dimensional ultrasound offers gains in safety and quality when compared with an anatomical landmark technique. Because of missing data, we did not compare effects with experienced versus inexperienced operators for all outcomes (arterial puncture, haematoma formation, other

complications, success with attempt number one), and so the relative utility of ultrasound in these groups remains unclear and no data are available on use of this technique in patients at high risk of complications. The results for Doppler ultrasound techniques versus anatomical landmark techniques are also uncertain.

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