Complications of central venous catheters. Internal jugular versus subclavian access: a systematic review
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Authors' objectives
To test whether complications happen more often with the internal jugular or the subclavian central venous approach.

Searching
MEDLINE, EMBASE and the Cochrane Library were searched up to June 2000, without any language restrictions. The keyterms used in the search were 'central venous catheter', 'catheterisation', 'catheterization' 'subclavian', 'jugular', 'complication', 'infection', 'thrombosis', 'success rate', 'stenosis', 'pneumothorax', 'hemathothorax', 'clinical trial' and 'prospective'. The reviewers also checked the reference lists of retrieved studies and review reports.

Study selection
Study designs of evaluations included in the review
No randomised controlled trials (RCTs) relevant to the purpose of the review were identified. The review therefore included prospective, comparative non-randomised studies where the difference between the group sizes was less than two-fold; studies where the group sizes differed by more than two-fold were excluded. Likewise, data from abstracts, letters, review articles, animal studies and post-mortem studies were not considered. Only studies published in peer-reviewed journals were considered for inclusion.

Specific interventions included in the review
Studies that compared internal jugular and subclavian central venous catheterisation (reporting dichotomous data on any complications that were possibly related to central venous catheters, CVC) were eligible for inclusion. The indication for CVC (e.g. dialysis) did not affect the inclusion criteria. Studies that assessed tunnelled catheters, implantable devices, radiologically-assisted catheter insertion, or catheter placement by cut-down technique, were excluded.

Participants included in the review
Studies that assessed adults or children were eligible for inclusion. Of the included studies, one trial was in children and all the others were in adults. Most of the patients were from surgical or medical intensive care units. The catheters were inserted by house officers, residents or fellows.

Outcomes assessed in the review
Only studies that reported dichotomous data on any complications that were possibly related to CVC (insertion- or catheter-related) were considered for inclusion. The outcomes assessed in the review were the number of arterial punctures, the number of malpositions of the catheter, the incidence of bloodstream infection, the incidence of haemato- or pneumothorax, and the incidence of vessel occlusion.

How were decisions on the relevance of primary studies made?
Two reviewers assessed the studies for inclusion. The authors did not state whether this was undertaken independently, or how any disagreements were resolved.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
The data were extracted by one reviewer and crosschecked by two others. Data on the author, catheter type, clinical setting, patients and operators were extracted from each included study.
Methods of synthesis
How were the studies combined?
The relative risks (RRs) and 95% confidence intervals (CIs) were calculated for each complication with inserted catheters. A fixed-effect model was used when the data were homogeneous (P<0.1), otherwise a random-effects model was used. The number-needed-to-treat (NNT) was also calculated; a positive NNT indicated that the end point occurred more often with the jugular approach, while a negative NNT indicated the opposite.

How were differences between studies investigated?
Differences between the studies were assessed using a chi-squared analysis. When significant heterogeneity was present (P<0.1) the results from the random-effects model analysis were presented.

Results of the review
Seventeen prospective, comparative non-randomised studies (total n=4,513; 2,085 jugular and 2,428 subclavian catheters) were included.

Arterial puncture (6 trials, 2,010 catheters): this was significantly more often reported with the jugular approach (3.0%) than with the subclavian approach (0.5%). The RR was 4.70 (95% CI: 2.05, 10.77) and the NNT was 39 (95% CI: 27, 73).

Catheter malposition (6 trials, 1,299 catheters): this was significantly less often reported with the jugular access (5.3%) than with the subclavian approach (9.3%). The RR was 0.66 (95% CI: 0.44, 0.99) and the NNT was 25 (95% CI: -15, -82).

Bloodstream infection (3 trials, 707 catheters): the incidence of bloodstream infection was 8.6% with jugular access and 4.0% with the subclavian approach. The data were heterogeneous; the RR was 2.24 (95% CI: 0.62, 8.09).

Haemato- and pneumothorax (10 trials, total n=3,420; 1,556 jugular and 1,864 subclavian catheters): there was no significant difference in the incidence of haemato- or pneumothorax for jugular catheterisation (1.3%) or subclavian access (1.5%). The RR was 0.76 (95% CI: 0.43, 1.33).

Vessel occlusion (4 trials, 899 catheters): the trials reported on vessel stenosis or thrombosis. There were no significant differences in the incidence of vessel occlusion: 0% versus 1.2% for jugular versus subclavian access, respectively. The RR was 0.29 (95% CI: 0.07, 1.33).

Other complications were insertion site infection and local haematoma. These were reported in no more than 2 trials each; no sensible conclusion could be drawn from the data.

Authors' conclusions
There was some evidence that there are more arterial punctures, but less catheter malpositions, with the internal jugular approach in comparison with subclavian access. There was no evidence of any difference in the incidence of haemato- or pneumothorax and vessel occlusion. Bloodstream infection happened more often with internal jugular access, but the data were heterogeneous and there was no evidence of statistical significance.

CRD commentary
The authors addressed a clear review question in terms of the interventions, the participants and the outcome measures that were to be assessed in the review. The literature search was adequate, but was limited to published studies; this means that publication bias could have been introduced into the review process. The authors stated that the design of the included studies was set to increase the validity of the review, but did not provide further details of the validity assessment. It is therefore difficult to assess the quality of the studies included in the review.

Adequate details on the characteristics of the primary studies were provided in the paper, allowing the reader to assess whether the results are consistent with the evidence base reviewed. The statistical analysis undertaken was appropriate and heterogeneity between the studies was adequately explored. Overall, it would appear that the authors' results and
conclusions are consistent with the evidence base reviewed. However, given the type of study designs included in the review, the results should be treated with some caution.

**Implications of the review for practice and research**

**Practice:** The authors stated that until the number and type of adverse events that occur using the internal jugular and subclavian access routes are compared in RCTs, clinical decision-making will have to be based on the best available evidence.

**Research:** The authors stated that randomised comparisons are needed to verify the findings of the review.

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