Atraumatic (pencil-point) versus conventional needles for lumbar puncture

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Atraumatic (pencil-point) versus conventional needles for lumbar puncture: a clinical practice guideline

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Is the needle tip configuration important when performing a lumbar puncture for any indication? A systematic review published in the Lancet in December 2017 suggests that it is. The review found that using atraumatic (pencil-point) lumbar puncture needles instead of conventional lumbar puncture needles reduced the risk of post-dural-puncture headache and of return to hospital for additional pain control.1 This guideline recommendation aims to promptly and transparently translate this evidence to a clinical recommendation, following standards for GRADE methodology and trustworthy guidelines.2

The BMJ Rapid Recommendations panel makes a strong recommendation for the use of atraumatic needles for lumbar puncture in all patients regardless of age (adults and children) or indication instead of conventional needles.3

Box 1 shows the article and evidence linked to this Rapid Recommendation. The main infographic provides an overview of the absolute benefits and harms (although none were present here) of atraumatic needles. Table 1 below shows any evidence that has emerged since the publication of this guideline.

Current practice
Physicians perform lumbar punctures for diagnostic or therapeutic purposes. Among the complications associated with this procedure, post-dural-puncture headache is the most common, affecting up to 35% of patients.4 This complication can be debilitating, requiring return visits to the hospital for controlled analgesia, invasive therapy, or increased hospital duration of stay.5 6

Post-dural-puncture headache, among other adverse effects of lumbar punctures, is attributed to the leakage of cerebrospinal fluid from the dural defect into the epidural space that is created by the spinal needle during puncture. Conventional needles have a sharp tip (designed to cut through tissues) and a distal opening. In comparison, atraumatic needles are more blunt with a closed pencil-point or cone shaped tip and a side port for injection or collection.7

Cadaveric studies using histological examination have shown that, compared with conventional needles, atraumatic needles more often separate and dilate surrounding dural fibres rather than cutting through them. Subsequent contracture of the fibres after needle removal results in a small pinpoint opening in the dura, as opposed to the
RAPID RECOMMENDATIONS

Population

Patients with any indication for lumbar puncture

- Diagnosis
- Anaesthesia
- Myelography

Not applicable to:

Patients only undergoing epidural puncture

Comparison 1

Conventional needle

Lumbar puncture with any conventional needle

Atraumatic needle

Lumbar puncture with any atraumatic (pencil point) needle

Comparison of benefits and harms

<table>
<thead>
<tr>
<th>Event</th>
<th>Conventional needle</th>
<th>Atraumatic needle</th>
<th>Evidence quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postdural puncture headache</td>
<td>98</td>
<td>59 fewer</td>
<td>High</td>
</tr>
<tr>
<td>Need for epidural blood patch</td>
<td>24</td>
<td>52 fewer</td>
<td>High</td>
</tr>
<tr>
<td>Backache</td>
<td>166</td>
<td>No important difference</td>
<td>High</td>
</tr>
<tr>
<td>Hearing disturbance</td>
<td>53</td>
<td>40 fewer</td>
<td>High</td>
</tr>
<tr>
<td>Nerve root irritation</td>
<td>126</td>
<td>37 fewer</td>
<td>Moderate</td>
</tr>
<tr>
<td>Hospital for fluids or analgesia</td>
<td>39</td>
<td>22 fewer</td>
<td>High</td>
</tr>
<tr>
<td>Failed lumbar puncture</td>
<td>38</td>
<td>No important difference</td>
<td>High</td>
</tr>
</tbody>
</table>

We recommend the use of atraumatic over conventional needles

Key practical issues

Atraumatic needles do not eliminate the risk of complications entirely and clinicians should continue to discuss potential adverse consequences of the lumbar puncture with their patients

Preferences and values

The panel believes patients will put a high value attributed to the large reduction in symptoms that they may suffer following the procedure. Given the lack of harms from atraumatic needles, most patients are likely to choose this option

Training and use

While atraumatic and conventional needles are reported to be similar to use, some learning may be required for clinicians to use the new types of needle

Subgroups

There are no differences in the effects of atraumatic versus conventional needles between subgroups defined by:

- Patient age
- Patient sex
- Needle gauge
- Prescription or use of prophylactic measures
- Position of the patient during the lumbar puncture
- Clinical specialty of the individual performing procedure
- The indication for the procedure
- Use of bed rest after the procedure

See an interactive version of this graphic online http://bit.ly/BJMrrATN

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irregular and larger opening created by conventional needles. Use of atraumatic needles may therefore reduce the incidence of post-dural-puncture headache by limiting the leakage of cerebrospinal fluid after lumbar puncture. Surveys indicate that use of atraumatic needles in routine clinical practice is limited.8-10

Although terminology varies, for the purposes of this guideline, we will refer to atraumatic needles and conventional needles, which have a sharp tip to cut through tissues with a distal tip opening.

### The evidence
The systematic review summarised the results of 110 randomised clinical trials (RCTs) conducted between 1989 and 2017 in 29 countries (including both high and middle/low income): it suggests that atraumatic needles consistently reduce the risk of major adverse effects associated with lumbar puncture done for any indication compared with conventional needles. More specifically, the risk of post-dural-puncture headache was significantly reduced when atraumatic needles were used for lumbar puncture (relative risk 0.40 (95% confidence interval 0.34 to 0.47)).

Graphic 2 presents an overview of the number and types of patients, as well as a summary of the benefits and harms (although none were present here) of atraumatic needles for lumbar punctures.

Individuals who were included in the eligible studies underwent lumbar punctures for any diagnostic or therapeutic indication. Baseline characteristics were similar between atraumatic and conventional needle groups,
The recent publication of a systematic review and meta-analysis of studies comparing atraumatic with conventional needles for any lumbar puncture triggered the following guideline recommendation. The Rapid Recommendations team believed that the results of this systematic review, which considered the full body of evidence, had important clinical implications and might change practice.

Our international panel—including intensivists, neuro-intensivists, intensists, anaesthesiologists, neurologists, neurosurgeons, emergency physicians, paediatricians, methodologists, and people with lived experience of lumbar puncture and caring for those with lumbar puncture—decided on the scope of the recommendation and the outcomes most important to patients (see appendix 1 on bmj.com). The panel met to discuss the evidence and formulate a recommendation. No panel member had financial conflicts of interest; intellectual and professional conflicts were minimised and transparently described (appendix 2 on bmj.com).

The panel followed the BMJ Rapid Recommendations procedures for creating a trustworthy recommendation, including using the GRADE approach to critically appraise the evidence and create recommendations (see appendix 3 on bmj.com). The panel considered the benefits, as well as any harms, and burdens of atraumatic needles, the certainty (quality) of the evidence for each outcome, typical and expected variations in patient values and preferences, acceptability, feasibility, and resource implications. Following the GRADE based approach, recommendations can be strong or weak (also known as conditional) for or against a specific course of action.

The panel identified 13 patient-important outcomes to inform the recommendation: post-dural-puncture headache (severe or mild), any headache, hearing disturbance, nerve root irritation, return to hospital for intravenous fluids or controlled analgesia or need for epidural blood patch (GRADE high to moderate quality evidence). The panel agreed that there is minimal variability in patient preferences to favour the use of atraumatic needles.

Absolute benefits and harms

The main infographic explains the recommendation and provides an overview (GRADE summary of findings) of the absolute benefits of atraumatic needles. Estimates of baseline risk for effects are generated from the control arms of the included trials. The infographic also leads to point-of-care formats in the MAGICapp.

The panel agreed that:

- Use of atraumatic needles meaningfully decreases the risk of postdural puncture headache (both severe and mild), any headache, hearing disturbance, nerve root irritation, return to hospital for intravenous fluids and controlled analgesia or need for epidural blood patch (GRADE high to moderate quality evidence).
- Use of atraumatic needles has little or no effect on the risk of backache (GRADE high quality evidence).
- Use of atraumatic needles has little or no effect on the incidence of traumatic tap, failed lumbar puncture, and probability of success on first attempt (GRADE high to moderate quality evidence).
- There are no differences in the effects of atraumatic versus conventional needles between subgroups defined by age and sex of patients, the prescription or use of prophylactic measures, needle gauge, position of the patient during the lumbar puncture, the clinical specialty of the individual performing the lumbar puncture, or the indication for the procedure.
- It is unlikely that new information will change interpretation for outcomes for which the evidence is of high to moderate quality.

The panel was less confident about whether:

- Use of atraumatic needles affects the efficiency of cerebrospinal fluid drainage (that is, the time required to draw the necessary amount of cerebrospinal fluid) regardless of the indication. It is likely there are other more important factors that influence drainage efficiency than just needle type. Also, this outcome is of varying importance depending on the context and indication for lumbar puncture.
- The panel believed that the recommendation is generalisable even to patients who are unconscious, such as those who are mechanically ventilated and sedated in the intensive care unit as data suggests that post-dural-puncture headache can persist for several days and can be felt even under sedation. Increased pain in this population may lead to undesirable indirect effects such as increased heart rate and increased sedation or analgesic requirement.

Values and preferences

The panel placed high value on the large reduction in symptoms. The panel believes that values and preferences regarding all important outcomes are unlikely to vary greatly across patients, particularly given the lack of detectable harm from atraumatic needles. We do not agree that there is minimal variability in patient preferences to favour the use of atraumatic needles.

In addition the panel agreed that there is minimal variability in patient preferences to favour the use of atraumatic needles.

Understanding the recommendation

The guideline panel makes a strong recommendation for the use of atraumatic over conventional needles in lumbar puncture for any indication because the benefits are perceived to be large with no associated harm.

The panel is confident that the recommendation applies to all patients (adults and children) who require a lumbar puncture and all physicians as the results were consistent across all predefined subgroups mentioned above.

with the exception of needle gauge, which was larger in the conventional needle group (larger gauge equals smaller needle diameter).

Only 1065 of the 31412 participants were children (3%). The proportion of elderly participants was unknown. The results were consistent across the predefined subgroups including:

- Age <18 v ≥18 years old
- Males v females,
- Bed rest after lumbar puncture v no bed rest
- Prophylactic intravenous fluids v no prophylactic intravenous fluids
- Needle gauge (small v large)
- Lateral v sitting position during lumbar puncture
- Indication for lumbar puncture (anaesthesia v diagnosis v myelography)
- Clinical specialty of person doing the lumbar puncture (radiologist v neurologist v anaesthesiologist).

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RAPID RECOMMENDATIONS

HOW PATIENTS WERE INVOLVED IN THE CREATION OF THIS ARTICLE

Two people with lived experience of lumbar punctures, and one person with experience as a patient and a carer, were members of the guidance panel and authors. They identified and rated outcomes, and led the discussion on values and preferences. The patient partners rated all included outcomes as important to them. Although these values may not be shared by all patients for all outcomes considered, the panel expected little variation in how much importance other patients would place on the main outcomes of severe post-dural-puncture headache and the need to return to the hospital for an epidural blood patch. All panel members participated in the teleconferences and email discussions and met all authorship criteria.

anticipate that patients would opt for lumbar puncture needles associated with a greater risk of severe headaches. In contrast, the panel believes that there is considerable variability in how much importance individual patients and physicians attribute to traumatic taps (lumbar punctures contaminated with red blood cells negatively affecting fluid analysis). Accordingly, this outcome was considered to have limited importance in the recommendation.

The panel felt confident that atraumatic needles would be acceptable to patients, although this was not measured in the systematic review. Most clinicians found atraumatic and conventional needles similar to use. Some clinicians expressed potential concern regarding puncturing of the skin with the blunter atraumatic needle; however, this can be overcome by inserting the lumbar puncture needle through the same skin hole used for local anaesthesia, by using an introducer needle, or by spinning the atraumatic needle around its axis while advancing the needle.1

Practical issues and other considerations

Atraumatic needles do not eliminate the risk of complications entirely, and clinicians should continue to discuss potential adverse consequences of the lumbar puncture with their patients.

Costs and resources

The panel reviewed three published cost-effectiveness studies.15-17 In those studies, the per-unit cost of atraumatic needles was greater than the cost of conventional needles, but atraumatic needles were ultimately cost-reducing because of the decreased need for additional care (perspective of the third-party payer) and lost working hours for patients (perspective of the patients and society). Moreover, as with conventional needles, the per-unit cost varies with the specific needle subtype and manufacturer.

Uncertainties

Addressing the following remaining knowledge gaps may inform decision makers and future guideline recommendations:

• Given the plausible greater risk of spinal stenosis and degenerative process in elderly patients who require a lumbar puncture, is the success rate for atraumatic and conventional needles similar in this population?

EDUCATION INTO PRACTICE

• Are certain subtypes of atraumatic needles (such as Cappe-Deutsch, Eldor, Gerti-Marx, MicrOt, Sprotte, or Whitacre) associated with greater reduction in adverse events than others?

Updates to this article

The table shows evidence which has emerged since the publication of this article. As new evidence is published, a group will assess the new evidence and make a judgment on to what extent it is expected to alter the recommendation.

Funding: This guideline was not funded.

Transparency: B Rochweg affirms that the manuscript is an honest, accurate, and transparent account of the recommendation being reported, that no important aspects of the recommendation have been omitted, and that any discrepancies from the recommendation as planned (and, if relevant, registered) have been explained.

New evidence which has emerged after initial publication

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There are currently no updates to the article.

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Competing interests: All authors have completed the BMJ Rapid Recommendations interests disclosure form, and a detailed description of all disclosures is reported in appendix 2 on bmj.com. As with all BMJ Rapid Recommendations, the executive team and the BMJ judged that no panel member had any financial conflict of interest. Professional and academic interests are minimised as much as possible, while maintaining necessary expertise on the panel to make fully informed decisions. Three authors of the systematic review were on the guideline panel (WA, SAA, JB).

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