Cost-effectiveness of mechanical thrombectomy compared with standard treatment in patients with acute ischaemic stroke

Robert Heggie1, Olivia Wu1, Keith Muir1, Phil White1, Gary Ford1, Martin M Brown1, Andrew Clifton1, Joanna Wardlaw1
1University of Glasgow; 2Newcastle University; 3Oxford University Hospitals NHS Trust; 4University College London, 5University of London; 6University of Edinburgh

Background

Eight recently published clinical trials1-4 have supported the use of mechanical thrombectomy (MT), using stent retrievers, in the endovascular treatment of acute ischaemic stroke. All the trials, with the exception of one5, were terminated early due to demonstrated efficacy. In 2014, the European Stroke Organisation (ESO)-Karolinska Stroke Update conference released a consensus statement, supporting the use of MT. Similarly, in 2015, the National Institute of Health and Care Excellence (NICE) guideline made a recommendation for the use of MT.

“Mechanical thrombectomy, in addition to intravenous thrombolysis within 4.5 h when eligible, is recommended to treat acute stroke patients with large artery occlusions in the anterior circulation up to 6 h after symptom onset.”

“Current evidence on the safety and efficacy of mechanical clot retrieval for treating acute ischaemic stroke is adequate to support the use of this procedure provided that standard arrangements are in place for clinical governance, consent and audit.”

Aim

To estimate the cost-effectiveness of mechanical thrombectomy in combination with IV-tPA compared with standard treatment (IV-tPA alone), in patients with acute ischaemic stroke.

Methods

A cost-effectiveness analysis of MT compared with IV-tPA, from the perspective of the UK NHS. The analysis was carried out over two time horizons: (i) 90 days based on the PISTE trial and (ii) lifetime, using all available evidence.

90-day within-trial analysis

• The Pragmatic Ischaemic Stroke Thrombectomy Evaluation (PISTE) trial was the only trial conducted in a UK setting.
• The primary outcome of the trial was the modified Rankin Scale (mRS). A mapping algorithm6 was used to convert mRS to health utilities, in order to calculate quality-adjusted life-years (QALYs).
• Unit costs were applied to resource use data collected within the trial.
• Generalised linear models were used to estimate mean costs and QALYs for each arm of the trial.
• Cost-effectiveness was expressed as incremental cost-effectiveness ratio (ICER).
• A non-parametric bootstrap was used to estimate the standard errors and 95% confidence intervals for the mean costs and QALYs.

Lifetime economic model

• A model consisting of a decision tree (representing pathway for the first 3 months) and a 4-state Markov model10 (representing pathway beyond 3 months) were used.
• The probabilities mRS outcomes in each arm were estimated by meta-analysis of data from the 7 published trials of MT (data from THERAPY trial not available at time of publication).
• Transition probabilities between health states in the Markov model were sourced from other literature sources (data not shown).
• Cost of treatment and lifetime care were obtained from the literature. The costs of MT and IV-tPA alone were estimated to be £8111 and £1919, respectively.

Results of lifetime model

Mechanical thrombectomy

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision tree: mRS 0-2 (MT)</td>
<td>0.57</td>
<td>Health utility: Independent</td>
<td>0.74</td>
</tr>
<tr>
<td>Decision tree: mRS 3-5 (MT)</td>
<td>0.27</td>
<td>Health utility: Dependent</td>
<td>0.38</td>
</tr>
<tr>
<td>Decision tree: mRS 3-5 (MT)</td>
<td>0.16</td>
<td>Health utility: Recurrent</td>
<td>0.34</td>
</tr>
<tr>
<td>Decision tree: mRS 0-2 (IV-tPA)</td>
<td>0.26</td>
<td>Cost first 3 months: Independent</td>
<td>£7,303</td>
</tr>
<tr>
<td>Decision tree: mRS 3-5 (IV-tPA)</td>
<td>0.55</td>
<td>Cost first 3 months: Dependent</td>
<td>£15,627</td>
</tr>
<tr>
<td>Decision tree: mRS 6 (IV-tPA)</td>
<td>0.19</td>
<td>Cost first 3 months: Death</td>
<td>£10,039</td>
</tr>
</tbody>
</table>

Conclusion

Mechanical thrombectomy (MT) in combination with IV-tPA was associated with higher costs, but greater health benefits, when compared with IV-tPA alone. Based on the time horizon of 90-days, MT was not cost-effective compared with IV-tPA. However, this result was reversed if we consider a lifetime horizon. The long-term health benefits associated with MT outweigh the additional costs, compared with IV-tPA. In line with clinical evidence, cost-effectiveness improves further as time-to-treatment reduces. We estimate that the value of implementation is greater than the cost of implementation of MT into routine practice is the UK. The results holds if we assume full implementation or 50% implementation. Mechanical thrombectomy has recently been approved by NHS England and it is estimated that potentially 9,100 patients per year could benefit from this treatment.