Advances in Stroke Research

Chapter 2

Improved Costs and Clinical Benefits of Mechanical Thrombectomy in Acute Ischaemic Stroke: Data from the Largest UK Thrombectomy Centre

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Abstract

Objectives: We describe improved clinical outcomes by treating patients with acute large vessel occlusive stroke using mechanical thrombectomy and calculate the cost savings within our Hospital Trust and the community.

Methods: We retrospectively analysed 275 patients with acute ischemic large vessel occlusion treated with mechanical thrombectomy at our institution between January 2010 and March 2016. Our results are compared to the SITS registry of 14,145 patients treated with IV t-PA alone.

The main clinical outcome measured was the modified Rankin Scale (mRS) assessed at 90 days. Secondary outcomes were the proportion of patient discharged direct to home and length of stay in hospital; this data was used to calculate the change in-hospital costs and community care.

Results: 47% of patients receiving mechanical thrombectomy achieved functional independence (mRS $\leq$ 2) vs. 35% of patients treated with IV t-PA alone, Mechanical Thrombectomy significantly decreased the length of stay with a mean of 12 days compared to 28 and increased the likelihood of discharge direct to home. This resulted in direct saving of £1.5 million because of the reduction in the length of stay and additional nurs-

ing care savings of £6.6 million.

Conclusion: The introduction of mechanical thrombectomy at our institution in a cohort of 275 patients led to favourable outcomes at 3 months. The resultant reduction in disability produced savings of £8.1 million (£1.5 million from reduced length of hospital stay and £6.6 million from decreased dependence on community nursing care).

Keywords: Stroke; Thrombectomy; Cost analysis; Clinical audit; Health economics

1. Introduction

Stroke remains the second cause of death and the leading cause of disability in Europe [1], with approximately 650.000 strokes annually [2]. It is also a leading cause of functional impairments, with 20% of survivors requiring institutional care after 3 months and 15 to 30% remaining permanently disabled [3]. This societal burden is mainly affecting those in the population beyond 55 years old. Given the increase of this population subset in the UK and the current financial climate, there is an increasing need to focus on ensuring a transformational change in the NHS to support safe and effective treatment of stroke patients and to positively impact the associated hospital and societal costs. The high consumption of health care resources for Stroke care is mainly linked to initial hospitalization, and to rehabilitation services. Stroke severity is also a cost predictor in all phases of care. Severe strokes are often correlated with Large Vessel Occlusion (LVO) associated with an increased mortality, morbidity, poor clinical outcomes, and therefore higher overall cost burden.

Endovascular intervention (mechanical thrombectomy) consists of an arterial catheterization to the level of occlusion and the delivery of mechanical treatment and/or a thrombolytic agent. Mechanical treatment uses a stent retriever and/or an aspiration system to extract the clot [4]. In the treatment of LVO stroke, mechanical thrombectomy with stent retriever has recently proven superiority in safety and efficacy over conventional intravenous thrombolytic therapies alone [5]. This form of treatment is widely used in Western Europe and the United States, but relatively new to the UK. In January 2010, following clinical governance and trust board approval, patients with LVO were allowed to receive endovascular treatment at UHNM.

2. Methods

2.1. Study design

The study evaluating mechanical thrombectomy presents an analysis of acute ischemic stroke patients from a retrospective case review series done at UHNM. The study protocol obtained approval by the relevant institutional review board.

The addition of an endovascular treatment option required a complete redesign of the patient pathway. For a successful implementation, this change required a multi-disciplinary approach. Driven by the interventional neuroradiologist, the neurologist, and the stroke team, a collaborative protocol has been implemented to define optimal patient selection criteria.

2.2. Patient selection and intervention

A total of 275 patients have been studied at UHNM (University Hospitals of North Midlands NHS Trust) from January 2010 to March 2016 to evaluate the effectiveness of mechanical thrombectomy.

In order to be included in this retrospective study, patients had to:

- Fit for general aesthesia and thrombectomy
- Be previously independent
- Be aged < 80 years
- Not bleed or have a sub-acute infarct on CT (computerized tomography) head
- Have a large vessel occlusion shown in CTA (computerized tomography angiography)

For anterior Circulation Strokes:

- NIHSS must be superior or equal to 8
- Onset of symptoms must be within 6 hours of treatment

For posterior Circulation Strokes:

- Time window could be extended to 12 to 16 hours
- In our patient series 85% of the patients were treated with stent retrievers and the remaining 15% were treated with aspiration thrombectomy.

2.3. Outcome assessments

The main outcome measure was the clinical outcome assessed at 90 days post-procedure by the modified Rankin Scale (mRS), comparing patients treated with mechanical thrombectomy at UHNM (275 patients treated from January 2010 to March 2016) and patients treated with IV t-PA alone in the SITS [ ] registry (14,145 patients treated from December 25, 2002 to April 2013). Good functional outcome (functional independence) was defined by a mRS of 0-2 at 90 days.

Secondary data was collected for the calculation of cost savings. The length of hospital stay for patients treated with mechanical thrombectomy come from UHNM and has been compared to data of Dawson J. et al.[6] for patients treated with IV t-PA only.

3. Results

3.1. Participants

Data from 275 participants with strokes from acute LVO treated with mechanical thrombectomy were included in this retrospective analyses. They were compared to clinical data from 14,145 participants treated with IV t-PA alone of SITS6 Registry and compared to patient length of stay data of Dawson J. et al [7].

3.2. Patient characteristics

Patient baseline characteristics were similar between the 3 cohorts (Table 1). Mean age was 63 years old in the UHNM retrospective study after 2010; 69.7 years old in the Dawson J. et al. study [7] and 64 years old in the SITS [6] registry. Median NIHSS pre procedure was 18 in UHNM and SITS [6], whereas NIHSS score was below in Dawson J. et al. study [7] patients.

Table 1: Patient characteristics

	Number of patients	Age (mean)	EVT (Mechanical Thrombectomy)	NIHSS pre procedure (median)	Symptom onset to arrival at UHNM
EVT at UHNM	275	63	All	18	2h30
IV thrombolysis from Dawson J. et al. study [7]	1,717	69.7	No	13.1 (mean)	-
IV thrombolysis from SITS [6]	14,145	64	No	18	2h30

3.3. Clinical outcomes

The new treatment approach, using mechanical thrombectomy significantly increased clinical benefits: 47% of patients achieved functional independence (mRS ≤ 2) vs. 35% of patient treated with IV t-PA alone, with a relative risk of 1.4 in favour of mechanical thrombectomy (Table 2).

Table 2: Clinical outcomes (mRS at 90 days)

	mRS≤ 2 at 90 days
Endovascular treatment at UHNM	13.1 (mean)
IV thrombolysis from SITS6	35%

3.4. Cost estimates

3.4.1. In-hospital care

Bed days play a significant role in the direct heath care costs for stroke patients [ ]. Therefore, the cost savings are highly dependent on reduction in the length of stay, which correlates with the reduction in disability and thus an early discharge. In our series of patients treated with mechanical thrombectomy, 23% of the patients were discharged home within a week. The median stay in the Stroke Unit at UHNM was 12 days, compared with 28 days in the Dawson J. et al. study [7] following the previous routine treatment offered to patients with intravenous thrombolytic agent in patients with large vessel strokes. This amounts to a reduction in hospitalization of 16 days. The length of hospital stay included emergency room, intensive care, high dependency, general ward, rehabilitation unit or undefined bed days [7].

Employing the NICE estimate of a stroke unit cost of £350/day [9], the length of stay reduction in this cohort of 275 patients allowed savings to our Trust of £1.5 million.

3.4.2. Social and nursing care costs

Informal care represents the second component of the stroke cost for the UK, comprising 27% of the overall cost [9]. Stroke management in residential care homes for disabled frail elderly persons and by community nursing services for disabled adults are correlated to the severity of disability. With the hypothesis that only patients with mRS score superior to 2 will need nursing care, 53% of patients treated with mechanical thrombectomy and 65% of patients treated with IV t-PA only may need nursing care. Furthemore, for a stroke patient, life expectancy is around 10 years (age adjusted), and an average annual cost in social care per patient is £20,000 [11]. By extrapolation, we can say that a savings of approximately £6.6 million to the social care has potentially been created at UHNM, taking into account the 275 patients treated.

4. Discussion

4.1. Benefits and cost savings anticipated

The social burden of acute ischemic stroke is very much correlated with an economic burden. The overall healthcare costs of stroke approach £8.9 billion a year, with treatment costs accounting for approximately 5% of total UK NHS costs. The direct care accounts for approximately 50% of the total, informal care costs 27%, and the indirect care costs 24% [10]. The in-hospital care cost is mainly attributed to the length of stay of a patient.

By implementing this new treatment pathway, our institution has achieved one of the lowest mortality and disability rates in the UK for Stroke patients. Patients with LVO strokes,

treated within 6 hours from symptom onset, are more likely to achieve good clinical outcomes after 3 months (mRS≤2) when treated with mechanical thrombectomy. In our patient series, this new treatment significantly reduced the median length of stay from 28 days using conventional treatment, to 12 days. Due to the reduction in hospitalization, £1.5 million was realized in cost savings and £6.6 million saved from a reduction in social care costs. By reducing or preventing patient disability, the institution saved costs from reduced hospital bed days, rehabilitative care and social care packages for disabled stroke patients within the community. This translated to significant financial savings.

This financial saving should be offset by the difference in the cost of the procedure (higher for mechanical thrombectomy). But this additional cost should be taken in charge by the funding of the procedure in the new HRG tariff: HRG YA12Z.

4.2. How the initiative will improve quality of care and clinical outcomes

The institution has the largest patient series treated by this new innovative method in the UK. In our series, 275 patients were treated with severe strokes, the 3-month follow up data (n=106) showed 47% of patients are alive and independent with an mRS of 2 or less, and 58% of patients had a good outcome with mRS ≤ 3. This new treatment has a direct impact on this patient population, reducing mortality to one of the lowest for such severe strokes in the UK – 17%. We have demonstrated a significantly reduced length of hospitalization. 94% of live discharges were discharged home, with 23% of discharged home within a week.

Demand for acute stroke treatment is expected to increase. The prevalence of stroke-related symptoms was found to be relatively high in a general population free of a prior diagnosis of stroke or TIA. On the basis of data from 18.462 participants enrolled in an international cohort study, 17.8% of the population over the age of 45 reported at least 1 symptom. By 2030 projections show a 20.5% increase in prevalence from 2012 [ ], alluding to a potential increase in the number of persons suffering from a stroke.

The organisation of delivery of mechanical thrombectomy per region around stroke centres will be critical in order to treat all the patients in the coming years. If we consider the 30 current stroke centres and the 9,000 potential patients [11], this means 300 patients annually per centre instead of the 20 to 30 patients currently being treated per centre. This is a complete change of scale that will require implementation of 24/7 services in each centre and a team able to treat several cases per day. Our organisation and pathway demonstrated benefits for the patient and also for the stroke centre. This could be replicated in the different regions to meet the need.

Currently, only 400 patients per year (data current for 2016) have been treated with an endovascular method in the UK. The main goal is to make this pathway replicable across the

NHS so that a wider UK population can benefit from this new treatment option. We estimate that over 10,000 [ ] potential patients can benefit from mechanical thrombectomy. Major savings could be achieved in reduced bed days in hospital care, and cost implications from social care, by using mechanical in combination with IV t-PA.

5. Conclusion

The introduction of mechanical thrombectomy at our institution in a cohort of 275 patients lead to favourable outcomes at 3 months. The resultant reduction in disability produced savings of £8.1 million (£1.5 million from reduced length of hospital stay and £6.6 million from decreased dependence on community nursing care).

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