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EDITORIAL

Middle Meningeal Artery Embolisation for Chronic Subdural Haematoma—Time for a Paradigm Shift?

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Abstract

Chronic subdural haematoma (CSDH) is a common condition and surgical intervention is the mainstay of treatment. Recurrence rates are high and this patient cohort is frequently elderly, comorbid, or both. Middle meningeal artery (MMA) embolisation has emerged as a technique to manage CSDH, either as an adjunct or as a stand-alone procedure. Three recently published trials have added to the evidence in favour of this technique. MMA embolisation seems set to become commonplace but more evidence is needed to understand in which cases it should be considered.

Key words: chronic subdural haematoma; endovascular technique; neurosurgical procedures

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Introduction

Chronic subdural haematoma (CSDH) is a common condition that frequently affects the elderly and the comorbid (particularly those taking antiplatelet or anticoagulant medication). As the global population ages, the incidence of CSDH is also climbing (Rauhala et al, 2019).

While surgery to evacuate a CSDH is typically simple to perform, there is a well-recognised recurrence rate. Other than a randomised trial confirming the efficacy of leaving a drain, little has changed in the management of this condition, for decades, despite trials that have considered medical adjuncts, such as dexamethasone (Hutchinson et al, 2020; Santarius et al, 2009).

Surgery is not without its risks, especially in this patient cohort and therefore interventions that reduce recurrence rates should be welcomed.

Middle meningeal artery (MMA) embolisation (typically by means of liquid embolic materials) has emerged, as an endovascular technique to treat CSDH; either as an adjunct to surgery or even as an alternative to it.

While patients with a substantial, compressive collection, with associated neurological deficits will doubtless continue to require surgical drainage, MMA embolisation is potentially a useful addition to the armamentarium of the Neurosurgeon/Neuroradiologist, when managing these patients.

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Evidence for MMA Embolisation

As with any new technique, a threshold of evidence must be achieved, in order to demonstrate both its safety and efficacy. An early meta-analysis and systematic review of the published literature (undertaken in 2019) concluded that recurrence and complication rates in the embolisation cohorts were lower than in published surgical series, concluding that MMA embolisation was a promising treatment, noting that future randomised clinical trials were needed (Srivatsan et al, 2019). In the UK, recently published clinical guidelines on MMA embolisation concluded that "MMA embolisation for CSDHs should be used only in research" (NICE, 2023).

Recently, three trials were simultaneously published, in the New England Journal of Medicine, on the subject of MMA embolisation: Embolisation of the Middle Meningeal Artery with Onyx Liquid Embolic System in the Treatment of Subacute and Chronic Subdural Hematoma (EMBOLISE) (Davies et al, 2024), Managing Non-acute Subdural Hematoma Using Liquid Materials: a Chinese Randomized Trial of Middle Meningeal Artery Treatment (MAGIC-MT) (Liu et al, 2024) and Squid Trial for the Em- bolization of the Middle Meningeal Artery for the Treatment of Chronic Subdural Hematoma (STEM) (Fiorella et al, 2024). These trials add to the growing body of evidence in favour of the technique.

The EMBOLISE trial (Davies et al, 2024) was an industry-funded trial of symptomatic CSDH with two cohorts: observational and interventional. Observed patients were randomised to MMA embolisation (Onyx liquid embolic material) or to medical care alone, interventional patients underwent surgery +/- (neo) adjuvant MMA embolisation. In treated patients, the rate of CSDH recurrence/progression requiring repeat surgical drainage was significantly lower in patients who received adjuvant MMA embolisation, as compared with surgery alone (4.1% vs 11.3%; relative risk 0.36, 95% confidence interval (CI) 0.11 to 0.80, $p = 0.0081$). The results for the observational cohort are yet to be published.

MAGIC-MT (Liu et al, 2024) is a second industry-funded trial. Again, it compared the addition of Onyx embolisation to standard care, which could be either medical or surgical. In surgical cases, embolisation was almost always on a neoadjuvant basis. Patients who underwent MMA embolisation were significantly less likely than those who did not, to require subsequent CSDH (re) treatment (7.2% vs 12.2%; odds ratio (OR) –4.92, 95% CI –9.37 to 0.63, $p = 0.02$).

The STEM trial (Fiorella et al, 2024), which was also industry-funded, utilised a different liquid embolic agent, Squid. As with the other two trials, both operated and non-operated cohorts were defined and for each, there was randomisation to additional treatment with MMA embolisation or not. The primary outcome measure was recurrence (which could be radiological alone) or progression requiring surgical treatment, at 180 days. This trial also concluded that the addition of MMA embolisation was effective in preventing CSDH recurrence or progression (15.2% vs 39.2%; OR 3.60, 95% CI 1.91 to 6.78, $p = 0.0001$).

The safety of these agents appears comparable to standard treatment across the three trials, with similar rates of all-cause mortality at 30 days and no episodes of disabling stroke within the trial arm in the STEM trial (Fiorella et al, 2024), a low

2% rate of serious adverse events in the EMBOLISE trial (Davies et al, 2024), and 6.7% in the treatment arm (compared with 11.6% in the standard treatment group) of MAGIC-MT (Liu et al, 2024).

These three trials constitute early evidence to support a role for MMA embolisation in the management of CSDH. Further trials are already underway and should further contribute to a greater understanding about the potential efficacy and safety profile of this new technique (Tudor et al, 2024).

Future Directions & Applications

MMA embolisation has the potential to substantially improve the outlook for patients presenting with CSDH and, while these early studies seem to demonstrate comparatively low risk profiles and good efficacy, this should form only part of the decision-making process, as we seek to understand where MMA embolisation will sit, in the wider management of this common condition. Care needs to be taken, to recognise the natural history of this disease; especially for smaller CSDH collections, many of which will resolve spontaneously; without the need for any treatment at all. Conversely, there are some patients in whom MMA might prevent patients with smaller minimally-symptomatic or asymptomatic CSDH from progressing to the point that patients require surgery.

Another potential cohort of patients who might benefit from MMA embolisation are those with smaller, minimally-symptomatic or asymptomatic CSDH, and concurrent antiplatelet or anticoagulant use. Some patients will be managed conservatively, with cessation of their regular medications for several weeks, in the hope of avoiding progression to needing surgery. Future studies might examine whether MMA embolisation would be sufficient to safeguard against such progression, allowing patients to continue to receive the benefits of their antiplatelet or anticoagulant medications and even to leave inpatient hospital care sooner after diagnosis.

Early adopters are already offering MMA embolisation for patients with CSDH and so independent studies (i.e., not industry-sponsored) will doubtless become more prevalent in the coming years. It seems likely that MMA embolisation will become more established as a mainstay of treatment, either as an adjunct or as a stand-alone procedure. However, despite the positive early results, we must not get carried away. Other authors have already pointed to the importance of cost-effectiveness, when considering this new intervention. It might well be that MMA embolisation is, in fact, more cost-effective than standard care, but cost-effectiveness calculations should be factored into future trials, especially since this is a common condition and therefore the impact could be substantial (Catapano et al, 2022; Tong et al, 2023). We must remember that even a minimally invasive treatment will carry more procedural and peri-procedural risks than conservative management. *Primum non nocere*!

Conclusion

Three trials have recently been published, each supporting the potential role for MMA embolisation, in the management of CSDH. The trials suggest that MMA emoblisation is associated with lower rates of recurrence and reoperation, as compared with standard care. Further trials (ideally conducted independently of industry sponsorship) will further establish the role for this new technique.

Key Points

- Chronic subdural haematoma (CSDH) is a common condition, with high post-operative recurrence rates.
- Middle meningeal artery (MMA) embolisation is an emerging endovascular technique for managing CSDH that may have a role in treatment, either as a stand-alone procedure or as an adjunct to neurosurgery.
- Recently, three industry-funded trials have been published, demonstrating the early efficacy and safety data for MMA embolisation.
- Further work is needed, to better understand this potentially promising new treatment and also to fully understand if and when it should be considered, for patients presenting with CSDH.

Availability of Data and Materials

Not applicable.

Author Contributions

AS and IA designed the research. AS prepared an original synopsis of the available literature. IA constructed the editorial and drafted the manuscript. Both authors contributed to important editorial changes of important content in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

Ian A. Anderson is serving as one of the Editorial Board Members of this journal. We declare that Ian A. Anderson had no involvement in the review of this article and has no access to information regarding its review. Alex Smedley declared no conflict of interest.

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