Should magnetic resonance imaging or computed tomography be the primary brain imaging modality in the transient ischemic attack clinic?

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Abstract
Objective: The Royal College of Physicians and National Institute of Clinical Excellence have recommended that magnetic resonance imaging should be the modality of choice for cerebral imaging in transient ischemic attack patients. However, implementation of this is often difficult. Therefore, it is important to know whether magnetic resonance imaging contributes significantly to early clinical management in transient ischemic attack patients.

Design: A retrospective case-notes review of 65 consecutive patients seen by one neurology trainee (with consultant review), in a neurovascular service where computed tomography has been the primary cerebral imaging modality.

Setting: Outpatient TIA/Neurovascular clinic at Imperial College hospital.

Participants: 65 consecutive patients seen by one neurology trainee (with consultant review).

Main outcome measure: We recorded the preliminary clinical diagnosis, details of investigations performed and whether or not patients had a magnetic resonance imaging brain scan subsequently, the number followed up in clinic and the final diagnosis.

Results: Of the 65 cases seen, 55% were classified initially as transient ischemic attack/stroke mimics. Of the 29 cases (45%) that were classified as transient ischemic attack, all had computed tomography scans, 12 had magnetic resonance imaging scans subsequently and 14 were followed up several weeks later. Of the 36 cases classified as stroke mimics, 27 had computed tomography scans immediately and 31 had carotid Dopplers, six subsequently had magnetic resonance imaging scans and 14 were followed up in clinic. Only two patients had their diagnosis revised on the basis of the magnetic resonance imaging.

Conclusions: Our study suggests that magnetic resonance imaging brain changes the diagnosis in a relatively small percentage of cases. A good history and examination remain paramount in the assessment of patients presenting to the transient ischemic attack clinic, particularly when more than 50% of cases referred are transient ischemic attack/stroke mimics.

Keywords
Transient ischemic attack, magnetic resonance imaging, computed tomography

Background
The Royal College of Physicians (RCP) and National Institute of Clinical Excellence have recommended that magnetic resonance imaging (MRI) should be the modality of choice for cerebral imaging in transient ischemic attack (TIA) patients.1,2 This has had widespread support but the implementation of this is often difficult because there are many competing demands for MRI slots in most acute Trusts which may limit their availability. An effective TIA service is a rapid access one, and it is difficult for many Trusts to ‘ring-fence’ MRI slots for a TIA service. If one is to make a convincing case for doing so, it’s important to know if MRI can be demonstrated to improve the accuracy of diagnosis and early management in TIA patients, compared with computed tomography (CT).

Aims
To determine whether early MRI changes clinical management in the TIA clinic.

Methods
The study was conducted as a retrospective case-notes audit of the investigation and management of 65 consecutive patients referred to our rapid-access daily outpatient TIA service and seen by one neurology trainee with consultant review. Our service is run to a performance standard of seeing all high-risk patients within 24 h of referral and all low-risk patients within seven days. High-risk patients are defined using the ABCD2 score (high risk = ABCD2 ≥ 4). Additionally, patients on anticoagulants, in atrial fibrillation, or with crescendo events (≥2) in the previous seven days are considered high risk.

In our neurovascular service, CT has historically been the primary cerebral imaging modality, with carotid Doppler ultrasound as the primary vascular
imaging modality. We recorded the preliminary clinical diagnosis, details of investigations performed acutely (principally CT brain and/or carotid Doppler ultrasound) and whether or not they had a subsequent MRI brain scan. We recorded the number followed up as outpatients and the final diagnosis.

Results

Of the 65 consecutive cases seen in clinic, 55% were initially diagnosed clinically as TIA or stroke mimics. Of the 29 cases (45%) that were diagnosed clinically as TIA, all had CT brain scans and carotid Doppler ultrasound on the day of assessment. Twelve patients had MRI scans subsequently and 14 were followed up several weeks later. Of the 36 cases classified as stroke mimics, 27 had CT scans and 31 had carotid Dopplers. Six subsequently had MRI scans and 14 were followed up in the outpatients clinic. Only three of the 65 patients (two initially classified as TIA and one as a mimic) had their diagnosis revised following MR imaging (see Figures 1 and 2).

One of the apparent mimics had a subsequent MRI that revealed a subacute ischaemic lesion in the brainstem. One of the TIA cases had an asymmetrical prominence of the left optic nerve suggesting an underlying inflammatory process. The other case had a normal MRI scan and the Consultant felt after reviewing the history that this was unlikely to be a TIA; it could be argued that this was not a decision based on the MRI findings, so it appears that the MRI findings changed the diagnosis only in two patients.

In all, 28% of the 65 cases had dual cerebral imaging with CT and then MRI, and 43% were followed up in clinic. We decided then to explore this in a larger sample of patients. In an independent sample of 100 patients seen consecutively in the TIA clinic over a two-month period, with retrospective data collection, we found that 38% had dual cerebral imaging: CT initially followed by MRI; and 59% were followed up in clinic. Combining datasets, overall 34% had repeated imaging, and 53% were followed up in clinic.

Discussion

In summary, our data revealed that of the 65 patients initially assessed in the TIA clinic, MRI changed the diagnosis and subsequent management in only two cases. Of the 165 cases analysed in total, 56 patients had repeated imaging. The RCP have made recommendations based on the fact that MRI brain has superior sensitivity to CT brain in detecting relevant abnormalities in TIA/minor stroke cases and in detecting structural abnormalities in stroke mimics.3 Using MR as the primary imaging modality in a TIA service might prevent unnecessary duplication of imaging, reduce radiation exposure and may facilitate accurate early diagnosis. A CT head scan exposes an individual to seven and a half months of background radiation. This risk is cumulative as the individual has more scans through the individual’s lifetime. With regard to repeated imaging, we found that 34% of patients had a CT first and then an MRI brain. If we had implemented locally a strategy of MRI as the first choice modality, we would have had to perform 109 extra MRI brain scans, offset against a reduction of 165 CT scans. Using Healthcare for London tariffs where a CT cost £122
pounds and MRI scan cost £201, for these 165 patients, the total cost for 156 of these patients to have one MRI brain scan would be £31,356. The cost of imaging for this cohort of 165 patients (156 CT scans and 56 MRI scans) was £30,132. Therefore, the cost would be approximately the same as the extra cost of MRI scan versus CT scan is offset by the cost of repeated imaging in 34% of cases. There are several assumptions in this calculation: that no patients had a contra-indication to MRI (such as having a pacemaker in situ), that all patients would have been able to tolerate the procedure, and that all patients would need cerebral imaging. In addition, it was noted that 86% of stroke mimics were having carotid Dopplers organised at their first appointment. Avoidance of this would free up space for patients such as those on the local hyper-acute stroke requiring carotid imaging, facilitating faster referrals to the vascular surgeons if indicated, as well as potentially reducing delays in discharge.

MRI diffusion weighted imaging (DWI) sequences and apparent diffusion coefficient mapping have allowed us to diagnose patients with stroke earlier with higher sensitivity and relatively high specificity. Moreau et al.\(^5\) reported 347 patients presenting with a suspected stroke or minor TIA and demonstrated that a CT scan has a sensitivity of 20% and specificity of 98% compared to MRI brain scan as the gold standard and therefore suggests MRI should be used as the preferred imaging modality. However, we also know that only a minority of brief episodes (presenting as TIA) are associated with abnormalities on MRI. The majority of the MRI brain scans in this study were non-contributory but this may have been due to the timing of the scan since they were often being performed more than two weeks after the event when DWI changes would no longer be apparent.\(^5,6\)

In addition, MRI in the hyper-acute stroke pathway can still result in false negatives in a small percentage of cases, particularly if it is a posterior circulation syndrome.

Our study suggests that MRI changed the diagnosis in only a very few cases. Our data emphasise the importance of the history and examination in the assessment of patients presenting to the TIA clinic, particularly when >50% of cases referred are subsequently classified as mimics. An experienced specialist assessment will help to answer key questions in the history such as the speed of onset, any associated symptoms or other pointers to an alternative diagnosis, and will help to define the likely vascular territory involved in TIA cases. Indeed, good clinical assessment initially may render any cerebral imaging unnecessary in some cases.
Retrospective studies do lend themselves to bias in recruitment. In this study, this was overcome by including all patients seen by the authors over a set period of time. The other limitation is confounders although this study was not trying to prove a causal relationship between two variables. However, this approach does not allow us to explore the reasons behind the decision making.

In this study, 53% of patients were followed up in clinic. In the UK, there is a lot of pressure for healthcare commissioners for acute Trusts to reduce new to follow-up ratios. MR as the primary imaging modality in TIA clinics could reduce this follow-up burden, particularly if all other necessary investigations could be completed at the first visit. Patients and general practitioners (GPs) could be contacted by letter, phone or email with results not available at that visit such as blood tests.

Final comments

There are considerable arguments for having a MRI as the first choice of imaging modality as recommended by the RCP. However, this study has emphasised that a good history and examination remains paramount in the assessment of patients presenting to the TIA clinic, particularly when more than 50% of cases referred are TIA/stroke mimics. Logistically, the avoidance of repeated imaging would potentially cost a similar amount (although this would also depend on local contractual arrangements with commissioners as to whether there is a block contract or payment by results) and free up slots for the CT scan to be used for other purposes. Further, there would be potential to reduce these costs by implementing a ‘phone clinic’ for this cohort group that have resolved neurological symptoms and signs to feed back on results and letters sent to GP and advise on further management. This would reduce new to follow-up ratios as well as reduce waiting lists.

Declarations
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Guarantor: IHJ
Contribution: JG saw all the patients in clinic. Follow up was by IHJ. JG collected the data, and both authors were responsible for the analysis and interpretation of this, and for writing the paper.

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