

An Analysis of the Referral Pattern of Urgent MRI in an Acute Unit

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Abstract

Background : Urgent MRI (Magnetic Resonance Imaging) in clinical management is quite often required in the modern hospitals. In many cases, it may be needed for emergency patients and may save a valuable life. A few previous papers show MRI provision needs to be improved and many clinical situations need urgent MRI for management. This project was done with the objective to explore the range of urgent applications of MRI and aim to provide information supporting development of MRI service with the null hypothesis: "there is no need to introduce on call service for urgent MRI".

Materials and methods: This thesis explored the applications of MRI as urgent investigations both retrospectively and prospectively in the busy MRI unit of the John Radcliffe Hospital, Oxford, UK, from 2004 to 2005. To assess the necessity of introducing an on-call service in the unit, a null hypothesis was developed: "There is no need to introduce on call service for urgent MRI". To test the hypothesis, patients' records were analysed to observe the effect in clinical management of MRI carried out as an urgent basis.

Results: The results explored the demographic trend, common examination areas, types of indications and the nature of MRI reports among the urgent patient referrals. The retrospective and prospective results showed similarity between the two years' practices. The results of clinical effect of urgent MRI were found to be positive in the majority cases and the null hypothesis was rejected.

Conclusion: Overall, the thesis argues that the urgent MRI is not being carried out sufficiently in comparison to routine MRI, although urgent MRI has a good effect on clinical management. The study showed the necessity to develop the on call service in MRI.

Key words: Magnetic Resonance Imaging (MRI); On call service; Urgent.

INTRODUCTION

MRI has become the primary technique throughout the body in the routine diagnosis of many disease processes, replacing and sometimes surpassing Computed Tomography (CT).¹ MRI has particular advantages in that it is non-invasive, uses non-ionising radiation and has a high soft tissue resolution and discrimination in any imaging plane. It may also provide both morphological and functional information. The resultant MR image is based on multiple parameters, any of which can modify tissue contrast.² In its development, MRI has incorporated a multidisciplinary team of radiologists, technicians, clinicians and scientists who have made and are continuing to make combined efforts extending the clinical usefulness and effectiveness of this technique.³ This thesis explores the range of urgent applications of MRI in a busy acute unit, with retrospective and prospective patient

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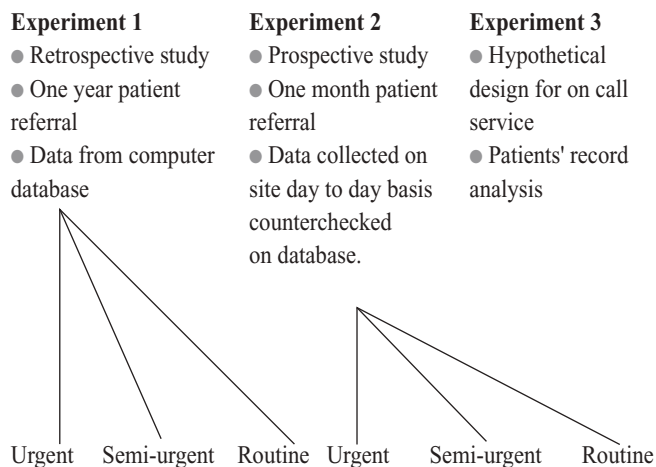
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referral analysis. A null hypothesis was made to introduce on call service for urgent MRI. "There is no need to introduce on call service for urgent MRI". To test the null hypothesis, patients' records were analysed to see the effect of urgent MRI.

MATERIALS AND METHODS

Keeping the objectives and aim of this project in mind, I divided my experimental works into three parts. The experiments were done by analysing patient referral database from the Radiology Information System, collecting data from MRI unit on day to day basis and by analysing the patients' records.

METHODS AT A GLANCE



Analysis of urgent MRI of both the experiments (1 and 2) as follows-

- Age
- Sex
- Examination area
- Indications
- MRI reports.

EXPERIMENT 1:

Retrospective Analysis of Patient Referral in the MRI Unit

Aim: To explore the objectives of this project by analysing the urgent patient referrals to acute MRI unit.

Retrospective study:

For the retrospective study, the list of 12 months of patient referral to MRI centre, the John Radcliffe Hospital, was collected from RIS (Radiology Information System). This 12 month consists of the whole of the year 2004. To get a significant amount of data, 12 months was selected.

In the specified sampling period of 12 months in 2004, the referred patients were divided into three groups:

- i) Urgent: MRI done within 24 hours of referral.
- ii) Semi - urgent: MRI done within 1 - 5 days of referral.
- iii) Routine: MRI done after 5 days of referral.

As experiment 1 was done to explore the range of urgent

applications of MRI, only the urgent patient referrals were marked and separated. Then each urgent case was explored individually by data collection sheet.

EXPERIMENT 2:

Prospective Analysis of the Patient Referral

Aim: To explore the urgent range of applications and to compare the findings of previous practice with the present situation.

Prospective study:

For prospective analysis, only one month from January 25, 2005 to February 25, 2005 was chosen.

This time data was collected by day to day basis at the reception desk of the MRI centre in the specified period. As the MRI reports were not available on the same day, they were collected from the computer database later.

After collecting data from all the patient referrals in one month, the urgent patients' data were separated as that of experiment 1. Now each of the urgent referrals was explored according to the data collection sheet.

For both the retrospective and prospective study, the analysis was done in the identical way for comparison.

EXPERIMENT 3:

Exploration of Effect of Urgent MRI in Clinical Management:

Aim: To observe the necessity of introducing an on call service for urgent MRI procedures with the null hypothesis:

"There is no need to introduce on call service for urgent MRI".

Clinical Management after Urgent MRI Procedures

To get the information regarding the management after urgent MRI, the patients records were analysed with strict confidentiality.

The effect on management after urgent MRI was analysed for only the retrospective data of experiment 1 (The patients who went through MRI within 24 hours of their referral).

Considering the time of preparing this project, I did not wait for the effect of the urgent MRI procedures in the prospective study of one month. According to the retrospective study, the hospital number of the patients who got urgent MRI in 2004 was marked and the records of those specific patients were brought in the MRI centre to analyse the effects in a confidential way. According to the patients' record, the effect on clinical management after each urgent MRI procedure was analysed as follows:

Effect on Diagnosis and Treatment in 24 Hours:

- None: there was no effect on diagnosis and treatment.
- Positive: there was good effect on diagnosis and treatment.
- Negative: there was bad effect on diagnosis and treatment.

Effect on Hospital Stay

- None: there was no effect on hospital stay.
- Positive: hospital stay was ≤ 7 days after urgent MRI

- Negative: hospital stay was >7 days after urgent MRI.

The length of stay after urgent MRI was measured as an indication of the management following MRI. This did not record the reduction in hospital stay resulting from MRI; this information could not be obtained from this study.

Consideration of the Null Hypothesis:

To reject the null hypothesis, I anticipated obtaining a > 50% positive result in diagnosis and treatment after urgent MRI as well as a >50% positive result in hospital stay.

Choice of more than 50% positive result in both the clinical effects as a deciding

parameter was not evaluated statistically, rather I took consideration of clinical outcome as well as the cost benefit ratio in the major population.

Prior to commencement of this study, the research protocol was approved by thesis committee of University of Oxford.

RESULTS

Results of Experiment 1:

Duration: Jan, 01 - Dec, 31: 2004 (One year)

Total patient referral in the MRI unit:

5670 (Total population as 100%).

Table I Retrospective analysis (At a glance)

NUMBER OF URGENT MRI	33	0.6%
NUMBER OF SEMI - URGENT MRI	252	4.4%
NUMBER OF ROUTINE MRI	5385	95%

Results of Experiment 2:

Duration: Jan, 25, 2005 - Feb, 25, 2005 (One month)

Total patient referral in MRI the unit:

511 (Total population as 100%)

Table II Prospective analysis (At a glance)

NUMBER OF URGENT MRI	09	2%
NUMBER OF SEMI - URGENT MRI	38	7%
NUMBER OF ROUTINE MRI	464	91%

OVERALL RESULTS AT A GLANCE IN EXPERIMENT ONE AND TWO

Comparative Results of Retrospective and Prospective Analysis:

Table III Results of the urgent MRI in retrospective one year and prospective one month

Topic	Results of urgent MRI Duration: Jan - Dec, 2004 Retrospective data base analysis.	Results of urgent MRI Duration: Jan25 - Feb 25, 2005 Prospective on site data collection.
Percentage	Out of total 5670 referral, the number of urgent MRI was 33 which represent less than 1%.	Out of 511 referrals, the urgent cases were only 9 which are around 2% of the total referrals.

Age	0-12:12% 13-60:55% >60: 33%	0-12:11% 13-60:56% >60: 33%
Sex	M - 48% F-52% Most common:	M - 33% F-67% Most common:
Examination area:	Brain: 28% Lower limb: 18% Cervical spine: 18% Lumber spine: 18% MRICP:- 9% Nil: Chest, Face, Upper limb and Total spine. Most common-	Brain: 34% Lower limb: 11% Cervical spine: 11% Thoracic spine: 11% Total spine: 11% MRICP: 11% Nil: Chest, Face, Upper limb, Pelvis, Lumbar spine. Most common:
Indications	Non - specific: 43% Orthopaedic - Traumatic: 30% Oncological: 15% Medical: 9% Surgical: 3% Nil: Gynaecology and Obstetric.	Orthopaedic - Traumatic: 33% Medical 33% Surgical: 11% Oncological-. 11% Non - specific: 11% Nil: Gynaecology and Obstetric.
Reports:	Positive: 57% Negative: 31% Equivocal: 12%	Positive: 56% Negative: 11% Equivocal:33%

RESULTS OF EXPERIMENT 3:

Effect on Clinical Management after Urgent MRI:

Total urgent MRI in 2004: 33

Patients' record found in the hospital: 21

Out of 21 patients' records (Total population as 100%), following results were found:

Table IV Effect on clinical diagnosis and treatment in 24 hours

NONE	NO EFFECT	6	29%
POSITIVE	GOOD EFFECT	15	71%
NEGATIVE	BAD EFFECT	00	0%

Table V Effect on hospital stay

NONE	NO EFFECT	3	14%
POSITIVE	≤ 7 DAYS	14	67%
NEGATIVE	> 7 DAYS	4	19%

As there was more than 50% positive result found in both studies, the null hypothesis: "There is no need to introduce an on call service for urgent MRI" was rejected.

DISCUSSION

MRI is relatively a new technique among different imaging modalities in the present clinical arena. The radiation free imaging with excellent multiplaner capability shows good potential of the technique in the long run. In the light of technological development, it will be no surprise if MRI

service is developed in the A & E department for emergency patients, as is CT right now. Considering the future potential of this imaging modality, this project related to urgent MRIs relevant as well as effective.

In 2004, the total urgent MRI procedure was below 1% but in the present practice of 2005, it was around 2%. Overall, the percentage reflected the scarcity of urgent MRI. Due to the long waiting list of routine MRI, urgent cases are probably not getting sufficient access.

The urgent MRI results could be clearly compared in the two-year practice.

Though the comparison was done between one year of data and one month of data, the results showed similarity in the demographic trend, examination areas, MRI reports and common indications. The study result revealed no such major difference.

To accept / reject the null hypothesis, I found no reason to perform statistical analysis. Even one positive effect after urgent MRI procedure out of 21 patients (Who went through urgent MRI in 2004) should reject the null hypothesis if it is financially possible.

But considering the financial cost involved with an on call service and other alternative imaging modalities available, I conclude more than 50% positive results should be found in the two parameters (Good effect on diagnosis and treatment in 24 hours and Hospital stay ≤ 7 days) to reject the null hypothesis. More than 50% was taken as the borderline to show a positive result in the majority population.

As I discussed in methods, this length of hospital stay after urgent MRI was measured as an indication of the management following MRI. This does not record the reduction in hospital stay resulting from MRI; this information could not be obtained from this study. It would only be available from a study which randomised patients into MRI and non - MRI groups followed by prospective observation of the hospital stay in the two groups. There are other factors to consider like disease pattern, severity etc.

As the majority population (>50%) showed a positive effect in clinical situations as well as hospital stay, I thought to reject the null hypothesis upon which other workers may start to consider - how to implement the on call MRI.

A study concluded that demand for MRI was likely to grow by 12.5 and 18.5% per annum in West Midlands, UK. The work proposed that 8 - 14 additional MRI scanners might be required in the next few years.⁴ According to another article, detecting acute coronary syndrome in the emergency department using cardiac MRI was studied in 161 consecutive patients in a prospective study. The study concluded that MRI was more specific than an abnormal ECG and the strongest predictor of acute coronary syndrome. This work shows the necessity of urgent MRI in the emergency clinical situation like acute coronary syndrome, when a few minutes delay may cause fatal

outcome in the prognosis of the patient.⁵ Another work results showed that the bed cost is the major expense incurred by the delayed diagnosis of a suspected occult femoral neck fracture. However, the study concludes that an urgent MRI study performed at the time of initial assessment could markedly reduce the cost of managing this group.⁶ Objective of another study was to highlight the diagnostic challenge of spinal epidural abscess. A retrospective study of non - tubercular Spinal Epidural Abscesses (SEA) was carried out. It was concluded in the article that fever is not mandatory for the diagnosis of SEA. Patients with localized back / neck pain and raised inflammatory markers need urgent MRI.⁷ Another study concluded that patients who develop spinal metastasis are at risk of irreversible spinal cord damage. Weakness and sensory abnormalities are reported late and identified even later, despite patients having reported pain for a considerable time. The only accurate investigation to establish the presence and site of a compressive lesion is MRI.⁸

Another article indicates that basilar artery thrombosis should be diagnosed immediately, as intra - arterial thrombolysis might improve the outcome. Diffusion weighted MRI, three dimensional time of flight MR angiography provide additional insight into the extent of ischemia and the level of the occlusion. The article suggests the feasibility of a non - invasive diagnostic and prognostic approach with MRI in basilar occlusion.⁹

An article states that a 50 year old female nurse with an unremarkable medical history experienced acute mid thoracic pain, radiating to the chest and increasing during inspiration. Laboratory tests, chest X-ray and ECG all were normal. The clinical diagnosis of probable pulmonary embolism was made and anticoagulant therapy was started. An MRI revealed a large anterior spinal epidural hematoma, extending from C7 down to T8. Urgent decompression laminectomy and subsequent partial evacuation of the hematoma were performed. No bleeding source was found during operation. The patient made a remarkable post - operative recovery.¹⁰

Little work has already been done on the need of urgent MRI in clinical management. These works were mainly focused on the need of urgent MRI in individual clinical situations. But there was no work on overall urgent MRI applications. This project therefore creates an overall idea on urgent MRI procedures in an acute unit. My work cross - sectioned almost all the aspects of urgent MRI referrals including age and sex of the referred patients, common examination areas, frequent indications and MRI reports.

Very few previous works on MRI service were found. The previous articles were mainly related to general MRI provision among the patients. This project was very specific for MRI service development on call.

LIMITATIONS

In the comparison of one-year previous practice and one-month present practice, the ratio of duration was 12: 1. But for a better comparative result, the duration of both studies should be the same.

Developing on call MRI may involve huge expenditure for maintenance. The expense of on call radiologists, radiographers and other supporting staff as well as excess workload on MRI scanners may be the limiting factor to introduce on call for many developing and third world countries.

Ideally, this project would be effective with a prospective study involving prospective analysis of referral justification, effect on clinical management and analysis of costs.

CONCLUSION

From the study in general, the project can conclude that:

- Urgent MRI is needed for many clinical situations at present.
- Effect on clinical management after urgent MRI is good and effective in majority of cases.
- There is a necessity to introduce on call MRI.

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DISCLOSURE

The author declared no competing interest.

REFERENCES

1. Catherine Westbrook Handbook of MRI technique 2nd Edition. Blackwell science limited. 1999.
2. Catherine Westbrook and Carolyn Kaut MRI in practice 2nd Edition. Blackwell Science limited. 1998.
3. Catherine Westbrook. MRI at a glance 1st edition Blackwell science limited. 2002.
4. Szczepura A, Clark M. Creating a strategic management plan for magnetic resonance imaging provision. Centre for health service studies, Warwick Business School, University of Warwick, Coventry, UK. Health Policy. 2000;53 (2): 91-104.
5. Andrew E. Arai, Raymond Y. Kwong. Detecting acute coronary syndrome in the emergency department using cardiac magnetic resonance imaging. Medscape cardiovascular review and reports, Le Jacq Communications, Inc. 2004;25(4): 149-154.
6. Pool FJ, Crabbe JP. Occult femoral neck fractures in the elderly: Optimisation of investigation. Auckland Hospital. N J Med J. 1996; 109 (1024): 235-237.
7. Joshi SM, Hatfield RH, Martin J, Taylor W. Spinal Epidural Abscess (SEA): A diagnostic challenge. Department of Neuroscience, University Hospital of Wales, UK. Br J Neurosurgery. 2003; 17(2): 160 -163.
8. Levack P, Graham J, Collie D, Kidd J, Kunkler I, Gibson A, Hurman D, McMillan N, Rampling R, Slider L, Statham P, Summers D. Don't wait for a sensory level - listen to the symptoms. prospective audit of the delays in diagnosis of Malignant Cord Compression (MCC). Scottish Cord Compression study group. Roxburghe House and Ninewells Hospital, Dundee, UK. Cli Oncology. 2002;14 (6): 472-480.
9. Nighoghossian N, Derex L, Turjman F, Honnorat J, Lucian P, Artru F, Froment JC, Trouillas P. Hyperacute diffusion weighted mri in basilarocclusion treatment with intra arterial t - pa. Cerebrovascular disease and actually research Centre, France. Cerebrovascular disease. 1999; 9 (6): 351-354.
10. Bun KP, de Nie J, DeKoninck GM, Kamphuis DJ, Groen RJ. Clinical thinking and decision making in practice. a nurse with acute pain between shoulder blades. Ned Tijdschr Geneesk. 1999; 143 (49):2454-2460.