Purpose

We decided to embark on this project to provide a snapshot of current CT head usage among elderly patients at a local district general hospital in the UK. It was conceived with the intention of forecasting future CT utilisation patterns by hospitalised elderly patients in an ageing society. This poster also includes a brief introduction and discourse on population ageing and its potential impact on future health service provision.

INTRODUCTION

Across the globe CT scanning has emerged as the front-runner as imaging of choice in investigating unwell patients. Since its inception, the use of CT scanning now accounts for almost 13% of all diagnostic radiological procedures in the US, rising from 3 million scans in the 1980s to 70 million in 2007 (Mettler, Wiest, Locken, & Kelsey, 2000). Indications and use of CT scanning have burgeoned from screening for lung cancers to atheroma to acute imaging in strokes and head Injury. This relentless advance of CT imaging has raised concerns about safety, as CT is thought to be responsible for 70% of collective radiation dose delivered to patients in the US (Dixon & Goldstone, 2002). Recent controversy has surfaced surrounding recent publications that imply there is much variance in the radiation dose received by patients undergoing routine CT scans (Smith-Bindman, et al., 2009) and the gloomy prospect of increased incidence of cancer related to radiation exposure from CT scans (Smith-Bindman, et al., 2009) (Gonzalez, et al., 2009).

Concurrent with the rise of CT imaging, the advent of the twentieth century has ushered fantastical gains in human life expectancy through advances in public health, medical technology and improvements in sanitation. This was followed by plummeting fertility rates across much of the developed world. An unexpected sequelae has been the raising of the spectre of Population Ageing.

Population Ageing refers to any population that experiences an increase in the proportion of elderly people[over-65s] :

- Considering the UK as of 2008, there were more over-65s than children aged-below-16
- By 2032 the elderly will constitute 25% of the population, with the number of oldest-old[over-80s] doubling to 3.1million(GAD 2008)-fig 1.
- The greying population is not just confined to Western Europe as the WHO projects that the world population of over 65s will double to 1 billion by 2030-fg 2.
Swelling numbers of longer-lived elderly, with decreasing proportions of the worker cohort[20-60year olds], will have major repercussions on society. There will be huge strains placed on welfare states particularly in realms of health-care, pensions, housing and social care.

With regards to health-care, most commentators are divided between a doomsday scenario- unrelenting tide of frail, sick elderly patients overwhelming local health-care systems (BBC, 2008) (Telegraph, 2008) to the optimistic camp that opines that health-care systems will adapt to this new challenge (Gray, 2004). CT heads are an increasingly common investigation among elderly patients. It is commonly used in the assessment of CVAs; dementia; falls; acute neurological illness and staging of tumours. The first three being age-related diseases. However the advent of population aging, has made it difficult to discern the future pressure and demands on local radiology departments as frail elderly patients compete with younger patients for finite CT resources. A literature search revealed scant papers ascribed to this particular subject.

We decided to embark on this present project to provide a snapshot of current CT head usage among elderly patients at a local district general hospital in the UK. Due to resource constraints, we decided to limit the scope of this audit to exclusively scrutinize inpatient CT head scans in elderly patients [thereby excluding requests from the community medical practitioners]. It was felt that by focusing solely on hospital physicians, present trends and request patterns could hint towards future CT utilisation by hospitalised elderly patients.

This audit took place in Broomfield Hospital, a district general hospital in Chelmsford, Essex, UK. The DrFoster hospital guide describes the hospital as possessing "546 acute beds and provides a comprehensive range of acute and community based services (including A&E, emergency medicine and surgery; elective surgery in most specialties; and maternity and paediatric services) to a local population of approximately 360,000. 98 per cent are of the Trust's resident population are of white ethnic origin with the majority aged between 16 to 64 years old. Life expectancy in the area is significantly higher than the UK national average and reflects a catchment area comprising of a relatively high proportion of older residents" (DrFoster, 2010).

Broomfield Hospital presently boasts two CT scanners [128 slice Toshiba scanner and a 16 slice Toshiba scanner]. Both are utilized during normal working hours and one allocated for out-of-hours and weekend coverage for emergencies. A recent internal radiological service review highlighted, that for a 3 month period, the hospital performed a total of 503 CT head scans (Broomfield, 2010). This averages at 168 scans a month.
Fig. 0

© - CM1 7TU/UK
Fig 2:

**Old dependency ratio**
(age group 65+ as share of age group 15-64)

- **1970**
- **2000**
- **2030**

Source: UN World Population prospects (2002 Rev. - Medium Variant); For EU25: Eurostat 2004 Demographic Projection (Baseline scenario); CC=BG, RO, HU, TR

---

**Fig. 0**

© - CM1 7TU/UK
Methods and Materials

We decided to collate all CT head scans done as an inpatient in all patients aged over 75 years. The audit was prospectively carried out over a period of 30 days, from May 19th - June 19th 2010, with data collected at the end of each day. This included imaging done 'out-of-hours'. The hospital PAS and IMPACs systems [radiological image viewing and reporting computer software] allowed us to review all requests that had been made in the specified period. This enabled us to identify all CT head scans involving the over 75's. We then tracked the medical notes and examined the written medical documentation describing the clinical presentation and management plans to co-relate the reason for request of the CT head scan. Data was collected by two foundation year doctors over seen by two specialist registrars.

A proforma was used to record presenting complaint, indication for request, request priority, source of request, time to CT, request correlating to documentation, CT result and correlation to NICE guidelines in set cases [Stroke and Head injury]. The results were analysed using Microsoft Excel. We excluded outpatient requests. Appropriateness of the CT scan was deemed by reading through the patients clinical notes and determining if the scan request was an appropriate reflection of the patients' clinical need. Certain guidelines such as the NICE head injury, Stroke and dementia guidelines were consulted as they specify exact clinical presentations that would warrant a CT head scan (NICE, 2007) (NICE, 2006) (NICE, 2008).
Results

In total 107 patients [over 75 years old] were scanned in a 30 day period [roughly 3.5 patients a day]. Considering the present monthly average (168), older patients accounted for over 63% of the CT head scans done at Broomfield Hospital. However for the confines of this audit, 15 patients had to be excluded from this study as their case-notes could not be retrieved to co-relate their clinical presentation. This was mainly due to case-notes being in transit or en-route to another location. Overall 92 patients’ head scans were analysed for the audit. The average age of the patient was 83.6 years and the distribution is reflected in figure 3.

The audit revealed that common indications in the request forms for inpatient CT head scans with relation to elderly patients were (Fig 4):

- stroke 42%
- subdural haematoma 14%
- head injury 13%
- Dementia/ chronic confusion 9%
- acute neurology 5%
- staging for cancer 2%
- subarachnoid haemorrhage 1%
- 13% involving a combination of factors listed above [eg Head injury and confusion]
- 1% of cases the reason for the request could not be discerned.

Eighty percent of scans were requested as urgent, eleven percent routine and nine percent as an emergency. Eighty three percent of requests corresponded to the medical notes. One in 5 scans were ordered direct from the emergency department. The rest originated following a medical team consultation. One in three scans were done on a presentation of falls and/or confusion. Within this group, Forty-two percent of scans did not conform to NICE guidance for head injury ie there was no clinical indication for the patient to undergo the scan.

Results also showed that 16% of requested CT head scans were deemed to be inappropriate or non-essential. This reflected a combination of requests that did not follow NICE guidance for head injury [patients did not warrant being scanned] and screening for dementia in patients who had prior CT brain scans in the past 6 months and thus did not need new scans. 2 patients who presented with delirium and no new neurology were also scanned when observation for clinical improvement was indicated. However, the remainder 84 % satisfied or warranted an urgent inpatient CT head scan.
Images for this section:

Fig. 0

© - CM1 7TU/UK
Fig. 0

© - CM1 7TU/UK

Inappropriate Scans

- Dementia Screening 9%
- Head Injury 5%
- Acute on chronic confusion 2%
- Appropriate scans 84%
Conclusion

Surmising the above results:-

- Elderly patients formed the bulk of CT head scans carried out at Broomfield Hospital [especially taking into account that this audit only concentrated on scans ordered by hospital doctors rather than Community doctors].
- 107 of 168 ct head scans were conducted on patients aged over the age of 75.
- The indications for the use of CT imaging in this patient group were also unsurprising with Stroke, Head Injury and Sub-durals forming the bulk of all requests (Falls and CVA being pre-dominantly age biased).
- In the acute setting, when faced with old, frail and confused patients who provide a history of a fall, clinicians seem to have a low thresh-hold for ordering CT imaging of the brain.
- This audit highlights that almost half of all elderly patients who presented with head injury were imaged inappropriately [when compared to NICE guidelines].

The observed increase of CT head scans amongst elderly patients is driven by a host of factors.

1. Remarkable gains in life expectancy has led to a proliferation of older patients and age-related illnesses like Stroke and dementia
2. the advent of evidence-based medicine and guidelines such as those for head injury, stroke or dementia seem to advocate early use of CT scans [see NICE guidelines].
3. The universal availability, non-invasive nature and relative ease of conducting a CT scan [ie a head scan can be done in under 10 minutes] is another likely factor contributing towards increased utilization of CT.
4. Medico-legal implications have also led to the nurturing of the 'scan the whole body' approach in western medicine.
5. The dangers of dose related radiation exposure is probably not a significant concern with regards to the elderly patient.

However, extrapolating the future prospect of an ageing population, it is not difficult to envisage a forthcoming tsunami of patients [both young and old] requiring a CT scan at the local hospital or GP practice. It is evident that demand will far out-strip supply. In order to address this contingency shortfall, potential counter-measures will probably come into play.

1. CT scanning technology [like all forms of technology] will get cheaper with time and thus perhaps facilitate the purchase of more CT scanners to address increased demand.
2. However, it is also probable that MRI or newer scanning technologies [SPECT] might supplant CT as investigations of choice, thereby negating any cost-savings incurred by the use of cheaper CT alternatives.

3. With regards to dementia and strokes, it is a well-demonstrated fact that MRI imaging is far superior to CT, in identifying strokes and ruling out other sinister pathology like brain tumours (Mullins, et al., 2002).

4. It is also likely that fiscal budgetary restrictions (in welfare states like the NHS in the UK) will impose limitations on the scope of exponentially increasing our imaging capability to be in-line with the demands of population ageing.

Discerning the future impact of an ageing population on health costs is an unknown entity but is viewed as a potential time-bomb by the general media in that it is projected to rise as populations age.

Present day clinicians are at present spared from confronting this particular 'elephant in the room'. If we lived in an ideal world with infinite resources than imaging everyone with the best scanner is a realistic goal. However, we are faced with an ageing world and finite resources. Difficult decisions and pot-holes lie in the road ahead. It is a very probable scenario in the future that not everyone will be able to be imaged due to pressures and increased workload of local radiology departments. There is a strong case for the introduction of rationing and perhaps re-configuring of certain guide-lines, like for instance dementia where imaging may not be necessary in all patients who provide a good concise clinical history and demonstrate no relevant neurological findings. Radiologists will also have to increase their gate-keeping roles to control access to investigations. The dilemma of how far doctors should go in investigating the frailest group like the oldest old with multiple co-morbidities or bed-bound patients from nursing homes with poor quality of life will need to be addressed. A large CVA or sub-dural in this group of patients is probably a fatal event with very little scope for treatment. Is a CT head scan warranted?

Some of the short-comings of this audit, begin with the relatively short period through which this audit was carried out - only a month, in the summer. It is feasible that the winter months which see an increased rate of admission of elderly patients in the UK, may herald even higher volumes of CT scans. Also, the review of patients case-files and CT requests by the researchers introduced an element of subjectivity. We were dependent on what was written down, to form judgments as to the merits of a particular CT scan request. Documentation may have been lacking as to all the clinical details of the case. With regards to population ageing, there is an element of conjecture and supposition associated with this work, as no body of scientific literature or computer modelling can or has predicted the impact of population ageing on health care systems.

Population ageing is a remarkable testament of man-kinds' resolve and endeavour over the past millennia in routing the horsemen of death, pestilence and famine. But it will
also pose a challenge that is likely to provoke debate in both clinical and political settings across the globe. There is urgent need for clinicians to encourage research and discourse about its possible impact on health services. Action is needed sooner rather than later.
References


Personal Information

All questions or correspondence to

Dr Y. Suthahar
Geriatric SPR
London Deanery

dr_sutha@yahoo.co.uk
Fig. 0

© - CM1 7TU/UK