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Original research

The prevalence of cognitive impairment in emergency general surgery[☆]Jonathan Hewitt^{a, *}, Matthew Williams^a, Lyndsay Pearce^b, Amy Black^a, Emily Benson^c, Madelaine Tarrant^c, Mahua Chakrabati^d, Michael J. Stechman^e, Susan J. Moug^f, Kathryn McCarthy^c^a Cardiff University, UK^b North West Surgical Rotation, UK^c North Bristol NHS Trust, UK^d West of Scotland Surgical Rotation, UK^e University Hospital, Cardiff, UK^f University of Glasgow, UK

H I G H L I G H T S

- This is the first use of the Montreal Cognitive Assessment (MoCA) in older acute surgical patients.
- Nearly 85% of this population had impaired cognition.
- This has implications for informed consent in surgical decision making.

A R T I C L E I N F O

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Objectives: Rates of all surgical procedures are increasing at a faster rate than the population is ageing. However, this encouraging statistic, necessitates a robust evidence base. The epidemiological evidence base in acute general surgery in the older person is sparse. This is the first assessment of the prevalence of cognitive impairment measured using the Montreal Cognitive Assessment tool (MoCA) in acute general surgery. **Methods:** In three sites in Wales, England and Scotland comprising rural and urban populations, we studied consecutive patients aged over 65 years. We considered any older person admitted to the acute general surgical unit. We assessed them for baseline demographic data. They each underwent a MoCA assessment. **Results:** We collected data on 245 people, mean age 76.9 years (8.1, standard deviation), 136 (55.5%) were women. Of these 201 completed the MoCA test, mean score of 18.9 and median score 20 (range 0–30). There were 37 (15.1%) MoCA scores in the normal range (≥ 26) and 44 (18%) people were unable to attempt (or complete) the MoCA. Increasing age ($p < 0.01$) but not sex ($p = 0.14$) predicted an abnormal MoCA. Considering only the 44 people who were unable to attempt the MoCA assessment, 11 (25%) were known to have a diagnosis of dementia, 9 (20.5%) were too unwell and the remainder unable to complete the assessment to due pre-existing disability. **Conclusions:** In a representative UK wide population, a high proportion of older people admitted with an acute general surgical problem had cognitive impairment when assessed using the MoCA.

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1. Introduction

Increasing numbers of older people are being referred to secondary care and this trend is also apparent when considering the numbers presenting to acute general surgical services. This increase is due to a combination of factors. Patients are living longer, there is greater active management of chronic medical conditions resulting in more favourable operative morbidity and mortality risk, and

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patient expectation continues to increase. Currently, the number of surgical procedures performed on older patients is outstripping the rate of population increase in the UK [1].

One comorbidity frequently encountered in older patients is cognitive impairment; which may be acute (delirium), chronic (dementia) or a delirium on a background of dementia.

One of the commonest and well validated tools for assessing cognitive function is the Montreal Cognitive assessment (MoCA) [2]. This instrument is particularly well suited to the detection of mild cognitive impairment (MCI) [3]. The MoCA was first characterised in 2005, since then it has become increasingly familiar to clinicians and is now utilised as the cognitive assessment method of choice within the National Health Service. In the UK, the readiness to use the MoCA has been directly driven through the need to identify a suitable alternative to the Mini Mental State Examination (MMSE). This well known and clinically familiar cognitive assessment tool has fallen out of favour due to the enforcement of copyright requirements and the need to purchase a licence for use in a clinical setting [4]. The MoCA is free to use in clinical and educational based settings, although permission needs to be obtained from the MoCA authors for use in a research setting (www.mocatest.org).

The MoCA has been tested and validated against other cognitive assessment methods. It is used in a wide variety of clinical settings predominantly in disease areas where cognitive impairment is most commonly seen e.g. geriatric medicine or neurology or when the MoCA is being tested and validated against other cognitive assessment methods [5,6]. In the surgical setting, there is little awareness of the tests available for the assessment of cognitive impairment. Most surgeons would rely upon the 10 point abbreviated Mental test (AMT), however it is not commonplace for surgeons to factor in cognitive impairment in their surgical decision making [7] unless it is particularly severe or observed in the presence of an advanced directive in which the patient has decided against future surgical intervention. The MoCA has been studied in vascular surgery [7] and neurosurgical settings [8–10]. In vascular surgery it has been used as an outcome measure to assess improvement following carotid endarterectomy and in neurosurgery the MoCA has been assessed in traumatic brain injury [8] and validated in subarachnoid haemorrhage [9,10]. Consequently, it is still a relatively unknown tool for assessing cognitive function in patients presenting with acute general surgical diagnoses.

While the MMSE and the AMT have been studied in the context of general surgery, for example to assess post operative delirium [11,12], to our knowledge the MoCA has not been previously measured in an acute general surgical setting. We aimed to assess the prevalence of cognitive impairment in this setting using the MoCA.

2. Methods

Data were collected in three hospital sites, one each in Wales, England and Scotland over a continuous 2 month period (July–August 2013). Two sites were teaching hospitals and the third a district general hospital, all of which serve a mixture of urban and rural populations. The study was registered according to local guidelines and since it collated information obtained as part of routine clinical care the study was deemed a service evaluation project and as such did not require ethical approval.

We prospectively studied consecutive patients aged over 65 years of age admitted to the acute general surgical admission and assessment units. Patients admitted under the care of acute general surgical services in the UK are varied in their presenting pathology. Most admissions relate to gastrointestinal disturbance e.g. appendicitis, diverticulitis, bowel obstruction or pancreatico-biliary

disease but can include more minor surgical conditions such as abscesses, urinary tract infections or non-specific abdominal pain. Many of these conditions may require surgical intervention in the acute setting. Orthopaedic, urological, neurosurgical or vascular conditions, are referred directly from primary care or emergency departments for assessment and ongoing management to subspecialty teams in most UK hospitals, including our hospital sites. However, patients are occasionally admitted under the general surgical team and are found, after assessment by a senior surgeon or following radiological imaging to have a primary diagnosis that is not consistent with a 'general surgical' problem. We included all patients in this study who met the inclusion criteria regardless of their final diagnosis.

Each of the three hospital sites already used the MoCA as part of routine clinical care, although the MoCA was not routinely used in the acute general surgical setting in any of the sites. Five researchers across the three hospital sites were responsible for collecting the MoCA data. We used the MoCA test in English (Original Version, 7.1). Each researcher read the English instructions available via the [mocatest](http://mocatest.org) website. After obtaining permission to use the MoCA for research purposes, staff recruiting to the study and gathering MoCA data underwent training in the implementation and use of the questionnaire. Following familiarisation with the test, each of them practiced performing a MoCA in a simulated clinical situation supervised by a clinician experienced in using the test before approaching their first patient. The MoCA is not available in Welsh.

The MoCA is a 30 point questionnaire (see Fig. 1, the MoCA assessment). Any score of 26 and above is considered normal. If the MoCA was not attempted the reasons were recorded. We recorded participants age and sex. To characterize comorbidity we collected data on haemoglobin (≤ 129 g/l classified as anaemia), albumin (≤ 35 g/l classified as low) and the number of current medications (grouped into less than or greater than and equal to 5). We did not assess delirium.

All data were collated using a password protected Microsoft Excel spreadsheet, patients were anonymised with all patient identifiable data removed. Data were handled and stored according to local data management guidelines. These data were prospectively collated using the respective hospital electronic patient records, case notes and prescribing charts.

3. Results

Two hundred and forty-five people were studied. Their average age was 76.9 years, standard deviation (sd) 8.1. There were 136 (55.5%) women in the sample. In total 164 (66.9%) of participants failed ($\leq 25/30$) the MoCA, 37 (15.1%) passed and 44 (18%) were unable to complete the MoCA. Scores ranged from 0 to 30, with a mean score of 18.9 and a median score of 20.

Of the two hundred and forty five patients included in the study only 201 completed the MoCA. We found that those who passed the MoCA were younger with an average age of 72.5 years (6.8, sd) compared with 77.4 years (7.8, sd), $p < 0.01$. There were 87 (43.3%) men and 114 (56.7%) women who completed the test. Of the men, 19 of 87 (21.8%) passed and 18 of 114 (15.8%) women passed, which was a similar likelihood of failure ($p = 0.14$).

There were equal proportions of men and women who did not attempt the MoCA test ($n = 44$). These patients were found to be older 78.6 years (9.3, sd) versus 76.5 (8.1, sd), $p < 0.04$. The reasons documented for not completing the MoCA included 11 (25%) who were previously diagnosed with a dementia and 9 (20.5%) were deemed too unwell to complete the test. The full breakdown of the reasons stated for failing to complete the test are given in Table 1. Additionally, one person who completed the test (score = 14) did

MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

NAME : _____
Education : _____ Date of birth : _____
Sex : _____ DATE : _____

| VISUOSPATIAL / EXECUTIVE | | | | | | | POINTS |
|--------------------------|--|--|--|------------------|---------------|----------------------------|-------------------------------------|
| | | Copy cube | Draw CLOCK (Ten past eleven) (3 points) | | | | |
| [] | [] | [] | [] | [] | [] | ___/5 | |
| NAMING | | | | | | | |
| | | | | | | | ___/3 |
| [] | [] | [] | | | | | ___/3 |
| MEMORY | Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes. | FACE | VELVET | CHURCH | DAISY | RED | No points |
| | 1st trial | | | | | | |
| | 2nd trial | | | | | | |
| ATTENTION | Read list of digits (1 digit/ sec.). | Subject has to repeat them in the forward order | | | [] 2 1 8 5 4 | | |
| | | Subject has to repeat them in the backward order | | | [] 7 4 2 | | |
| | Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors | [] FBACMNAAJKLBAFAKDEAAAJAMOF AAB | | | | | ___/1 |
| | Serial 7 subtraction starting at 100 | [] 93 | [] 86 | [] 79 | [] 72 | [] 65 | ___/3 |
| | | 4 or 5 correct subtractions: 3 pts , 2 or 3 correct: 2 pts , 1 correct: 1 pt , 0 correct: 0 pt | | | | | |
| LANGUAGE | Repeat : I only know that John is the one to help today. [] The cat always hid under the couch when dogs were in the room. [] | | | | | | ___/2 |
| | Fluency / Name maximum number of words in one minute that begin with the letter F [] ____ (N ≥ 11 words) | | | | | | ___/1 |
| ABSTRACTION | Similarity between e.g. banana - orange = fruit [] train - bicycle [] watch - ruler | | | | | | ___/2 |
| DELAYED RECALL | Has to recall words WITH NO CUE | FACE [] | VELVET [] | CHURCH [] | DAISY [] | RED [] | Points for UNCUED recall only |
| | Category cue | | | | | | |
| | Multiple choice cue | | | | | | |
| ORIENTATION | [] Date | [] Month | [] Year | [] Day | [] Place | [] City | ___/6 |
| © Z.Nasreddine MD | | www.mocatest.org | | Normal ≥ 26 / 30 | | TOTAL | ___/30 |
| Administered by: _____ | | | | | | Add 1 point if ≤ 12 yr edu | |

Fig. 1. The Montreal Cognitive Assessment Test (MoCA) (with permission) [2].

Table 1
Unable to attempt or complete the MoCA.

| | Number (%) |
|----------------------------------|------------|
| Dementia | 11 (25) |
| Deemed too unwell | 9 (20.5) |
| Too tired | 6 (13.6) |
| Physical impairment (not visual) | 5 (11.4) |
| Refusal | 3 (6.8) |
| Unavailable | 3 (6.8) |
| Visual impairment | 2 (4.5) |
| Asleep | 2 (4.5) |
| Reduced Glasgow Coma Scale (GCS) | 2 (4.5) |
| Unable to finish | 1 (2.3) |
| Total | 44 (100) |

not have English as a first language and one person (score = 17) did not have the correct reading glasses, resulting in a reduced scores.

There were 149 (60.8%) participants who were taking 5 or more medications, 117 (47.8%) who had low albumin and 129 (52.7%) who were anaemic. There were no demonstrable differences between the people who passed and failed the MoCA with each of these outcome measures. Likewise, there was no difference between those who completed the MoCA (regardless of score) and those that did not with respect to polypharmacy, low albumin and anaemia. The complete results are given in [Table 2](#).

4. Discussion

There are two striking features within our study cohort. Firstly, that the prevalence of cognitive impairment detected using the MoCA is high (66.9%) and secondly that the proportion of people who were unable to complete the MoCA is also high (18%). However, this latter group includes a large proportion already known to have a pre-existing diagnosis of dementia. Due to the lack of previous studies assessing the prevalence of cognitive impairment in acute general surgical patients, it is not possible to directly compare our results to other studies.

The high prevalence of cognitive impairment in the older acute general surgical patient has implications for the provision unscheduled general surgical care. These include ensuring that an adequate level of medical and nursing support is available, and that appropriate personnel are trained to deal with and manage confused patients. Patients with cognitive impairment present numerous challenges to health service providers; increased risk of falls, increased post-operative complications, increased length of hospital stay and increased nursing needs [13]. In surgical patients, there is also the consideration of a cognitively impaired patient's ability to comply with a standardised enhanced recovery pathway of care.

Table 2
Characteristics of participants.

| | | Total participants <i>n</i> = 245 (%) | MoCA | | | MoCA completed | | |
|--------------------------------------|---------|---------------------------------------|--------------------------|---------------------------|----------------|----------------|-----------|----------------|
| | | | Passed <i>n</i> = 37 (%) | Failed <i>n</i> = 164 (%) | <i>P</i> value | Yes | No | <i>P</i> value |
| Polypharmacy (≤ 5 medications) | Yes | 149 (60.8) | 22 (59.5) | 103 (62.8) | 0.78 | 125 (83.9) | 24 (16.1) | 0.71 |
| | No | 89 (36.4) | 14 (37.8) | 59 (36) | | 73 (82) | 16 (18) | |
| | Missing | 7 (2.8) | 1 (2.7) | 2 (1.2) | | | | |
| Low albumin (≤ 35 g/l) | Yes | 117 (47.8) | 19 (51.4) | 75 (45.7) | 0.29 | 94 (80.3) | 23 (19.7) | 0.33 |
| | No | 121 (49.4) | 15 (40.5) | 88 (53.7) | | 103 (85.1) | 18 (14.9) | |
| | Missing | 7 (2.8) | 3 (8.1) | 1 (0.6) | | | | |
| Low haemoglobin (< 129 g/l) | Yes | 129 (52.7) | 18 (48.6) | 84 (51.2) | 0.78 | 102 (79.1) | 27 (20.9) | 0.15 |
| | No | 115 (52.7) | 19 (51.4) | 80 (48.8) | | 99 (86.1) | 16 (13.9) | |
| | Missing | 1 (0.4) | 0 | 0 | | | | |

p value calculated using chi testing.

The other major implication in the surgical setting is the ability to obtain, and validity of, informed consent. It is clear from these findings that many older people admitted with acute general surgical disease may lack capacity to make informed decisions. The MoCA is particularly good at detecting mild cognitive impairment [2,14]. Hence, at least some of the abnormal results we obtained represent people with some residual cognitive ability. In the UK, consent is decision specific and some of these individuals will be able to make informed and consistent choices about their surgical management. While consent will still need to be carefully obtained in this patient group, it is still possible that some of these individuals will have MCI and valid consent can still be obtained.

Data were collected in three different sites, in three geographically distinct areas (England, Scotland and Wales). All three sites serve racially and socioeconomically diverse populations. In Wales, the University Hospital of Wales in Cardiff, serves a predominantly urban population. The English and Scottish sites, Frenchay Hospital in North Bristol and Royal Alexandra Hospital in Paisley in Greater Glasgow, both lie on the outskirts of large urban conurbations, close to rural areas. Due to the lack of comparable data, direct comparison with other countries cannot be made, nonetheless, we feel that our data is generalizable.

Unsurprisingly, the people who scored less than 26 in their MoCA assessment were older, as were those who did not attempt to complete the MoCA. Both of these findings can be attributed to the increasing prevalence of cognitive impairment with age. This is further supported by the other markers of comorbidity which we assessed; polypharmacy, hypoalbuminaemia and anaemia. This indicates that the two groups were comparable physiologically.

There is one major limitation which must be highlighted. These results reflect cognitive impairment but do not differentiate between the chronicity of the impairment. A proportion of these people will have an acute delirium associated with their surgical condition. Delirium is caused by a wide spectrum of aetiologies but in this situation the surgical condition, associated sepsis, the interventional insult, analgesia or concurrent medical illness would all be likely causes. We were not able to perform any follow up data collection to assess the number of people who regained baseline cognitive function. Hence it is not possible for us to accurately estimate the proportion of patients in whom this would be the case. Previous estimates of delirium in different surgical populations estimate preoperative cognitive impairment in older people to be between a quarter and a third [15,16], with post operative delirium said to occur in up to 45% of people [16,17]. A recommendation from our study would be that future studies assessing the MoCA are combined with assessments of delirium, such as the Confusion Assessment Method (CAM) score [18]. These simple assessments are becoming more commonly used in practice and form an

important way of differentiating between acute delirium and chronic dementias.

Building from this work, our team plans to repeat this study with the inclusion of the CAM score to assess delirium. The linkage of outcomes, such as comorbidity and death, would be the next step for research in this subject area. Our research team has formed the Older Persons Surgical Collaboration (www.opsoc.eu) to continue to research all aspects of surgery in older people including those with cognitive impairment.

Our results also highlight the need for blind versions of the MoCA to be readily available and in bilingual countries, such as Wales, it is important to have translations to hand. The MoCA has been translated into, and validated in, many different languages [19,20]. These can be readily downloaded from their website (www.mocatest.org). However, in the case of the Welsh language no translation is available. We would therefore recommend that clinicians consider the availability and validity of the MoCA, before adoption into their country if English is not a first (or bilingual) tongue and no translation has been validated.

In conclusion, we present the first estimate of the prevalence of cognitive impairment assessed using the MoCA. Our data do not allow for the assessment of acute delirium and one recommendation would be that futures studies allow for this assessment. We found cognitive impairment to be very common and this has implications for the pre and post operative management of these patients, the services they use and their ability to provide fully informed consent.

Ethical approval

Not applicable, this was a service evaluation.

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Author contribution

JH, MS, SM and KM, conceived and designed the project.

JH, MW and LP analysed the data.

JH wrote the first draft with LP.

JH, LP, MS, SM and KM wrote and critiqued all subsequent drafts.

MW, AB, EB, MT and MC all collected the data.

Conflicts of interest

None.

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