A prospective observational study to investigate the association between abnormal hand movements and delirium in hospitalised older people

RACHEL HOLT1, ELIZABETH ANN TEALE2, GRAHAM PETER MULLEY3, JOHN YOUNG2

1Elderly Care, York Teaching Hospital, NHS Foundation Trust, York, UK
2Academic Unit of Elderly Care and Rehabilitation, Bradford Institute for Health Research, Bradford, West Yorkshire, UK
3University of Leeds, Leeds, UK

Address correspondence to: E. A. Teale. Tel: (+44) 1274383406; Fax: (+44) 1274382766. Email: elizabeth.teale@bthft.nhs.uk

Abstract

Objective: to examine the relationship between carphology (aimlessly picking at bedclothes), floccillation (plucking at the air) and delirium in older patients admitted to specialist elderly care wards.

Design: daily observation for behaviours of carphology and floccillation embedded within a ‘before’ and ‘after’ study.

Setting: three specialist elderly care wards in a general hospital.

Subjects: older people admitted to hospital as emergencies.

Methods: patients recruited into a delirium prevention study were observed daily for delirium using the confusion assessment method (CAM). Occurrences of carphology and/or floccillation were also recorded. Sensitivity, specificity and positive and negative predictive values for carphology/floccillation for the diagnosis of delirium were calculated. Inpatient mortality rates were compared for patients who did, and did not exhibit features of carphology and/or floccillation.

Results: four hundred and thirty-seven patients were recruited into the study. One hundred and ten participants experienced an episode of delirium, 21 exhibited behaviours of carphology and/or floccillation. The sensitivity and specificity of carphology and/or floccillation for the diagnosis of delirium were 14 and 98%, respectively; positive likelihood ratio 6.8. Carphology and floccillation were associated with both hyper- and hypo-active delirium subtypes, and occurred early during incident delirium (67% within 2 days of delirium onset). The inpatient mortality rate in patients with carphology/floccillation was double the rate in patients without the behaviours (23.8 versus 11.2%, Fisher’s exact test \( P = 0.16 \)).

Conclusions: carphology and floccillation are uncommon physical signs, but their presence is highly suggestive of delirium. The behaviours are unrelated to delirium subtype making their presence particularly useful in the diagnosis of hypo-active delirium.

Keywords: delirium, physical examination, diagnosis, older people

Introduction

The actions of apparently aimlessly plucking or picking at clothes or bedding (carphology), and plucking at the air (floccillation) have been associated with the presence of delirium since first described by Hippocrates in 500 BC (Box 1). Carphologia is a Greek word derived from ‘karphoi’ (bits of twig, straw or wool) and ‘lego’ (I gather). ‘Floccus’ is a Latin word meaning ‘tuft of wool or hair’ [1]. ‘Carphology’ therefore describes the action of attempting to pick up small items and floccillation, plucking at the air as if from a woolly cloud.

Delirium is a complex syndrome comprising impairments of cognition, consciousness, perception and behaviour. It has an acute onset and symptoms tend to fluctuate. The diagnosis of delirium is based on a clinical assessment to determine the presence of specific features according to the Diagnostic and Statistical Manual (DSM) [4], or
Box 1 Hippocrates book of prognostics 4 [2]

Respecting the movement of the hands, I have these observations to make: when in acute fevers, pneumonia, phrenitis*, or headache, the hands are waved before the face, hunting through empty space, as if gathering bits of straw, picking the nap from the coverlet, or tearing chaff from the wall—all such symptoms are bad and deadly. *The term ‘phrenitis’ was used from the time of Hippocrates until the nineteenth century when it was replaced by the term delirium [3].

International Classification of Diseases criteria. Although operationalised into several diagnostic tools [5], these have not become commonly used in routine care, and studies have shown that delirium is considerably underdiagnosed [6]. This is potentially deleterious as delirium is a serious condition associated with an increased risk of adverse outcomes including increased mortality, acceleration of cognitive decline [7, 8], reduced functional abilities and increased need for long-term care [9, 10]. In addition, an episode of delirium can be a particularly unpleasant experience for the patient, the family and staff [11]. Improved methods to detect delirium in routine care are required to prompt identification of modifiable factors in individuals in whom an episode of delirium is suspected. Bedside observations of abnormal hand movements associated with delirium may contribute to this process. This is the first study specifically to investigate the association between carphology and/or floccillation and the presence of delirium.

Methods

The study was pre-planned and embedded within a larger ‘before’ and ‘after’ study to investigate the effects of a multi-component intervention designed to reduce delirium incidence in elderly care wards. Methods are described in detail elsewhere [12]. Briefly, consecutive patients with an acute medical illness admitted to one of three specialist elderly care wards in a general hospital between October 2007 and March 2008 (‘before’) and August 2008 and January 2009 (‘after’) were invited to participate. Patients too unwell for assessment (as assessed by clinical staff), unable to communicate (dysphasia, or unable to speak English) or where recruitment could not occur within 24 h of admission were excluded. Informed consent was obtained. If patients lacked capacity to consent, a consultee declaration was obtained. The study was approved by the local Research Ethics Committee. At enrolment, age, gender and cognitive status were recorded. Cognitive status was assessed using the Mini-Mental State Examination (MMSE). A score <24 was used to indicate at least moderate cognitive impairment.

Assessments

Patients enrolled into the study were assessed daily for delirium (including weekends) with the 4-item confusion assessment method (CAM) [13] administered by trained research assistants. The CAM has been shown to be a robust method for the diagnosis of delirium (sensitivity 86% and specificity 93%). [5] The diagnosis of delirium is established if there is evidence of acute onset and fluctuating course of poor concentration and either disorganised thinking or alterations to the conscious level. The clinical features necessary for delirium diagnosis were operationalised using the criteria outlined in the CAM training manual [13]. Specifically, inattention was assessed using a brief, formal assessment (counting backwards from 20 to 1) and a clinical impression gained during the interview. Conscious level was assessed clinically rather than through formal testing. Increased or decreased physical activity were identified clinically and recorded to subclassify each delirium episode as hyper- or hypo-active, or mixed. A delirium positive day was recorded if the CAM was three or four. If there were 1 or 2 days with CAM scores of two between delirium positive days, these were considered part of the same continuous episode of delirium. Researchers were trained by a geriatrician in the detection of carphology and floccillation before the start of data collection, and were blinded to baseline assessments of delirium. The behaviours were said to have occurred on a particular day if they were identified through direct observation by the research staff during daily assessments, through documentation of the behaviours in the medical case notes, or through verbal reports of the behaviours from clinical staff on questioning by the research assistants. Clinical staff received no formal testing in the identification of carphology or floccillation. The inter-rater reliability of research assistant completed CAM assessments was monitored periodically throughout the study.

Owing to the fluctuating course of delirium, we considered carphology or floccillation to have occurred coincident with an episode of delirium if the behaviours were observed on at least one occasion by clinical or research staff in the 3 days before, the day of, or up to 3 days following a delirium positive day.

Analysis

As the data are clustered (episodes of delirium within individuals), individuals and not delirium episodes were used as the unit of analysis. The sensitivity, specificity, positive and negative predictive values and likelihood ratio of carphology and/or floccillation for the diagnosis of delirium were calculated from a $2 \times 2$ contingency table (presence of absence of any CAM-positive delirium episode during the observation period against the presence of observed carphology/floccillation during an episode of CAM-positive delirium). The temporal relationship between carphology/floccillation and onset of incident delirium was presented by calculating the median time from positive delirium assessment to observation of the behaviours (recorded as negative values if they occurred before delirium onset). Inpatient mortality rates were calculated for
patients who did, and did not exhibit features of carphology and/or floccillation, and compared using Fisher’s exact test.

**Results**

Four-hundred and thirty-seven patients were recruited to the delirium prevention research study (248 in the ‘before’ and 189 in the ‘after’ group). These two groups have been pooled for the purposes of this analysis. Fifty-two patients died before discharge from hospital, and nine patients withdrew consent before follow-up. The mean age of the participants was 85.3 years (range 73–104 years). Sixty per cent were female; and the majority (65%) had a baseline MMSE score of <24 (Table 1; baseline characteristics). Sixty-five participants had prevalent delirium at baseline; 21 of these patients developed one or more additional episodes of delirium during their admission. Forty-five participants developed incident delirium during the course of their admission. Thus, 161 episodes of delirium were observed in 110 patients over the combined 12-month study period.

**Relationship between carphology or floccillation and delirium**

Carpology was observed in eleven patients; floccillation in eight and two patients exhibited both behaviours (21 patients in total). In 15 patients, carphology and/or floccillation were associated with an episode of delirium; 6 patients demonstrated carphology and/or floccillation without delirium. Sensitivity and specificity for carphology and/or floccillation for the diagnosis of delirium were 14 and 98%, respectively. Positive predictive value was 71%, negative predictive value, 77%. The likelihood ratios were 6.8 positive and 0.88 negative.

In the majority of cases where carphology or floccillation occurred during incident delirium, the behaviours were seen on the day of, or the day after delirium onset (8/12). In a further two cases of incident delirium, the behaviours were observed on the third day. In cases of prevalent delirium, the behaviours were observed on the day following admission in four out of seven cases, and within 6 days of admission in the remaining three patients. No participants were observed to have carphology or floccillation before the onset of delirium.

**Relationship of carphology and floccillation to delirium subtype**

Of the fifteen patients in whom carphology and/or floccillation were associated with delirium, eight had hyperactive delirium; five had hypo-active or mixed delirium and two patients were neither hyper- nor hypo-active.

**Association between carphology/floccillation and mortality**

Of 54 inpatient deaths, 5 occurred in the 21 patients with carphology or floccillation, 16 in patients with delirium but no carphology/floccillation and 33 in non-delirious patients. The inpatient mortality rate in patients exhibiting carphology/floccillation was double the rate in patients without the behaviours, although the difference did not reach statistical significance (23.8 versus 11.2%, Fisher’s exact test \( P = 0.16 \)).

**Discussion**

The behaviours of carphology and floccillation have long been linked to delirium. This study is the first robustly to investigate this relationship. We have demonstrated that carphology and floccillation are uncommon (12.5% of delirium episodes) but highly specific to the presence of delirium. That is, patients demonstrating these behaviours are very likely to have delirium. A likelihood ratio positive test of 6.8 suggests patients in whom these behaviours are observed are nearly seven times as likely to have, as not to have, delirium. Carphology and floccillation appear to be associated with both the hyper- and hypo-active delirium subtypes. The observed presence of these behaviours is likely to be a particularly useful diagnostic sign for the more easily overlooked hypo-active delirium. Demonstration of the behaviours tends to occur early in the episode of delirium; within the first 48 h of delirium onset in two-thirds of patients developing incident delirium. The very low sensitivity of carphology and floccillation for the detection of delirium makes the absence of the behaviours unreliable as a simple bedside assessment to exclude delirium. This study provides evidence to support the Hippocratic observation that carphology and floccillation are ‘deadly’; the mortality rate in those exhibiting the behaviours was double that of non-delirious patients.

There are some important limitations to the study. The detection of carphology and floccillation was dependent on recognition by the clinical and research staff. As the behaviours tend to be intermittent, there may have been under-reporting. Although we identified a large number of delirium episodes (161), carphology and floccillation were infrequently observed. This means that the effective sample size for analysis was small. Patients recruited to this study underwent repeated assessments resulting in a reduction in between-measurement independence. To reduce the risk of over-estimation of sensitivity and specificity, [14] the patient was used as the unit of analysis. This further reduced the effective sample size.

**Conclusion**

Although carphology and floccillation are relatively uncommon behaviours in older people with delirium, they are easily

<table>
<thead>
<tr>
<th>Table 1. Baseline characteristics of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delirium (n = 110)</td>
</tr>
<tr>
<td>Age (mean, years)</td>
</tr>
<tr>
<td>Sex (F : M) (%)</td>
</tr>
<tr>
<td>MMSE &lt;24 at baseline (%)</td>
</tr>
</tbody>
</table>
recognised by bedside observation. Their presence should prompt further assessment for the presence of delirium and identification of treatable causes. The presence of these signs appears to be unrelated to delirium subtype and may therefore be particularly useful in the improved detection of hypo-active delirium.

Key points

• Carphology and florccillation are uncommon clinical signs.
• The presence of carphology or florccillation is suggestive of both hyper- and hypo-active delirium and should prompt further investigation.
• The absence of these behaviours does not exclude delirium.

Conflicts of interest

None declared.

Funding

This work was supported by a research grant from Research into Ageing.

References


Received 9 January 2014; accepted in revised form 14 May 2014