

Abnormal Level of Arousal as a Predictor of Delirium and Inattention: An Exploratory Study

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Objective: Abnormal level of arousal (LoA) and inattention are key features of delirium. However, the extent to which abnormal LoA alone might predict delirium and inattention is unclear. Here we tested the hypotheses that (1) patients with abnormal LoA have delirium, and (2) abnormal LoA is associated with worse performance on tests of attention. **Methods:** Thirty acute hip fracture patients aged 64–97 years underwent assessments of LoA, delirium status, and attentional functioning in the 24 hours before surgery and at 2–4 and 7–10 days after surgery. The Observational Scale of Level of Arousal (OSLA) and the Richmond Agitation-Sedation Scale (RASS) were used to assess LoA. Sustained attention was measured with the Edinburgh Delirium Test Box. Delirium was assessed with the Confusion Assessment Method and the Delirium Rating Scale-Revised-98. **Results:** Ten patients (33%) were diagnosed with delirium. Abnormal LoA as measured by the OSLA was strongly associated with the presence of delirium. The area under the receiver operating characteristic curve was 0.89 (95% confidence interval: 0.81–0.97), with a sensitivity of 0.87 and a specificity of 0.81. Area under the curve, sensitivity, and specificity for the RASS were 0.81 (95% confidence interval: 0.68–0.94), 0.80, and 0.79, respectively. Abnormal LoA was associated with worse attentional deficits preoperatively and at postoperative days 2–4 ($p < 0.01$). **Conclusion:** These exploratory findings suggest that abnormal LoA is a strong indicator of delirium. Also, abnormal LoA is strongly associated with inattention as measured by an objective cognitive test. These findings suggest that acute-onset abnormal LoA could be used as a trigger for delirium assessment in routine clinical practice. Future work will help to clarify further the interrelationships among abnormal LoA, inattention, and delirium. (Am J Geriatr Psychiatry 2013; 21:1244–1253)

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INTRODUCTION

Delirium is a severe neuropsychiatric disorder characterized by an acute onset and fluctuating course of disturbances in attention, arousal, and other mental functions. It is common in hospitalized elderly patients, particularly in those with acute hip fracture.¹ Delirium is associated with longer hospital stay, persistent cognitive impairment, higher rates of institutionalization, and increased mortality.² Nonetheless, it remains under-detected and understudied³; in particular, there are few studies of the neuropsychological profile of delirium.⁴

One under-researched area of delirium neuropsychology is the nature of, and interrelationships between, the attentional and arousal components of delirium. Studies suggest that abnormal level of arousal (LoA) is often present in delirium.^{5–8} Because inattention itself is required for delirium diagnosis, inattention and abnormal LoA are therefore frequently associated. However, it is currently unclear if inattention is generally present when there is abnormal LoA or if patients with abnormal LoA can exhibit normal attention.

Historically, inattention and altered LoA have been recognized as part of the delirium syndrome. The concept of “clouding of consciousness” was introduced by Greiner⁹ and, although variably defined, generally incorporates cognitive and LoA elements. Lipowski¹⁰ defined delirium as a “transient, global disorder of cognition, consciousness and attention.” *The Diagnostic and Statistical Manual of Mental Disorders (DSM) (Third Edition, Third Edition Revised [DSM-III-R], Fourth Edition Revised [DSM-IV])*¹¹ and *International Classification of Diseases*¹² criteria of delirium are, broadly, aligned with Lipowski’s conceptualization. However, because it was unclear how “consciousness” should be operationalized, DSM-III-R and DSM-IV linked this construct to attentional deficits. Thus, the DSM-IV criteria for delirium require “disturbance of consciousness (i.e. reduced clarity of awareness of the environment) with reduced ability to focus, sustain or shift attention.”¹¹

Attentional deficits are now established as being core to delirium.^{8,13} Three major functions of attention prominent in cognitive accounts of attention¹⁴ are alertness, orientation, and detection. Studies have used a range of neuropsychological tests to examine these deficits in delirious patients (e.g., digit

span and spatial span [attention span, distractibility], vigilance tests [sustained attention], and the Stroop task [selective attention]).^{15–18} Evidence suggests that patients with delirium show impaired performance in multiple different types of attention tasks, although the ability to maintain attention to stimuli over time (i.e., sustained attention) appears to be particularly affected.^{4,13} Thus, the status of attentional deficits in delirium is established in both the phenomenologic and neuropsychological literatures.

Less well studied is altered LoA.^{6,8,19} This construct can also be termed “wakefulness,” “degree of somnolence,” or “sedation” (the latter generally referring to drug-induced states). LoA does not incorporate cognition, unlike terms such as “clouding of consciousness,” “awareness,” or “alertness,” which encompass both cognition and arousal. LoA is assessed distinct from attentional or other cognitive deficits in several established delirium scales, such as the Confusion Assessment Method (CAM),⁷ the Memorial Delirium Assessment Scale,⁵ and the Delirium Index.²⁰ This construct is also reflected in multiple standalone scales, such as the Richmond Agitation Sedation Scale (RASS).²¹

Outside the field of delirium, abnormal LoA is increasingly seen as a crucial marker of illness severity. Studies have consistently found that reduced LoA (even if comatose patients are excluded) is a strong predictor of mortality in hospitalized patients.^{22–24} Because of these findings, level of consciousness as measured by the AVPU scale (A: alert; V: responds to voice; P: responds to pain; U: unresponsive) is now one of six indicators implemented in U.K. hospitals as a National Early Warning Score.²⁵ These important research findings and ensuing major changes in clinical care are directly relevant to delirium research and practice, because abnormal LoA is a component of delirium. Thus, adoption of level of consciousness assessment in standard practice could potentially lead to substantial increases in delirium recognition, if abnormal LoA routinely triggers focused assessment for delirium.

Few studies have assessed LoA as an indicator of delirium. In the original CAM validation study,⁷ “altered level of consciousness” was the most specific of all features tested in relation to reference standard delirium diagnosis, with specificities of 95% and 100% in the two validation cohorts studied (total N = 56). Direct empirical support for LoA as an indicator of delirium was recently provided in

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