

Pediatric Delirium in the Cardiac Intensive Care Unit: Identification and Intervention

Kristen J. Bryant, MSN, RN, CPNP-AC

Delirium is characterized by transient behavioral manifestations of acute brain disturbances. Delirium in the intensive care unit has been well researched and documented in the adult population. Pediatric delirium research has lagged, but recent developments in screening tools have shed light on the prevalence of delirium among children. The overall prevalence of delirium in the pediatric intensive care unit is 25%. A recent study showed a prevalence of 49% in the pediatric cardiac intensive care unit; this higher prevalence may be due to factors related to critical illness and the postoperative environment. This article is intended to increase awareness of delirium in the pediatric cardiac intensive care unit and give nurses the tools to identify it and intervene when necessary. A definition of delirium is provided, and its prevalence, risk factors, and current knowledge are reviewed. Available screening tools and environmental and pharmacological interventions are explored. (*Critical Care Nurse*. 2018;38[4]:e1-e7)

Critically ill patients are more susceptible to delirium than the general hospital population, because they are exposed to numerous risk factors, such as continuous sedation, mechanical ventilation, and greater severity of illness.^{1,2} Historically, delirium in the intensive care unit (ICU) setting has been referred to as “ICU psychosis” or “ICU syndrome.” Delirium in the adult population is well documented and has been studied since the early 1940s.³ With the more recent development and validation of reliable pediatric delirium assessment tools, knowledge of pediatric delirium has evolved. A recent multi-institutional study showed a delirium prevalence in the pediatric ICU (PICU) of 25%.⁴

CE 1.0 hour, CERP A

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:

1. Define 3 forms of delirium that occur in pediatric patients
2. Identify factors that increase the risk for delirium in pediatric cardiac intensive care units and screening tools for recognizing delirium in pediatric patients
3. Discuss 3 strategies for preventing and managing delirium in pediatric patients

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In the pediatric cardiac ICU (PCICU), delirium rates of up to 49% have been reported.⁵ In order to identify and treat pediatric patients afflicted with ICU delirium, it is important to be familiar with the definition of delirium, its risk factors, available screening tools, and possible interventions.

Definition and Background

Broadly, delirium is characterized by transient behavioral manifestations of acute neurologic disturbances. More specifically, the 5th edition of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* identifies 5 main features of delirium:

The best way to manage delirium is to provide the appropriate therapy for the underlying etiology.

(1) disturbance in attention and awareness; (2) the condition developing over

a short period of time and fluctuating in severity throughout the day; (3) additional disturbances in cognition such as memory deficit or disorientation; (4) the disturbances in attention, awareness, and cognition not being explained by a known or developing neurocognitive disorder; and (5) history, physical examination, or laboratory findings showing evidence of the disturbances being a direct physiological consequence of one or more etiologies.¹

The pathophysiology of delirium is not fully understood, but several theories have been put forth to explain the neuropsychiatric disturbances. Possible etiologic factors include brain changes as evidenced by neuroimaging, sepsis-related inflammation, genetics, biomarkers, and neurotransmitters.^{2,6,7} The role of neurotransmitters may best explain the 3 different types of delirium: hyperactive, hypoactive, and mixed. The type of delirium is based on the level of psychomotor activity, which is hypothesized to be altered by levels of the neurotransmitters dopamine, acetylcholine, and γ -aminobutyric acid (GABA).⁷⁻⁹ Dopamine has stimulatory effects,

while acetylcholine and GABA have inhibitory effects.⁸ In hyperactive delirium, patients are thought to have anticholinergic activity, decreased GABA activity, or excessive dopaminergic activity, which results in agitation, restlessness, fast speech, combativeness, and/or refusal to cooperate with medical care.^{1,7,8} In contrast, patients with hypoactive delirium are described as sluggish, apathetic, and/or withdrawn, with slowed speech, possibly because of insufficient dopamine activity or excessive acetylcholine or GABA activity.^{1,7,8} The mixed type of delirium occurs when patients exhibit both hyperactivity and hypoactivity by fluctuating between states.^{1,7,8} Hyperactive symptoms are most alarming to clinicians, while hypoactive delirium can go undetected or be confused with depression.^{7,10} When appropriately evaluated, hypoactive delirium is the most common type found among children, accounting for 46% to 64% of cases of pediatric delirium.^{11,12}

Outcomes

Delirium in adult populations has been shown to increase morbidity and mortality, hospital length of stay (LOS), and health care costs and to lead to worse cognitive and functional outcomes.¹³⁻¹⁵ Similarly, pediatric delirium has been found to increase mortality, LOS, and health care costs.^{10,12,16-18} Specifically, in the adult cardiac ICU, delirium was strongly associated with increased mortality and LOS.¹⁹ Among children in the PCICU, delirium was found to be a statistically significant independent predictor of prolonged LOS. The patients with delirium had a 60% increase in ICU days compared with patients without delirium.⁵

Prevalence

The overall prevalence of delirium in the PICU has been reported to range from 4% to 29%, with a recent multi-institutional study reporting an overall prevalence of 25%.^{4,20} Higher rates have been reported in children under 5 years of age: 56% for those younger than 2 years and 35% for those aged 2 to 5 years.¹¹ The most common diagnoses for the patients in that study were acute respiratory distress (34%) and congenital heart disease (31%).¹¹ In another recent study, the prevalence of delirium in a PCICU was 49%.⁵

Risk Factors

Many risk factors are associated with delirium in the ICU setting, and they can be divided into predisposing

Author

Kristen J. Bryant is a pediatric acute care advanced practice nurse at The Bristol-Myers Squibb Children's Hospital at Robert Wood Johnson University Hospital, New Brunswick, New Jersey.

Corresponding author: Kristen J. Bryant, MSN, RN, CPNP-AC, 1 Robert Wood Johnson Place, Children's Hospital Room 5118, New Brunswick, NJ 08901 (email: kristen.bryant@rwjh.org).

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factors and precipitating factors.⁹ Age and developmental status are predisposing factors. In adults, older age is associated with delirium.¹⁹ However, children younger than 5 years, especially those under 2 years, are more likely to develop delirium than older children.^{4,5,11,12,18} Children with a history of developmental delay were found to be at higher risk for developing delirium during their ICU admission than those without such a history.^{4,11,12} Precipitating factors include frequent nursing care, limited social interactions, immobilization, sleep disturbances, mechanical ventilation, sedation, and factors related to critical illness.⁹ Along with frequent nursing interventions in the ICU such as measuring vital signs, conducting assessments, and administering medications, there are often strict visitation rules and less mobilization of patients compared with other hospital units. Sleep disturbances also occur in association with delirium and can manifest as excessive daytime sleepiness, nighttime agitation, insomnia, or multiple nocturnal awakenings.^{1,7}

Mechanical ventilation and sedation are independent risk factors for delirium; thus, when they are used together, patients are placed at an even higher risk for developing delirium.^{4,12} An international survey revealed that 72% of pediatric intensivists used a combination of opioids and benzodiazepines as a sedation regimen for intubated children.²¹ The use of such drugs has been shown to increase the risk of delirium.^{4,22,23} A study in adults showed that the use of benzodiazepines on admission to the cardiac ICU caused a 3-fold increased risk for developing delirium during their hospitalization.²⁴ When considering factors related to critical illness, the number of risk factors for ICU patients increases dramatically. They include acidosis, anemia, central nervous system pathology, electrolyte disturbances, endocrine derangement, fever, hepatic failure, high severity of illness, hypoperfusion, hypotension, hypothermia, hypoxia/anoxia, intracranial hemorrhage, infection/sepsis, malnutrition, metabolic disturbances, myocardial failure, poisoning, respiratory failure, shock, and trauma.⁹

In adult studies, preoperative, perioperative, and postoperative risk factors such as lower preoperative cerebral oxygenation saturation levels, lower systemic perfusion pressure during cardiopulmonary bypass, longer aortic clamp time, and atrial fibrillation were associated with delirium after cardiac surgery.²⁵⁻²⁷ Specifically for pediatric cardiac patients, cyanotic heart disease and

the complexity of the surgical intervention were independently associated with the development of delirium.⁵ The association between delirium and cardiac surgery can be illustrated by a case in which a patient developed delirium as exhibited by agitation and insomnia after cardiac surgery as an infant, and then again after cardiac surgery as a toddler.¹⁰ The higher prevalence of delirium in the PCICU may be related to numerous factors associated with critical illness and the postoperative environment. For example, suppose a 4-year-old patient undergoes a complex cardiac surgery and experiences complications such as hypoxia, hypotension, acidosis, and myocardial and respiratory failure during the postoperative period. This patient would require mechanical ventilation and, consequently, sedation to prevent self-extubation and to achieve patient-ventilator synchrony. This patient could then experience a dozen risk factors for delirium, including the associated immobilization, frequent need to measure vital signs, and possible sleep disturbances.

Awareness

Insufficient awareness about pediatric delirium among physicians and nurses may contribute to underdiagnosis and undertreatment of delirium in children in the ICU. Lack of delirium screening in PICUs was reported by pediatric intensivists to be as high as 71%.²¹ Among PICU nurses, 38% believed that benzodiazepines were helpful in the treatment of delirium and 11% incorrectly identified the Glasgow Coma Scale as the appropriate screening tool.²⁸ Delirium education was performed on a PCICU, and although nursing knowledge regarding screening techniques significantly improved, nursing knowledge about delirium itself did not significantly improve.²⁹ Because patients in the PCICU have a high prevalence of delirium and numerous risk factors for it, it is imperative that nurses understand the condition in order to use screening tools appropriately and implement interventions.

Screening Tools

Screening tools that have been proven to be valid and reliable for assessing delirium in the PICU include both preschool and pediatric versions of the Confusion Assessment Method for the Intensive Care Unit (ps/pCAM-ICU) and the Cornell Assessment of Pediatric Delirium (CAPD). Other screening tools such as the Pediatric Anesthesia Emergence Delirium (PAED) and Delirium Rating Scale

have not been as effective for everyday use by nurses at the bedside. The PAED was designed for anesthesiologists in the immediate postoperative period and has shown low sensitivity to the hypoactive type of delirium.^{30,32} The Delirium Rating Scale was initially designed for psychiatrists and is labor intensive to administer.³¹

The ps/pCAM-ICU and the CAPD are rapid screening tools that take less than 2 minutes to complete. These instruments use *Diagnostic and Statistical Manual of Mental Disorders* criteria as a reference standard, giving them high sensitivity and high specificity as well as excellent interrater reliability.^{11,30,31,33} Before one can proceed with a delirium assessment with these tools, one must complete an arousal assessment. The ps/pCAM-ICU and

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the CAPD make use of a valid and highly reliable sedation scale called the

Richmond Agitation-Sedation Scale (RASS).^{11,31,33,34} The RASS is used to describe 3 different states of abnormal arousal: +1 through +4 for agitation, -1 through -3 for decreased arousal with retained responsiveness to verbal stimulation, and -4 or -5 for unresponsive to verbal stimulation or comatose.^{11,31,34} One cannot proceed with any delirium screening tool if the patient's RASS score is -4 or -5, because response to verbal stimulation is required for the diagnosis of delirium.^{11,31,33} Other validated instruments, such as the Motor Activity Assessment Scale and the State Behavioral Scale, can also be used to assess arousal before delirium assessment.³¹

The ps/pCAM-ICU instruments were adapted from the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU), the most commonly used delirium tool in adults. The ps/pCAM-ICU tool adaptation included recognition of the vast variations in language and cognitive development among pediatric patients. The psCAM-ICU is a highly valid and reliable tool for the diagnosis of delirium in critically ill children between 6 months and 5 years of age, and is currently being validated in neonates.¹¹ The pCAM-ICU is a highly valid and reliable tool to diagnose delirium in critically ill children older than 5 years of age.³¹ The ps/pCAM-ICU tests 4 features of delirium: (1) acute change or fluctuating course of mental status, (2) inattention, (3) altered level of consciousness, and (4) disorganized thinking. The diagnosis of delirium requires the presence

of features 1 and 2 plus either feature 3 or feature 4.^{11,31} The presence of feature 3 is any RASS score other than 0, or a lack of current alertness and calmness in the patient. The RASS score can also help determine the type of delirium: hypoactive for RASS scores 0 to -3 and hyperactive for RASS scores +1 to +4.¹¹

The initial CAPD was adapted from the PAED to allow for the detection of hypoactive and mixed types of delirium. The revised CAPD better captures a fluctuating course and alterations in cognitive functioning.^{30,33} The revisions also included “anchor points” for those using the tool that describe age-appropriate developmental expectations. Anchor points were developed for newborns, infants (4 weeks, 6 weeks, 8 weeks, and 28 weeks), and toddlers (1 year and 2 years), but the tool can be used for patients up to 21 years of age.^{33,35} The tool asks a total of 8 questions regarding the patient's consciousness, cognition, psychomotor activity, and affect, with scoring of 0 to 4 for each question. A score of 9 or above is considered to indicate a diagnosis of delirium.³³ Unlike the ps/pCAM-ICU, the CAPD is designed to be performed halfway through each nursing shift, ideally a 12-hour shift, after nurses have observed the patient's behavior for several hours.^{31,33} Unlike the ps/pCAM-ICU, which uses the RASS for both prescreening and scoring, the CAPD uses the RASS only for prescreening.

Interventions

After a child is diagnosed with delirium, one must consider the possible causes of the condition. BRAIN MAPS is an acronym designed to help with this important part of managing delirium.⁸ BRAIN stands for Bring oxygen, Remove/Reduce delirium-causing drugs, Atmosphere, Infection/Immobilization/Inflammation, and New organ dysfunction. MAPS stands for Metabolic disturbances, Awake, Pain, and Sedation. If a patient develops delirium related to anemia, decreased cardiac output, or hypoxemia, administering oxygen can help resolve the delirium. Whatever the cause of the delirium (eg, an infection, a renal problem, or a metabolic disturbance like hypoglycemia), the best way to manage it is to provide the appropriate therapy for the underlying etiology.

Environmental interventions can play a key role in the management of delirium, and they address the first “A” in the BRAIN MAPS acronym: atmosphere. Environmental interventions can also be used as preventive measures

for all patients. Frequent and repeated reorientation as well as reassurance on awakening by family members or familiar staff members can decrease agitation and distress.¹⁰ Family involvement, adherence to the patient's routine, providing familiar pictures, music, or objects, and removal of restraints or catheters, when appropriate, can reduce the risk or severity of delirium.⁹ If possible, patients should get out of bed and participate in activities of daily living. Most pediatric hospitals have child life specialists, music therapists, art therapists, and even teachers to help normalize the ICU atmosphere.

Additionally, promoting a normal circadian rhythm is important, and it addresses the second "A" in the BRAIN MAPS acronym: awake. Patients should have a bedtime routine and a set bedtime just as if they were at home. Natural or bright light during the day and dim lighting or darkness at night can help regulate the patient's sleep-wake cycle. Decreasing the noise level at night and minimizing nighttime interventions can also be helpful.⁸ Agents to help promote sleep, like melatonin, may be necessary for patients whose sleep-wake cycles have been significantly altered. However, clinicians must not use diphenhydramine, because it may worsen delirium.³⁶

Pain control is sometimes a forgotten part of delirium management, but it is essential in the ICU setting. The assessment and treatment of pain in children can reduce the risk and severity of delirium.⁸ Age-appropriate pain assessment tools should be used frequently, while considering possible sources of pain or discomfort, including postoperative pain, procedural pain, presence of catheters/tubes, a full bladder/bowel, hunger, thirst, or lack of repositioning.²⁰ It is also important to frequently reassess the need for sedation and to set sedation targets to avoid oversedating and to minimize the use of sedation.⁸ If sedation is needed, dexmedetomidine may be used to help reduce the risk of delirium. Because of its sedative and anxiolytic properties, it can decrease the use of benzodiazepines for patients who receive mechanical ventilation.³⁶ These and other interventions may be useful when certain delirium symptoms or risk factors are present (see Table).

The US Food and Drug Administration has not approved the use of antipsychotics, either typical or atypical, for the treatment of delirium in children or adults. Antipsychotics have side effects that include tachycardia, hypotension, sedation, reduced seizure threshold, and arrhythmias via an increase in QT time.³⁶

Table Environmental and pharmacological interventions for the treatment of delirium

Symptoms/Risk factors	Interventions
Sleep-wake cycle disturbance	Natural or bright lighting during the day Dim lighting or lights off at night Decrease noise level at night Melatonin Antipsychotics
Agitation	Reassurance by family members Assurance of adequate pain management Antipsychotics
Inattention	Family involvement Establishing and adhering to daily routine
Confusion	Frequent and repeated reorientation Use of calendar, clocks, pictures, and toys from home
Frequent nursing care	Cluster nursing interventions
Use of restraints	Removal of restraints One-on-one safety observation
Use of mechanical ventilation	Dexmedetomidine Constant discussion about extubation

However, typical antipsychotics, such as haloperidol, are used frequently in both children and adults with delirium owing to their proven efficacy in treating agitation, perceptual disturbances, sleep-wake cycle abnormalities, and behavioral issues.³⁶ Haloperidol antagonizes dopamine receptors, so it may be effective in hyperactive delirium but not in hypoactive delirium.⁹ The evidence on effective treatment of hypoactive delirium is lacking, but it is hypothesized that it may be better managed with atypical antipsychotics, such as risperidol, olanzapine, quetiapine, and fluphenazine.^{8,9,37,38} These agents have a global effect on several neurotransmitters, which may allow for neurotransmitter equilibrium.⁹ Antipsychotics should be used only for short periods when deemed necessary by the ICU team and/or a child psychiatrist. Also, it is recommended to obtain a baseline electroencephalogram and monitor QT intervals and magnesium and potassium levels while using these medications.³⁶

Implications for Practice

Pediatric cardiac patients have many risk factors for delirium, and the prevalence of this condition in the

PCICU is high. Therefore, PCICU nurses must not only learn about delirium but also learn how to use screening tools accurately and how to intervene appropriately. The core of delirium management is one of the things nurses do best: assess and reassess. Besides parents, nurses at the bedside are more likely than any other caregiver to identify a change in a patient's level of consciousness. Nurses can use either the ps/pCAM-ICU or the CAPD to effectively assess for delirium. The ps/pCAM-ICU is a more rapid assessment and thus can be used at any point of concern for delirium, while the CAPD requires observation of the patient over approximately 4 to 6 hours.^{31,33} After screening, nurses can use the BRAIN MAPS acronym to evaluate the possible cause of delirium in order to intervene appropriately. Nurses should continue to assess and reassess after interventions, because patients may have multiple causes of their delirium. Nurses in the PCICU should also be proactive. They can implement environmental interventions as preventive measures before a patient even develops delirium. Nurses can keep the patient on a schedule, control the noise and lighting, and bundle care. They can also encourage parents to bring in items from home and to be active participants in their child's care. In short, nurses play an integral role in reducing the incidence and severity of delirium in the ICU setting.

Conclusion

Delirium in the pediatric population has been underappreciated. It is imperative that clinicians in every ICU setting be aware of its prevalence and make their environments conducive to identifying and managing the condition. The research that has been performed in adults and more recently in children is enlightening. However, more studies need to be performed in the pediatric cardiac patient population to determine which tools and interventions are most effective in the PCICU. In the meantime, nurses in the PCICU should use the tools and interventions currently available to them to prevent and treat pediatric delirium. **CCN**

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See also

To learn more about delirium, read "Subsyndromal Delirium and Institutionalization Among Patients With Critical Illness" by Brummel et al in the *American Journal of Critical Care*, November 2017;26:447-455. Available at www.ajconline.org.

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