

Children's Factual and Delusional Memories of Intensive Care

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Rationale: Delusional memories are significantly associated with post-traumatic stress in adult patients after intensive care.

Objectives: In this study, we attempted to establish whether this relationship was found in children. We also examined the association between factual memory and distress.

Methods: One hundred two consecutive children, aged between 7 and 17 years, were interviewed about their pediatric intensive care unit (PICU) experience 3 months after discharge from a PICU. Principal measures were the ICU Memory Tool (a checklist of intensive care memories) and an abbreviated version of the Impact of Event Scale (a screen for post-traumatic stress disorder).

Measurements and Main Results: In total, 64 of 102 (63%) children reported at least one factual memory of their admission and 33 of 102 (32%) reported delusional memories, including disturbing hallucinations. Traumatic brain injury was negatively associated with factual memory (odds ratio, 0.23; 95% confidence interval [CI], 0.09–0.58; $P = 0.002$). Longer duration of opiates/benzodiazepines was associated with delusional memory (odds ratio, 4.98; 95% CI, 1.3–20.0; $P = 0.023$). Post-traumatic stress scores were higher in children reporting delusional memories (adjusted difference, 3.0; 95% CI, 0.06–5.9; $P = 0.045$) when illness severity and emergency status were controlled for. Factual memory was not significantly associated with post-traumatic stress.

Conclusions: This study indicates that delusional memories are reported by almost one-third of children and are associated both with the duration of opiates/benzodiazepines and risk of post-traumatic stress. More research is needed on the presence of delusional memories and associated risk factors in children receiving intensive care treatment.

Keywords: post-traumatic stress; hallucinations; memory; opiates; benzodiazepines

Adverse psychological reactions are increasingly being recognized in a significant proportion of both adults and children after treatment in critical care settings (1–3). In particular, symptoms of post-traumatic stress have been noted. To meet the criteria for post-traumatic stress disorder, a person needs to have experienced a traumatic event, usually involving a threat to life or physical integrity, and in addition be displaying three types of symptom: reexperiencing (e.g., flashbacks, intrusive images), avoiding reminders of the traumatic event (e.g., not talking about it), and hyperarousal (e.g., exaggerated startle response or irritability) (4). Although, intuitively, it would be

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

Delusional memories are associated with post-traumatic stress in adult intensive care survivors, but little is known about the prevalence of such memories in children or their association with subsequent psychological problems.

What This Study Adds to the Field

This study indicates that delusional memories are reported by almost one-third of children and are associated both with the duration of administration of benzodiazepines/opiates and subsequent risk of post-traumatic stress.

expected that those patients who remember their time in intensive care would be at risk of higher levels of post-traumatic stress symptoms, this has not turned out to be the case in adults. An association has been found, however, between memory for delusional events at the time of admission (defined as nightmares, hallucinations, dreams, or the sense that someone was trying to harm the patient) and subsequent post-traumatic stress (5). This may explain the apparent anomaly that some patients who remember very little factual information about their intensive care hospitalization continue to be very distressed when reminded of it.

The fact that pediatric intensive care unit (PICU) survivors are at higher risk of post-traumatic stress than other pediatric patients (3) and that the number of invasive procedures in the PICU is associated with distress at follow-up (6) has led to an assumption that traumatic experiences in the PICU cause post-traumatic stress. However, a study of recall for events in 38 children during admission found that only two-thirds remembered anything and the majority of their memories were neutral or positive (7). In summary, there is no information on rates of delusional memory in children in critical care settings. Furthermore, although a number of studies have reported post-traumatic symptoms in children, links with particular types of memory and subsequent distress have not been examined to date.

The aims of this study were as follows: (1) to establish the nature and extent of factual and delusional memories, in a representative sample of children after PICU discharge; (2) to examine the relationships between both types of memory and demographic and medical variables; and (3) to investigate whether there was a significant relationship between the presence of either type of memory and subsequent rate of post-traumatic stress symptoms. It was hypothesized that a significant number of children would report delusional memories and that the presence of delusional memories would be associated with higher rates of post-traumatic stress symptoms. Some of the results of this study have been reported previously in the form of an abstract (8).

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METHODS

Over the course of 18 months, the families of consecutive surviving children older than 7 years were approached, 6 weeks after discharge, to take part in the research project. Children were excluded if the reason for admission was self-harm. Other reasons for exclusion were significant learning difficulties (defined as requiring special educational placement), readmission between admission and contact, discharge on long-term ventilation, palliative care, or address abroad. The setting was a 21-bed ICU in a tertiary children's hospital in an inner city area.

Ethical permission for the study was granted by the hospital's ethics committee. Parents and children were provided with separate, age-appropriate information sheets about the study, and written, informed consent was obtained from the parents of all participating children. Families were given the option to be interviewed at home or in hospital and, when requested, interview dates were changed to fit around existing outpatient appointments.

During the interviews, which were conducted by an experienced clinical psychologist (G.C.), children were asked about the aspects of the PICU admission they were able to recall, using a checklist of factual memories, delusional memories, and memories of feelings provided in the ICU Memory Tool (9); and their responses were audio-taped and transcribed verbatim. They also completed the Children's Revised Impact of Event Scale (10), which measures post-traumatic stress symptomatology.

Demographic and medical data were obtained from the child's medical record. Illness severity was measured using the Pediatric Index of Mortality (11). Social deprivation was measured using the Townsend Deprivation Index, which is derived from U.K. Census data for a given geographical district and relates to four variables: car ownership, employment status, home ownership, and level of accommodation overcrowding (12).

The ICU Memory Tool was developed for use with adult patients after intensive care admission and has good test-retest reliability and internal consistency (9). It has been adapted for use in a number of countries (13–15), but its use with children has not been previously reported. Patients were coded as having factual memory for admission if they recalled any of the factual memory subscale items and were coded as having delusional memory if they recalled any item on the delusional memory subscale.

Post-traumatic stress symptoms were measured using the Children's Revised Impact of Event Scale. This is an eight-item screen for post-traumatic stress symptoms in children aged between 7 and 18 years, with established reliability and validity (10), which has been used with children who have experienced many types of trauma, including war, disaster, and road accidents (16–18). A cutoff score of 17 or greater has been found to classify correctly over 80% of children with a diagnosis of post-traumatic stress disorder (19).

Statistical Analyses

Analyses were performed using the SPSS 14.0 software (SPSS, Inc., Chicago, IL). Data are expressed as medians (range) or numbers (%). Multiple logistic and linear regression analyses were used to examine the associations between (1) presence of factual memory and medical and demographic variables, (2) presence of delusional memory and demographic and medical variables, and (3) associations between memory and post-traumatic stress score, adjusting for confounders. A *P* value of less than 0.05 was taken to indicate statistical significance. Results are reported as comparative odds ratio (OR) or adjusted difference score with a 95% confidence interval (CI).

Additional detail on methods is provided in the online supplement.

RESULTS

Sample Characteristics

All children aged 7 years or over who were discharged between February 1, 2004, and July 31, 2005, were considered for inclusion in the study. The following exclusions were made: readmission (*n* = 29), death (*n* = 33), palliative care (*n* = 4), learning difficulties (*n* = 79), overseas address (*n* = 20), self-harm (*n* = 3), or long-term ventilation (*n* = 4). Of the 132

remaining eligible cases, 102 (77%) agreed to take part, of whom only 3 had previously been admitted to the PICU. The median time to interview was 3 months (range, 1.8–5.7 mo). Sample characteristics are given in Table 1.

Reasons for not taking part, which were provided by the families of 20 of 30 children, were as follows: child too ill (*n* = 9), child reported to remember nothing (*n* = 6), or child unwilling to be interviewed (*n* = 5). The children in non-recruited families were older, and had shorter stays. Otherwise, the two groups were comparable in terms of demographic and medical variables (see Table E1 of the online supplement). In both groups, socioeconomically deprived families were over-represented as compared with the general population. This distribution is consistent with national data for the United Kingdom (20).

Children's Memories

The frequencies of factual memories, memories of feelings, and delusional memories are given in Table 2. Sixty-four children (63%) reported some factual memory of their PICU admission. In 29 cases, this was a single fragmented memory—usually an image of a family member. In the remaining 35 cases, the child reported two or more separate memories or was able to describe particular incidents in some detail. Thirty-eight children (37%) remembered nothing about the admission, even after being supplied with the cued recall list from the ICU Memory Tool.

In total, 33 of 102 children (32%) reported having experienced at least one delusional memory. Two children described positive feelings associated with what they experienced, but in all other cases the delusional memories were experienced as highly disturbing, particularly in relation to their persistence and threatening content (see Table 3 for children's descriptions of their hallucinations). In all but two cases, the delusional memories originated in the PICU. These hallucinations were most frequently visual only (*n* = 16), but two children reported

TABLE 1. SAMPLE CHARACTERISTICS

Characteristics	Frequency, n (%), or median (range)
Demographics	
Age, yr	11 (7–17)
Male sex	59 (58)
Ethnic category (white UK)	58 (57)
Social deprivation*	50 (49)
Medical variables	
Length of stay, d	2 (0–38)
PIM†	4 (0–42)
Mechanically ventilated	93 (91)
Reason for admission	
Respiratory	6 (6)
Neurological	10 (10)
Medical other	22 (22)
Surgical emergency	9 (9)
Traumatic brain injury	38 (37)
Elective surgery	17 (17)
Medication	
Benzodiazepines	86 (84)
Opiates	94 (92)
Thiopentone	4 (4)
Propofol	2 (2)
Paralyzing drugs	42 (43)
Clonidine	12 (12)

Total *n* = 102.

* Defined by proportion in the most deprived quintile, using the Townsend Deprivation Index (12).

† Pediatric Index of Mortality (11).

TABLE 2. CHILDREN'S MEMORIES*

	Frequency, n (%)
Factual memories	
Any factual memory	64 (63)
Faces	21 (21)
Family	48 (47)
Alarms	23 (23)
Voices	21 (21)
Lights	12 (12)
Dark	12 (12)
Clock	5 (5)
Breathing tube	23 (26) [†]
Suctioning	13 (15) [†]
Tube in your nose	27 (28) [‡]
Ward round	32 (31)
Memories of feelings	
Pain	17 (17)
Uncomfortable	17 (17)
Confused	34 (33)
Anxious/frightened	29 (28)
Panic	10 (10)
Delusional memories	
At least one delusional memory	33 (32)
Hallucination	25 (25)
Dream	16 (16)
Nightmare	14 (14)
Feeling that people were trying to hurt you	5 (5)

Total n = 102.

* Defined by responses to subscale items on ICU Memory Tool (9).

[†] Calculated only for n = 87 children who had an endotracheal tube *in situ*.

[‡] Calculated only for n = 96 who had a nasal tube.

auditory hallucinations only; two reported visual and tactile hallucinations; three reported visual and auditory hallucinations; and one reported visual, auditory, and tactile hallucinations. In addition, two children reported a strong sensation that their parents had been replaced by impostors. Eleven children described multiple hallucinations, beginning near the end of their PICU stay and continuing for several days after discharge, interfering with their sleep.

Cronbach α was calculated for the three subscales used from the ICU Memory Tool, to check for internal consistency. Values were 0.94 for factual memories, 0.81 for memories of feelings, and 0.71 for delusional memories.

Data Transformation

A composite measure of length of time on opiates/benzodiazepines (the two most commonly prescribed medications administered on the unit) was calculated for the purposes of examining associations between sedation/analgesia and other variables. These two types of drug were prescribed together in most cases (n = 86/102), although in some cases for slightly different lengths of time. This was a study of patients in a naturalistic setting and the usual practice of this PICU, and most pediatric units (21), is to prescribe benzodiazepines and opiates simultaneously, making it difficult to separate out the effects of individual drugs. The numbers of children prescribed one and not the other in this sample were small (opiates only, n = 8; benzodiazepines only, n = 2).

In addition, for the purposes of the proposed statistical analyses, length of stay and length of sedation were cut respectively at greater than and greater than or equal to 2 days (a median split in both cases to ensure roughly equal numbers in each group) to transform these data, which were not normally distributed, into categorical variables, because we could not make the assumption of a linear relationship with post-traumatic stress or presence of factual or delusional memory.

TABLE 3. EXAMPLES OF CHILDREN'S HALLUCINATIONS

"I was certain that I got here on a yellow train."	
"I was hanging out of the window and someone dropped a van on my head."	
"They put me in a glass box and sealed it."	(girl, aged 17 yr)
"Dad was fighting, people were getting killed."	(boy, aged 15 yr)
"A monster wanted to eat me—to eat me to bits."	(boy, aged 7 yr)
"I thought I was awake—I could see this man in my room. I had to call the bell and shout I don't want to share my room with a man."	
"I could see children at the bottom of my bed; they were laughing at me."	(girl, aged 12 yr)
"A cat bleeding on the ceiling."	
"A woman who looked like my mum but her eyes were different."	(girl, aged 14 yr)
"See-through scorpions—on my feet and on the walls."	(boy, aged 9 yr)
"Rats in cups moving across the wall."	(boy, aged 16 yr)
"(I remember thinking) 'These aren't my hands! This isn't my head!'"	(boy, aged 14 yr)
"I thought my friend's mum was in the secret police."	
"People being hurt, voices saying scary things."	
"A man who looked like my dad, a woman who looked like my mum."	
"All my friends jumping out of the window."	
"Loads of massive spiders—we had to throw stones at them."	
"Men were running after me—I had to run into the sunlight."	
"Hornets, desert beetles, scorpions, bees."	(boy, aged 9 yr)

Associations with Factual Memory

The associations between the demographic and medical variables and the presence of factual memory are presented in Table 4. Children who reported no factual memory were more likely to have sustained a traumatic brain injury, to have been admitted as an emergency admission, and to have been treated with opiates and/or benzodiazepines for more than 48 hours (Table 4).

When these three variables were entered simultaneously into a logistic regression, only traumatic brain injury remained as a significant predictor, reducing the likelihood of a child remembering anything factual about the admission by 77%. There was no independent effect of duration of opiates/benzodiazepines or of emergency admission.

Associations with Delusional Memory

The associations between the demographic and medical variables and the presence of delusional memory are presented in Table 5. Report of delusional memory was significantly associated with two variables: length of stay and duration of opiates/benzodiazepines.

In a logistic regression, children were nearly five times more likely to report a delusional memory if they were receiving opiates and/or benzodiazepines for 2 or more days, as compared with the remainder of the sample, after adjusting for length of stay. Length of stay was not significantly related to the presence of delusional memory, after controlling for duration of opiates/benzodiazepines.

TABLE 4. FACTUAL MEMORY: ASSOCIATIONS WITH DEMOGRAPHIC AND MEDICAL VARIABLES

	Odds Ratio (unadjusted)	95% CI	P Value	Odds Ratio (adjusted)*	95% CI	P Value
Demographic variables						
Child age, yr	1.1	(0.95–1.3)	0.22			
Male sex	1.2	(0.53–2.7)	0.67			
Ethnicity (white UK)	0.45	(0.2–1)	0.06			
Social deprivation† (n = 101)	1.5	(0.66–3.4)	0.34			
Medical variables						
Length of stay > 2 d	0.73	(0.33–1.6)	0.44			
Emergency admission	0.08	(0.01–0.64)	0.017	0.18	(0.02–1.53)	0.12
PIM‡ (n = 100)	0.98	(0.94–1)	0.34			
Traumatic brain injury	0.16	(0.07–0.40)	<0.001	0.23	(0.09–0.58)	0.002
Sepsis	1.1	(0.33–3.5)	0.90			
Opiates/benzodiazepines ≥ 2 d	0.42	(0.18–0.95)	0.038	0.13	(0.20–1.22)	0.49

Total n = 102 unless otherwise indicated. Values in boldface type indicate statistical significance higher than 0.05.

* Adjusted for emergency admission, presence of traumatic brain injury and duration of opiates/benzodiazepines.

† Defined by proportion in the most deprived quintile, using the Townsend Deprivation Index (12).

‡ Pediatric Index of Mortality (11).

Furthermore, although report of delusional memory was highest in children receiving opiates/benzodiazepines for 2 days or more (23/48, 48%), a number of children who had been prescribed these medications for less than 2 days also reported delusional memories (10/54, 19%). All children reporting hallucinations in this study had received opiates, but this finding needs to be interpreted with caution, because there were very few children who were not prescribed opiates (8/102, 8%).

Post-traumatic Stress Symptoms

In all, 96 children completed the Children’s Revised Impact of Event Scale, 3 months after discharge. Six children did not complete the questionnaire for the following reasons: interview discontinued early because of need for child to attend other outpatient appointment (3), child too unwell to complete interview (2), or child requested to stop because of feelings of distress (1). The median (range) score was 9 (0 to 26), with 27 (28%) children scoring above the recognized cutoff for probable post-traumatic stress disorder.

The univariate associations between post-traumatic stress score and demographic and medical variables are given in Table 6. Two variables, namely illness severity and emergency status, were significantly associated with post-traumatic stress score.

Separate linear regression models were examined to assess the strength of the association with post-traumatic stress for (1) factual memory and (2) delusional memory, controlling for the

two confounding variables given above (Table 7). No significant relationship was found between factual memory and post-traumatic stress. In contrast, however, children who reported any delusional memory had significantly higher post-traumatic stress scores than those who did not.

Finally, nonparametric statistics were used to compare the post-traumatic stress scores of children with both types of memory with those of children who reported delusional memory alone. No significant difference was found between groups (median [range], 12 [3–24] for those with both types of memory, vs. 7.5 [0–23], for those with delusional memory only; Mann-Whitney *P* = 0.71).

DISCUSSION

Nearly one in three children in this sample, who were all verbal and cognitively normal, reported delusional memories associated with their PICU admission. Furthermore, the hypothesis that delusional memories would be positively associated with higher rates of post-traumatic stress symptoms was confirmed. However, the suggestion that the coexistence of factual memory might be protective psychologically (5) was not upheld in this sample. It may be that children, as a result of lack of experience, are more disturbed by hallucinatory experiences and therefore less reassured by coexisting factual memories. Alternatively, it might just be that this finding was not replicated in a larger

TABLE 5. DELUSIONAL MEMORY: ASSOCIATIONS WITH DEMOGRAPHIC AND MEDICAL VARIABLES

	Odds Ratio (unadjusted)	95% CI	P Value	Odds Ratio (adjusted)*	95% CI	P Value
Demographic variables						
Child age, yr	1.2	(0.99–1.4)	0.065			
Male sex	1.0	(0.4–2.4)	0.97			
Ethnicity (white UK)	0.80	(0.34–1.9)	0.60			
Social deprivation† (n = 101)	0.79	(0.34–1.8)	0.57			
Medical variables						
Length of stay > 2 d	2.5	(1.1–6)	0.032	0.77	(0.19–3.1)	0.72
Emergency admission	0.85	(0.29–2.6)	0.78			
PIM‡ (n = 100)	0.99	(0.95–1)	0.81			
Traumatic brain injury	1.4	(0.59–3.2)	0.46			
Sepsis	0.81	(0.24–0.28)	0.75			
Opiates/benzodiazepines ≥ 2 d	4.1	(1.7–9.9)	0.002	4.98	(1.3–20.0)	0.023

Total n = 102 unless otherwise indicated.

* Adjusted for length of stay and duration of opiates/benzodiazepines.

† Defined by proportion in the most deprived quintile, using the Townsend Deprivation Index (12).

‡ Pediatric Index of Mortality (11).

TABLE 6. POST-TRAUMATIC STRESS SCORE*: ASSOCIATIONS WITH DEMOGRAPHIC AND MEDICAL VARIABLES

	Regression Coefficient	95% CI	P Value
Demographic variables			
Child age, yr	-0.29	(-0.81-0.24)	0.28
Male sex	-1.7	(-4.7-1.2)	0.25
Ethnic category (white UK)	0.21	(-2.7-3.2)	0.89
Social deprivation† (n = 95)	0.15	(-2.8-3.1)	0.92
Medical variables			
Length of stay > 2 d	-0.52	(-3.5-2.4)	0.73
Emergency admission	6.1	(2.3-10)	0.002
PIM‡ (n = 94)	0.18	(0.02-0.34)	0.028
Opiates/benzodiazepines ≥ 2 d	1.1	(-1.8-4)	0.45
Sepsis	1.4	(-2.8-5.5)	0.51
Traumatic brain injury	1.8	(-1.2-4.8)	0.24

Total n = 96 unless otherwise stated.

* Measured by the Children’s Revised Impact of Event Scale (10).

† Measured by Townsend Deprivation Index (12).

‡ Pediatric Index of Mortality (11)

sample. Overall rates of post-traumatic stress were similar to those found in another study of 19 PICU survivors (3).

A recent review of the prevalence of post-traumatic stress disorder in ICU survivors has recommended that researchers in this area keep exclusion criteria to a minimum in order to determine the scale of this problem for the population as a whole (22). Given that children with traumatic brain injury make up a significant proportion of admissions to the PICU studied, it was decided to include them. The finding that they were as likely as the other children admitted to suffer significant levels of post-traumatic stress, even though their factual memory for admission was poorer, is consistent with research in adults (23). This is an important finding, which calls into question the assumption that children who appear to remember nothing will not be distressed by what has happened to them, because it demonstrates that psychological distress is not simply a function of the degree to which patients remember their PICU hospitalization.

The strength of the association between duration of sedation/analgesia and presence of delusional memory is consistent with the adult literature (15, 24) and with a number of reports of children suffering withdrawal symptoms, such as hallucinations, in association with the types of medication most commonly used in the PICU (e.g., benzodiazepines and opiates) (25–27). The finding that some patients reported delusional memories after being sedated for less than 2 days has also been reported in adults in intensive care (28), and is worthy of further investigation. The variation in sensitivity to medication may reflect genetic differences, such as those recently reported in adults found to be at higher risk of experiencing delirium in intensive care settings (29).

This study has a number of strengths. The sample is believed to be the largest to date, both in terms of self-reported psychological symptoms and of reported memories in children

after PICU admission. The paucity of information on children’s direct experience in this situation is indicative of just how difficult these studies are to undertake. The majority of children admitted to PICU are nonverbal by virtue of their age, and this fact, together with parents’ understandable reticence about overburdening them (30), makes recruitment difficult. It is likely that the flexibility regarding timing and site of interview (31) in this study enhanced the recruitment rate, which was high for a study of this type, and thereby minimized differences between recruited and nonrecruited children, which were minimal. In particular, the sample was representative of the population from which it was drawn with regard to groups often under-represented in research in this area, such as the socially deprived (32) and children with chronic illness (33), increasing the validity of the results. Finally, this study is one of a very small number of studies of children’s experience in this situation to make use of established standardized psychological measures, facilitating replication and comparison with groups of other traumatized children in future research.

A number of limitations, however, should be acknowledged. First, there was no control group. Further research on the prevalence of delusional memories in other groups of hospitalized children is clearly needed. Also, there was no formal assessment of either withdrawal symptoms or delirium, reflecting the lack of validated measures for use with children of this age (21, 34), and, because this study reports only on the experience of children older than 7, the findings may not be applicable to younger children. Furthermore, in the interests of brevity, a screening measure was used to assess post-traumatic stress rather than a full diagnostic interview. Estimates of probable post-traumatic stress disorder should therefore be scaled down accordingly. Finally, given that delusional memory was retrospectively assessed at the same time as post-traumatic stress, causality cannot strictly be inferred. This association needs to be further explored in a prospective study.

Implications for Further Research

There is an urgent need for the development of measures of withdrawal and delirium across the pediatric age range and for further validation of measures of memory and post-traumatic stress symptoms in this population. In addition, more information is needed on the prevalence of the delusional memories reported here both in the community and in other groups of hospitalized children.

The content of the memories described in this study was very similar to that reported by adults after critical care treatment (5, 35, 36). The children’s hallucinations were more like those described by adults with organic delirium than those reported by patients with psychosis, in that they were predominately visual and frequently incorporated cues from the immediate environment. These phenomena cannot be said to constitute definitive evidence of delirium in children, because the interviews did not include assessment of inattention, which is regarded as essential for formal diagnosis of this condition (38). However, they are strongly suggestive of it and indicate that more research is

TABLE 7. POST-TRAUMATIC STRESS SCORE*: ASSOCIATIONS WITH FACTUAL MEMORY AND DELUSIONAL MEMORY

	Regression Coefficient (unadjusted)	95% CI	P Value	Regression Coefficient (adjusted for confounders) †	95% CI	P Value
Factual memory	-0.48	(-3.5-2.5)	0.76	1.3	(-1.7-4.3)	0.39
Delusional memory	3.0	(-0.05-6.1)	0.054	3.0	(0.06-5.9)	0.045

Total n = 96.

* Measured by Children’s Revised Impact of Event Scale (10).

† Confounding variables were illness severity, measured by Pediatric Index of Mortality (11), and emergency status.

required into the assessment of delirium across the age range, given its association with morbidity and mortality (39). A recent study of 40 pediatric cases has queried the applicability of the adult psychiatric diagnostic criteria in delirium in the PICU setting (34). To examine whether the associations between delirium and mortality and morbidity found in adults also apply to children, it will be necessary first to develop a measure of delirium appropriate for use with this population. It may be possible to adapt the Delirium Rating Scale (40), which has been used with children in a psychiatric setting (41), or either the Confusion Assessment Method for the Intensive Care Unit (42) or the Intensive Care Delirium Screening Checklist (43), both of which have been designed specifically for use with adults in critical care settings. However, the diagnosis of this condition in young (and particularly preverbal) children, who make up the majority of admissions to the PICU, will be a particular challenge.

Once a validated measure of delirium is available, it will be possible to determine whether symptoms can be prevented or reduced by manipulating variables that have been shown to affect delirium in adult and which are amenable to experimental manipulation, such as sedation and the ward environment. Promising avenues for future research include the following: changing the type of sedation (44); changing the mode of delivery either by altering rates of weaning (45) or by interrupting sedation, a strategy that has been associated with a reduction in delirium and subsequent post-traumatic stress in adults (46); and altering the child's immediate environment by simplifying physical surroundings, demarcating day and night and providing him or her with regular information designed to reassure and reorientate (47, 48). Further evaluation of sedation regimes in terms of psychological as well as physical aftereffects, in adults and children, is also warranted, given the dearth of research in this area (49).

Implications for Clinical Practice

Delusional memories, and in particular hallucinations, are frightening for patients to endure and upsetting for parents to witness (50). The frequency with which these phenomena were reported in this study suggests that there is a need to educate staff about this aspect of the PICU experience and to provide routine explanation and reassurance to families. Furthermore, because these children are at increased risk of developing post-traumatic stress disorder, by virtue of the circumstances leading up to admission as well as the invasive nature of their treatment, improved psychological monitoring of this group is advisable, so that timely support can be made available, in the interests of optimizing recovery.

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