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Research Article

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Incidence of Delirium in Hospitalized Children with Cancer

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Delirium is defined in the Diagnostic and Statistical Manual of Mental Disorders: Fifth edition (DSM-V) as a "disturbance and change in attention and awareness from baseline that develops over a short period of time, with fluctuating course" [1]. Delirium occurs as a result of factors related to primary illness, the treatment of that illness, and stressful and disorientating environment of the hospital [2]. There are limited data to describe the incidence of delirium in children hospitalized with cancer [3]. Delirium occurs frequently in adults and is an independent predictor of mortality, increased length of stay, and increased risk for long-term cognitive deficits [3]. The prevalence of delirium in hospitalized adults ages 18-56 with cancer ranges from 18%-44% [4]. Most pediatric studies on delirium focus on the critically ill child in the pediatric intensive care unit (PICU). It is estimated that the incidence of delirium in this population is as high as 29% [5].

Delirium is often unrecognized and untreated [6]. A survey performed by Flaigle et al. [6]. Found that 71% of PICU practices do not perform routine delirium screening and only 2% of PICU practices reported daily use of delirium screening tools on every child. A retrospective study performed by Combs et al [3]. Estimated the incidence of unrecognized delirium in a single pediatric oncology unit to be 10%.

Children with cancer are a high-risk population for delirium second to severity of illness, neurotoxicity related to chemotherapy, and frequent administration of benzodiazepines, anticholinergic agents, and opioids [3]. These manifestations place this population of patients at risk for developing delirium making screening for delirium essential part of the daily workflow. Delirium is associated with mortality rates in children ranging from 12-20% [3]. Identifying delirium in children with cancer is imperative so that targeted therapy can be initiated. Early recognition and initiation of targeted therapy have potential to shorten the course of delirium and decrease associated morbidities. Decreasing complications of delirium can improve clinical outcomes and quality of life in this vulnerable population [3].

Literature Search

The pathophysiology of delirium is complex and multifactorial resulting in brain injury and dysfunction [7]. Two biological etiologies connected to delirium are direct brain insults and increase of body stress responses [7]. Direct brain insults include any process that compromises brain function such as "energy deprivation, metabolic abnormalities, infection, trauma, hemorrhage, or use of particular medications" [7]. Medications associated with delirium include anticholinergic, benzodiazpines, and opioids Physiological conditions such as hypoxia, hypoglycemia, hypotension, electrolyte abnormalities, cerebral thrombus or hemorrhage, septic shock and primary CNS pathologies cause impairments in attention and cognition and can damage the brain [7]. Stressors such as surgery, systemic inflammation, and pain increase the activity of the limbic-hypothalamic-pituitary-adrenal axis, which increases cortisol levels [8].The surge in the body's stress responses contributes to potential adverse effects on the body, subsequently leading to delirium [8]. There is a persistent elevated level of cortisols which infiltrates the blood-brain barrier resulting in cognitive decline and impairs feedback regulation [8]. Furthermore, inflammatory markers cross the blood-brain barrier leading to further release of cytokines contributing to further neurological damage and decline [8].

Delirium is closely associated with severity of illness in children [9]. Differential diagnoses that have shown increased risk for delirium can be summarized in the acronym "IWATCHDEATH" [9]. "IWATCHDEATH" is the acronym for: "I: Infection, W: Withdraw, A: Acute metabolic, T: Trauma, C: CNS pathogen, H: Hypoxia, D: Deficiencies, E: Endocrinopathies, A: Acute vascular, T: Toxic drugs, H: Heavy metals" [10]. Utilizing this acronym maybe helpful to for remembering risk factors associated with patients with higher risk for delirium.

There are approximately 18,000 children diagnosed with cancer under the age of 18every year in the United States [11].While most studies focus on the risk factors of delirium in critically ill children in the PICU, children with cancer are often hospitalized for many of the same reasons [11]. Hospitalizations among children with cancer can be divided into four categories: to deliver chemotherapy, to undergo a procedure, to treat an infection, and manage non-infectious toxicity [11]. From data obtained from the Kids Inpatient Data Base, Russell et al [11]. Found that a majority of hospitalizations were for the administration of chemotherapy (38%), followed by treatment for toxicities (21%), infection (15%) and procedures (15%).

Bonner found that the highest rates of delirium among critically ill pediatric patients are those with infectious disease or inflammatory disorders [12]. The incidence of delirium nearly doubled in patients

with the length of stay greater than five days [12]. The belief for the increase in delirium with increased length of stay is that it is related to hospital-based risk factors such as medications, immobility, and sleep deprivation [12]. The average length of hospital stay for children with cancer is 12 days increasing their risk for developing delirium [13]. As discussed above, the 15%admission rate related to infection compounded by length of stay creates increase risk of developing delirium.

Delirium in critically ill children typically develops in the first three days of an admission to a pediatric intensive care admission and lasts between one to 5 days [14]. There are three different types of delirium described in the DSM-5. Hyperactive delirium refers to the individual with a hyperactive level of psychomotor activity combined with mood labiality and agitation [1]. Hypoactive delirium is characterized by sluggish and lethargic activity [1]. Mixed delirium occurs in the patient with normal psychomotor activity even when attention and awareness are disturbed [1]. This patient may also exhibit rapidly fluctuating activity levels. Most cases of diagnosed delirium are roughly evenly distributed between hypoactive (46%) and mixed (45%) [14]. The remaining 8% are demonstrating characteristics of hyperactive delirium [14].

Early symptoms of delirium are often subtle. Symptoms can manifest cognitively, perceptually, and in psychomotor disturbances [9]. Children may exhibit cognitive symptoms as being unable to concentrate or remember what they have just been told or know where they are [9]. Perceptual symptoms often present with visual hallucinations, delusions, irritability, and are frightening [9]. Psychomotor disturbances emerge in the form of being restless, agitated, or unable to be still [9].

The wide range of symptoms with in which delirium presents makes it challenging for the medical team to recognize and diagnose. Delirium is frequently a missed diagnosis in patients with cancer [15]. Cruz et al. reviewed inpatient consults to a palliative care team which were referred for other reasons than delirium. The most common referral for the palliative care consult was pain. Thirty-three percent of referrals were diagnosed with delirium by the palliative care team [15]. Of this delirium diagnosis, 61% were missed by the primary referring team [15]. Hypoactive delirium was the most common subtype (63%) followed by opioid-related (31%) [15].

The true incidence of pediatric delirium is unknown [16]. Smith et al. describe children referred to psychiatric specialists by the medical team during hospitalization were diagnosed with delirium 10% of the time. The prevalence is likely an underestimation and does not represent the patients with symptoms of delirium whom were not referred to the psychiatric evaluation. The incidence of misdiagnosed pediatric delirium occurs or several reasons. One reason for missed diagnosed incidence of delirium is due to the lack of use of screening tools and lack of awareness [16]. Additionally, patients with the hypoactive subtype of delirium often go unnoticed. Hyperactive subtype delirium is often mislabeled and described to agitated, confused, anxious, and irritable [16].

Outcomes of children with critical illness diagnosed with delirium are not well defined [14]. Traube et al. designed a study to describe delirium in critically ill children, associated risk factors, and hospital outcomes. Traube et al. found independent risk factors for the development of delirium to be age less than or equal to 2 years old, higher severity of illness, developmental delay, prior coma, mechanical ventilation, and the receipt of benzodiazepines and anticholinergic medications. Delirium is an independent risk factor for mortality [14]. It is associated with increased duration of mechanical ventilation and increased length of stay [14]. Kiekkas found delirium to be associated with hallucinations, delusions, and dream-like recollections in 20-75% of hospitalized critically ill children [17]. Delirium is a frightening experience for both patient and family. Coville, Kerry, & Pierce found that children who suffered from delirium also experienced post-traumatic stress up to a year or longer post-hospitalization [18].

Pediatric Cerebral Performance Category (PCPC) and Pediatric Overall Performance Category (POCP) are scales that measure a child's morbidity after a child's critical illness [19]. PCPC focuses on cognitive impairment and the POPC focuses on functional morbidity [19]. Children are scored on admission and discharge from the hospital to describe cerebral functional outcomes [19]. Dervan, Gennaro, Ferris, & Watson applied these scales to assess the cognitive function of critically ill pediatric patients diagnosed with delirium during hospitalization [20]. This study diagnosed critically ill children with delirium using the CAPD screening tool [20]. In children with normal cerebral functioning scores, younger children (<4.4 years old), children with co-morbidities, children who had > than 1 PICU admission during hospitalization, post-op status, and increased severity of illness were found to have a higher risk for developing delirium [20]. Children diagnosed with delirium experienced longer hospital stays and decline in cerebral functional status when discharged from the PICU [20].

Theoretical Framework

The theoretical framework chosen for this study is The Theory of Interpersonal Relations (TIR) developed by Peplau [21]. This theoretical framework was developed from the study of human interactions and understanding what transpires during nurse-patient interactions [21]. Peplau describes the nursing profession to contain elements of art and science. Peplau refers to the art of the nursing as caring and attentive focusing on patient advocacy and hands-on practice to improve the well-being of sick people. The science stems from the application of knowledge and understanding of a broad range of human problems and psychological difficulties [21]. These are essential skills for the nurse to possess in an oncology setting. The nurse often acts as a liaison between the patient and complex medical environment. The thoughts of Peplau are relevant in the process of identifying delirium in the oncology setting due to nurses' presence and interaction with patients. The TIR framework is divided into three phases which occur during the development of nurse-patient relationships and its associated challenges [21].These phases include orientation, working, and termination.

The orientation phase is the onset of the patient and nurse relationship. The main focus of this phase is focus on to get to know the patient by listening, hearing what is said, and to asking who, what, were, and when type of questions [21]. During this phase, the pediatric nurse gets to know the patient as a person and obtain information on the health conditions [21]. Observation and insight into the patient cognition, psychomotor activity, and behavior baseline are obtained here.

The working phase is the second phase of TIR. This phase is known for the development of the nurse-patient relationship [21]. In this

phase, the nurse is monitoring the patients' response to current health condition and targeted therapy [21]. The nurse caries out many functions during the working phase such as providing physical care, interpersonal communication, education, and observation of behavior [21]. The patient suffering from delirium is vulnerable. Nurses must use information gained from patient assessment to care in a therapeutic manner, with the purpose to recognize change in condition and to take steps to treat and avoid it. The CAPD screening tool was adapted to include an observational period to better capture hypoactive and fluctuating courses of delirium making this phase relevant for the recognition of delirium.

The final phase is the termination phase [21]. In preparation for termination, discharge planning begins. This is the time for the nurse to reflect on the nurse-patient relationship and closure for work [21]. Relationships are typically short, but in the case of pediatric cancer patients, there can be multiple encounters extending these relationships longer term.

The nurse must utilize each phase of the TIR when building a relationship with patients in order to observe changes in behavior and symptoms of delirium. Using the strategies developed by Peplau, nurses will be able to develop and establish a therapeutic relationship. Recognizing and caring for the delirious patient takes skill and patience. The neurological dysfunction of the delirious patient requires the nurse to have knowledge and expertise to be able to relate to and accurately assess and treat the patient.

Research Questions

What is the incidence of delirium in hospitalized pediatric patients with cancer?
Is there a particular admission diagnosis which carries a greater risk for patient's developing delirium?
Is there an age group is more vulnerable for developing delirium?

Methods

This is an evidenced, practice-based study incorporating a delirium screening tool to identify the incidence of delirium in pediatric patients with cancer. The study was be conducted in a single center pediatric oncology unit. Inclusion criteria included all admissions between the ages of 8 weeks and 21years of age with childhood cancer. Eight weeks was chosen as the cut-off age due to the established development anchor points (see Appendix B). Exclusion criteria include children without childhood cancer on unit and less than 8 weeks of age. Children status post bone marrow will be excluded post-transplant. Traube et al. [22]. Found the applicability of the CAP-D to be essential for identifying delirium in children less than 2 years of age. The 2014 study, Traube et al. found 31% of children less than 2 years old and 27% of children with significant developmental delay to score positive for delirium. Simone et al. [23]. Found the prevalence of pediatric delirium to be 17% in a single pediatric intensive care unit. Of the pediatric patients diagnosed with delirium, 46% were under the age of 12 months and 59% had development delay at baseline.

This researcher anticipated a sample size of 100 patients within a 5-month period of time based on average number of children admitted to study site monthly. Data in the literature is limited in providing adequate sample size guidelines. The study will enroll the first 100 consecutive admissions of children with cancer. Patients admitted more than once during the study timeframe will be included. A request to waive consent was obtained through IRB application. This study meets regulations US Department of Human and Health Services, 45 CFR 46.116(d) regulations protecting human rights [24]. There is minimal risk to the subject, subjects' rights and welfare will not be adversely affected by the waiver, and if appropriate, subjects are provided with additional pertinent information after their participation. The information gathered during this study will not be disclosed to anyone outside the research and identifiers will be destroyed at earliest opportunity complying with the Policy Rule section 164.512(i) [25]. Demographics to be collected include age, sex, primary diagnosis, admitting diagnosis, and surgical procedure requiring sedation. The Cornell Assessment of Pediatric Delirium (CAP-D) screening tool (Appendix A) will be used to detect delirium in pediatric cancer patients. Permission to use the CAP-D screening tool has been obtained. Delirium variables to be measured include CAP-D scores, onset of delirium, hospital day onset of delirium onset, duration of delirium, reoccurrence of delirium, and length of hospital admission. Delirium is diagnosed when the CAP-D score is 9 or greater.

The CAP-D is a validated and rapid observational tool that allows for early identification of delirium in hospitalized children from ages 0 to 21 years [22]. The CAP-D screening tool was developed by Traube et al., [22]. The CAP-D is adapted from the Post Anesthesia Emergence Delirium (PAED) screening tool used to detect emergence delirium after the administration of anesthesia [22]. The PAED design only captured those patients who experienced hyperactive delirium in the post anesthesia care unit [22]. The PAED was adapted by Traube and colleagues by adding additional elements to improve detection of delirium in hypoactive and mixed types. After the initial pilot study, the screening tool underwent revision that included screening each patient after a minimum of 4 hours of bedside nursing observation [22]. Orientation, arousal, and appropriate cognition are difficult to assess in young children and especially difficult to assess in infant [22]. The CAP-D was further adapted to include development anchor points that characterize infants' observable behavior in a hospital setting versus the infants' natural environment. Anchor points were established from classic texts and established child development scales.

The application of the CAP-D was compared against the "gold standard, DSMV-IV". After informed consent was obtained. Traube and colleagues, paired double blind assessments were performed. The bedside nurse independently completed the CAP-D checklist while the psychiatrist conducted a diagnostic interview and examination [22]. When the assessments were complete, CAP-D screening results were compared with the psychiatrist assessment and the interra later agreement was computed [22]. Analysis results demonstrated a sensitivity and specificity of 92% in children without significant delay [22]. In children with developmental delay, the CAP-D continued to demonstrate high sensitivity (96.2%) but a loss of specificity due to difficulty of assessment (51.2%) [22]. The CAP-D performed equally across all age groups from 0-13 years old [22]. The sensitivity was lower (50%) and increased in specificity (98.1%) in adolescent's ages 13 to 2 [22]. A score of nine or greater was noted to successfully detect delirium despite symptoms of sedation, agitation, pain, and anxiety. Patients, who were found to have a false positive screening, were diagnosed with delirium later in their course of treatment suggesting that the screen can begin to identify early onset [22].

Numerous studies have demonstrated the validity and benefit of bedside screening tools in early detection of delirium [26]. Screening tools should be integrated into nursing workflow in order to be successful [26]. Nurses have multiple patient care responsibilities and tasks to complete each shift. Hendrich, Chow, Skierczynski, & Lu found that nurses spend 35% of their time documenting, 17% distributing medication, 21% patient care, 19% care coordination, and engaged in patient assessment only 7% [27]. The CAP-D screening tool requires minimal training and can be completed in as little as two minutes [22]. Nurses will be asked to complete the survey at 0200 and 1400 daily. Traube et al. [22]. Found there to be good inter rater reliability when comparing results of CAP-D score between nurses and the "gold standard". The overall Cronbach's alpha of 0.9 was noted.

Procedure

Then IRB approval will first be obtained at the institution where data collection will occur. Then this researcher will submit the study to the university's Institutional Review Board for approval. Admission logs will be reviewed daily for eligible participants. The study included the first consecutive 100 participants. Participants were assigned a subject number by the researcher in ascending order and by date of data collection. Assigned number will correlate with medical record number which will be kept separate. Data will be kept in password-protected files by the researcher. The CPA-D has been validated across the pediatric age range and can successfully discriminate between delirium and other mental status changes. A patient with elevated CAP-D scores nine or greater will be reported to medical team and managed accordingly.

The unit nursing staff will receive education for CAP-D scoring prior to data collection. The education format will be power point, sample CAP-D paper forms (see Appendix A & B), and case studies. The power point will define delirium, explain the importance of recognition, and indicate how to recognize and apply the CAP-D.To ensure adequate education for all bedside nurses, education will be presented using same format in two different venues. These settings include staff meeting and at the bedside. During the staff meeting, the power point was be reviewed. Bedside nurses participated in hands-on CAP-D scoring, based on pediatric delirium scenarios. To establish nursing inter rater reliability, nursing staff was presented with scenarios to score. Nursing staff was than provided with the CAP-D scoring tool and separate answer form to score each scenario. Answer forms were collected after each of the scenarios. Scenarios will then be reviewed and scored. Education using delirium scenarios will continue until an inter rater reliability score of 0.90 is obtained. The current staff meeting attendance is approximately 30%. To ensure adequate education is provided to all bedside nurses, education sessions will be conducted during both shifts two weeks prior to start of study by this researcher. This researcher will meet with nurses at the bedside, review power point, case studies, and score scenarios prior to data collection as performed during staff meeting. Educational scenarios will be presented randomly to25% of the bedside nurses monthly throughout the study period at the bedside to reinforce scoring familiarity and maintain inter rater reliability of 0.90. This researcher will be available on site for questions and clarification use of CAP-D scoring tool during screening.

Appendix A

Figure 1: Cornell Assessment of Pediatric Delirium (CAPO) revised

RASS Score ____ (if -4 or -5 do not proceed) **Please answer the following questions based on you r Interactions with the patient over the course of your shift:**						
	Never 4	**Rarely 3**	**Sometimes 2**	**Often 1**	**Always 0**	**Score**
1.Does the child make eye contact with the caregiver?						
2. Are the child's actions purposeful?						
3.ls the child aware of his/her surroundings?						
4.Does the child communicate needs and wants?						
	Never 4	Rarely 3	Sometimes 2	Often 1	Always 0	
5.Is tbe child restless?						
6.Is the child inconsolable?						
7.Is the child underactlve-very little moven1ent while awake?						
8.Does it take the child a long time to respond to interactions?						

Appendix B

Selected Cornell Assessment of Pediatric Delirium Developmental Anchor Points and Diagnostic and Statistical Manual IV Delirium Domain Correlates

Cornell Assessment of Pediatric Delirium Item	Diagnostic and Statistical Manual Delirium Domains	Age (8 wk)	Age (1yr)
1. Does the child make eye contact with the caregiver?	Consciousness	Follows moving object past midline, regards hand holding object, focused attention	Holds gaze. Prefers primary parent. Looks at speaker
2. Are the child's actions purposeful?	Cognition	Symmetric movements, will passively grasp handed object	Reaches and manipulates objects, tries to change position, if mobile may try to get up
3. Is the child aware of his/her surroundings?	Consciousness Orientation	Facial brightening or smile in response to nodding head, frown to bell, coos	Prefers primary parent, upset when separated from preferred caregivers. Comforted by familiar objects (i.e., blanket or stuffed animal)
4. Does the child communicate needs and wants?	Consciousness Psychomotor activity	Cries when hungry or uncomfortable	Uses single words or signs
5. Is the child restless?	Cognition Psychomotor activity Affect/distress	No sustained awake alert state	No sustained calm state
6. Is the child inconsolable?	Orientation Cognition Affect/distress	Not soothed by usual comforting actions, for example, rocking and singing	Not soothed by usual comforting actions, for example, singing, holding, talking, and reading
7. Is the child underactive—very little movement while awake?	Orientation Affect/distress	Little if any purposive grasping, control of head and arm movements, such as pushing things that are noxious away	Little if any play, efforts to sit up, pull up, and if mobile crawl or walk around
8. Does it take the child a long time to respond to interactions?	Consciousness Psychomotor activity	Not cooing, smiling, or focusing gaze in response to interactions	Not following simple directions. If verbal, not engaging in simple dialogue with words or jargon

Scores of CAP-D will be evaluated after 4 to 8 hours of observation daily by the bedside nurse. CAP-D scores greater than or equal to nine will are a positive screen for delirium. The medical team was notified of all positive screening. Data collection will began on the day of admission. The hospital day from admission in which delirium was identified will be recorded along with frequency and reoccurrence. Collection of data will cease on day of discharge. The purpose for collecting data throughout the patient's entire admission is to capture fluctuating course, duration of course, and episodes of reoccurrence.

Numeric data was entered into IBM SPSS Statistical version 23 for data analysis. Descriptive statistics will be used to describe the sample age, sex, primary diagnosis, admitting diagnosis, procedure type, hospital day from admission delirium occurred, and length of stay in percentage and frequency. Frequency was be used to evaluate admitting diagnosis type with positive CAP-D score to assess if there is an admission diagnosis with higher risk of developing delirium.

Results

Ninety-four consecutive admissions, comprising 43individual patients, were included. These patients ranged in age from six months to 17.5 years, mean age of 6 years (SD=4.7 years) 52.7% (n=49) of the admissions were female and 47.3% (n=44) of the admissions were male. Of these 43 patients, there were 51 readmissions during the study period. Primary oncologic diagnosis was varied with a high percentage of admissions with acute lymphoblastic leukemia (35.1%, n=33), neuroblastoma (26.6%, n=25), and sarcomas (11.7%, n=14) see Table 1.

Table: 1 Description of primary diagnosis by frequency and percentage

Primary diagnosis	Frequency (n)	Percent (%)
Neuroblastoma	25	26.6
B-cell ALL	7	7.4
Ewings Sarcoma	7	7.4
Acute Lymphoblastic Leukemia	33	35.1
Langerhns Cell Histiocytosis	2	2.1
Hodgkin Lymphoma	2	2.1
Pleuroblastoma	2	2.1
Pilocytic Astrocytoma	1	1.1
Osteosarcoma	7	7.4
Burketts Leukemia	2	2.1
Rhabdomyosarcoma	4	4.3
Wilms Tumor	1	1.1
Hepatoblastoma	1	1.1
Totals	94	100

Of the 94 admissions, the most common reason for hospitalization was chemotherapy (51%, n=48), followed by fever and neutropenia (26.6%, n=25), and new cancer diagnosis (13.8%, n=13) that are

listed on Table 1. Description of admitting diagnosis is found on Table 2. Mean hospital length of stay was 6.14(SD = 8.74) days with a range of one to 69 days. Five hundred eighty-one patient days were included in analysis.

Table: 2 Description of admitting diagnosis by frequency and percentage

Admitting diagnosis	Frequency (n)	Percent (%)
Primary	13	13.8
Chemotherapy	48	51.1
Febrile Neutropenia	25	26.6
Dehydration	3	3.2
Establish Care	1	1.1
Shingles	1	1.1
Surgery	3	3.2
Totals	94	100

The nurses on the oncology ward were educated on screening for delirium and achieved greater than 0.9 inter-rater reliability prior to the beginning of the study. The unit nursing staff received education for CAP-D scoring by power point, sample CAP-D paper forms, and case studies. A random sample of 25% (n=20) oncology ward nurses were asked to complete additional scenarios. Scenarios were conducted monthly throughout the study. Re-education was provided for 10% (n=2) of this sample to maintain 0.9 inter-rater reliability.

The incidence of delirium was found to be 11.7% (n=11) of admissions in hospitalized children with cancer. Delirium was diagnosed in 11 children and found to recur in 27.2% admissions (n=3). Patients with a primary cancer diagnosis (Table 1) of acute lymphoblastic leukemia (27.2%, n=3) and neuroblastoma (27.2%, n=3) are more likely to be diagnosed with delirium (Table 3). Children with an admitting diagnosis with new cancer diagnosis (45.4%, n=5) and chemotherapy (36. 4%, n=4) were more likely to develop delirium (Table 4). Children between the ages of 1 to 3 (54.55%, n=6) and 3-6 (36.3%, n=4) years pose the highest risk for developing delirium. Developmental delay was not associated with delirium in this sample. During the 581 patient days studied, delirium was present on day two (16.7%, n = 2) with highest incidence on days 3 (25%, n=3), 4(25%, n=3) and 6(25%, n=3).

Table 3: Frequency of delirium associated with primary cancer diagnosis

Primary cancer diagnosis	No (n)	Yes (n)	Percent (%)
Neuroblastoma	22	3	27.27
B-cell ALL	6	1	9.09
Ewings Sarcoma	7	0	0
Acute Lymphoblastic Leukemia	30	3	27.27
Langerhns Cell Histiocytosis	1	1	9.09
Hodgkin Lymphoma	1	1	9.09
Pleuroblastoma	1	1	9.09
Pilocytic Astrocytoma	1	0	0
Osteosarcoma	7	0	0
Burketts Leukemia	2	0	0
Rhabdomyosarcoma	3	1	9.09
Hepatoblastoma	1	0	0
Totals	82	11	99.99

Table: 4 Percentage of delirium associated with admitting diagnosis

Admitting diagnosis	No (n)	Yes (n)	Percent (%)
Primary	8	5	45.45
Chemotherapy	44	4	36.35
Febrile Neutropenia	24	1	9.1
Dehydration	3	0	0
Establish Care	1	0	0
Shingles	1	0	0
Surgery	4	1	9.1
Totals	85	11	100

Eighteen percent of CAP-D scores were missing during this study period impacting the incidence of delirium in hospitalized children with cancer. Missing data entry can be attributed to the unaccustomed task in nursing workflow, nurses floating in from another unit without knowledge of CAP-D, and the on focus high acuity of patient care.

Discussion

Delirium is an understudied concept in hospitalized children with cancer. In this single center pediatric oncology unit, delirium affected 11.7% (n=11) of hospitalized children with cancer. These findings demonstrate the incidence of delirium to be higher than the estimated retrospective evaluation for delirium by chart review of 10%. Yet, the incidence is lower than the findings of Traube et al. [14]. Of 18.8% in their cohort of children with cancer. Perhaps, this difference can be attributed to the smaller sample size of this cohort and greater than 50% readmission rate than Traube et al. experienced [14].

Delirium was found to have a higher incidence in children aged 1 to 3. Children from 1 to 6 years of age had the highest admission rates for neuroblastoma and chemotherapy. Delirium is complicated by developmental variability. The cause of delirium is multifactorial and associated with many risk factors including age, severity and type of presenting illness, and iatrogenic factors [28]. Children with neuroblastoma are pre-disposed for developing delirium based on their severity of illness at admission, underlying malignancy, and sympathetic overdrive [22]. Drug toxicity in the setting of medical therapy is a frequent cause of delirium [29]. Chemotherapy along with many commonly used drugs such as opioids, benzodiazepines, steroids, tricyclic antidepressants, and monoamine oxide inhibitors to manage cancer patients increase risk of delirium [29].

Education was provided in prevention, recognition, and interventions. Providers were made aware of positive delirium scores. Therefore, it is possible that the incidence of delirium is less thanTraube et al. [14] Pound in this oncology unit. Additionally, the incidence of delirium may be lower due to the high frequency of readmission and hospital course familiarity. This study is limited by the patient small sample size.

Impact on Clinical Practice

Delirium is present in hospitalized children with cancer. Universal

screening and recognition of delirium has important implication in this high-risk population. Nurses are in the best position to identify these patients. By recognizing patients who develop delirium, targeted therapies can be initiated early [14].These therapies can decrease the duration of the disease and adverse events resulting in improvement of patients' outcomes and quality of life [14].

Further investigation and studies are necessary to understand the pathophysiology of delirium and its short and long-term effects on the developing child. Future multi-institutional prospective studies are warranted to identify risk factors, assess treatment, and prevention strategies. Longitudinal studies are necessary to investigate the long-term effects delirium has on survivors of childhood cancer. Identifying strategies to prevent and shorten duration of delirium can improve patient outcomes and quality of life while preventing adverse events [30-32].

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