Correlation Between the Richmond Agitation Sedation Scale and Neelon Champagne Confusion Scale in Critical Care Units in an Indian Suburban Tertiary Care Hospital

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Abstract— Psychological distress associated with delirium is condition commonly reported in intensive care unit patients, characterized by various environmental, medical and medication related factors. Delirium usually presents as a group of symptoms with an acute onset and a fluctuating course which have been categorized into cognitive and behavioural groups. This is a prospective observational cohort study conducted at Gleneagles Aware Global Hospitals, L.B Nagar, Hyderabad. for a study period of six months. 200 patients admitted with the hospitalization history of more than 24 hours in critical care units were enrolled as study population. Patient data collection form, contains the socio-demographic details of the patients and Observational study Informed Consent form was prepared for patients understanding for agreeing to participate in the study. The correlation and delirium assessment were done using Richmond Agitation Sedation Scale (RASS) Worksheet and Neelon Champagne Confusion Scale (NEECHAM). In this study, it is concluded that the majority of the delirious patients were assessed to be mild to moderate sedated (96.1%), followed by agitated to irritated (100%) when correlated with P-value <0.0001 (clinically significant). Out of 200 study population, only 126 patients passed the NEECHAM screening criteria. According to NEECHAM scoring, majority were assessed to be moderately confused 95.4% (16-20), followed by severe confusion 100% (11-15) when correlated with delirium (P-value <0.0001), indicating ICU patients are at risk of developing delirium (temporary) within the ICU during the course of hospitalization, which resolves with relevant patient orientated management. From the ρ-value –0.7003, there is a significant negative correlation between NEECHAM score and RASS score. When ρ is -1, the relationship is said to be perfectly negatively correlated. This negative correlation signifies that as the NEECHAM score decreases, the RASS increase (and vice versa), indicating two different criteria of assessment for the same perceptions of delirium developing in the ICUs are possible.

Keywords— Correlation, delirium, ICUS, prospective, observational, evidence-based study, CAM-ICU, NEECHAM, intensive care unit, critical care, terminal care

I. INTRODUCTION

The intensive care unit (ICU) syndrome is a range of psychological reactions leading to organic brain dysfunction, including fear, anxiety, depression, hallucinations, fluctuating levels of consciousness and delirium. ICU syndrome could be a temporary disorder in which the patient experiences a cluster of significant psychological symptoms, which can be within the sort of reversible mental illness, delirium or acute brain failure [1]. Delirium is majorly associated with anticholinergic activity that is drugs of different classes, including the tricyclic antidepressants and high-dose anti-epileptics constitute to higher-risk. A majority of drugs such as benzodiazepines, sedatives, Dopaminergic agents, Antiepileptic, Histamine H2 receptor antagonists, Digitalis and Analgesics are reported to be less frequently associated and constitute a moderate risk [2]. A better exploration is required in the aspects of mechanism & factors that affect the sleep deprivation and delirium, which can be implemented in the development of new methods for preventing and control of aggravating outcomes in the critically ill patients [4].

Epidemiology

The medical practitioner ought to take into account delirium, or acute central nervous system pathology, as the brain's type of "organ pathology." Delirium is very common in ICU patients because of factors like comorbidity, critical ill health, and iatrogenesis. This complication of hospital stay is very risky in older persons and has associated with prolonged hospital stays, institutionalization, and death. In summary, an intensive care unit psychopathy doesn't develop in all patients. Instead, several patients are in danger of hypoactive, hyperactive, or mixed hypoactive and hyperactive delirium [3].

Etiology

1. Sensory deprivation – The sensory impairment will be observed when a patient is kept isolated in a closed room with no windows.
2. Sleep deprivation – The continuous noises and disturbance with hospital staff round the clock to check vital signs, give medications may cause inadequate sleep to the patient.
3. Stress – In most scenarios ICU patients will be in a condition of no hope on life.
4. Continuous lights – Continuous disturbance of normal biorhythms with lights switched on round the clock in the ICU, i.e., no reference to day or night.
5. Lack of orientation – Patient's loss of knowledge about time and date
6. Uncontrollable pain in the ICU experienced by the patients.
7. Critical illness – The severity of illness, pathophysiology of disease or traumatic incident, the amount of stress a patient experiences during an illness/disease can cause a wide variety of psychological symptoms (Figure 1).
8. Infection-related fever and toxins in the body.
9. Metabolic disturbances – electrolyte imbalances – specially altered serum sodium levels, elevated metabolic enzymes and hypoxia.
10. Heart failure (inadequate cardiac output).
11. Drug reaction or side effects – Various new medications typically administered to the patient's in the hospital or ICU.
12. Dehydration.
13. Post-operative outcomes.
14. Glucose deficiency in the body.
15. Alcohol withdrawal delirium – delirium tremens.
16. Structural problems in the brain.
17. Severe vitamin deficiencies.
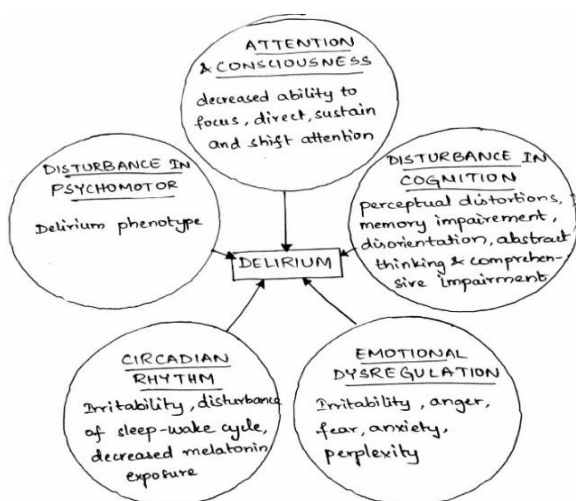18. Liver, kidney or thyroid failure [2].

Figure 1: Brief diagrammatic representation of factors or consequences inducing delirium

Pathophysiology:

Many hypotheses are describing the pathophysiology of delirium [5]. One among them postulates that the use of anticholinergic medications is associated with increased risk of delirious symptoms [6] and those patients with delirium have higher serum anticholinergic activity compared with those without delirium [7]. This hypothesis is mostly applicable to organophosphate poisoning patients receiving anticholinergic medications. As acetylcholine down-regulates the inflammation, there will be an imbalance between inflammatory and anti-inflammatory mediators in delirium condition which ultimately results in increased levels of inflammatory mediators and blunted anti- inflammatory response [8]. In a recent study of ICU patients, research was carried out on the role of inflammation and its consequential deranged coagulation. According to this study, five markers of inflammation and four markers of coagulation were measured in the plasma of the patients. On regulating the potential cofactors, along with the seriousness of the illness, higher plasma concentrations of inflammatory marker – soluble tumor necrosis factor receptor-1 and lower plasma concentrations of the coagulation marker – protein C were associated with the increased risk of delirium. However, it was also found that lower plasma concentrations of matrix metalloproteinase-9 are also involved in an increased risk of delirium [9] (Figure 2)
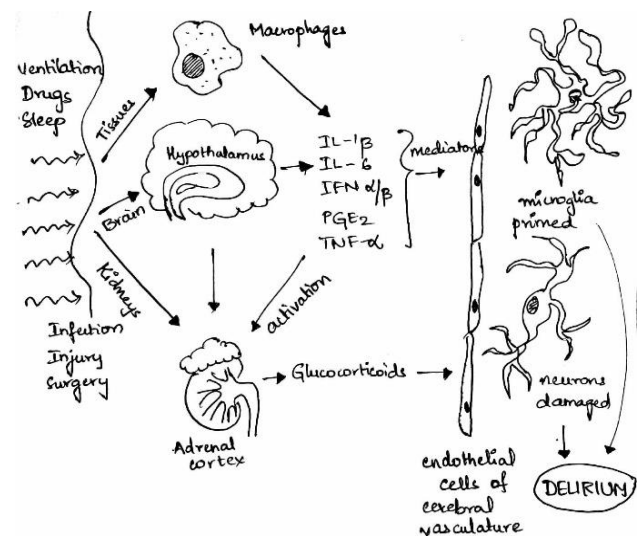

Figure 2: Brief diagrammatic representation of delirium pathophysiology

Clinical manifestations

Delirium usually presents as a group of symptoms with an acute onset and a fluctuating course. These symptoms have been categorized into cognitive and behavioral groups. Cognitive symptoms include disorientation, inability to assist attention, diminished visuospatial ability, altered level of consciousness and impaired short-time memory. Behavioral symptoms include disturbed sleep-wake cycle, hallucinations, irritability, and delusions [10].

Pharmacological Management

Pharmacological therapy in the treatment of delirium usually involves the administration of haloperidol. However, the efficacy to treat delirium in the ICU by using

haloperidol must be studied more through placebo-controlled trials. As an alternative for the therapy of delirium, second-generation antipsychotics came into view and had a better safety profile. Dexmedetomidine, a highly selective alpha-2 adrenergic agent, may be used as an adjunctive for delirious patients in the ICU [15]. Haloperidol, a first -generation antipsychotic has been traditionally used for the treatment of delirium [16]. According to 2002 clinical practice guidelines on sedatives, haloperidol is the choice of drug for the treatment of delirium 77 in ICU patients as there is also evidence that it is beneficial in preventing delirium in ICU patients. However, electrocardiographic monitoring for QT interval prolongation and arrhythmias must be done while administering haloperidol in critically ill patients. Nowadays research has been going on the evaluation of the efficacy of second-generation antipsychotics in critically ill patients. Sedatives have the potential to manage the delirium [17]. In an observational cohort study, it was found out that lorazepam is an independent risk factor for the development of delirium whereas other sedatives had no direct relationship with delirium [18].

Non-pharmacological Management
Non-pharmacological approaches, such as physical and occupational therapy, decrease the duration of hospital and ICU stay and also provide better management of delirium and hence should be encouraged. To prevent ICU delirium, several critical care units are: Providing periods for sleep, Using more liberal visiting policies, Preventing the patient from unnecessary excitement, Orienting the patient to date, time and place, Asking the patient if there are any concerns, Communicating with the family to obtain information regarding cultural and religious beliefs, Coordinating ICU lights with the normal day-night cycle, Monitoring patient's fluid and nutrition status, Reorientation methods, Avoiding physical restraints correction of sensory deficits, Behaviour modification, Usage of ear plugs in prevention of agitation induced by instrumental beeping and sounds, Psychiatric consultation (if required). Withdraw/taper the dose of drug suspected to induce delirium and re-assess the patient after withdrawal. Avoid anticholinergic agents, if possible. Reassess pain and add analgesic if required, or reduce the dose or avoid narcotics if high doses have been administered. Avoid all benzodiazepines if possible after dose tapering (1-2 weeks). Closely monitor the creatinine clearance and adjust the dosage of renally eliminated medications in patients with renal dysfunctions. Monitor specific antidotes administrated in poisoning or toxicities. If required, antipsychotics (haloperidol is the drug of choice) could be used to control the behavioural symptoms of delirium. If drugs with known risk of inducing delirium are to be used, then close evaluation and monitoring is mandatory for better patient outcomes [2].

Assessment and Evaluation
The RASS (Richmond Agitation Sedation Scale) contains 2 levels, each denoting a state of response that is voice (score -1 to -3) and touch (score -4 & -5). The scores are allotted based on the condition of the patient that is +4 combative, +3 very agitated, +2 agitated, +1 restless, zero alert and calm, -1 drowsy, -2 light sedation, -3 moderate sedation, -4 deep sedation, and -5 unarousable (unconscious). The scale can be rated within 1-2 minutes from observation. The score zero indicates the patient is normal, any score greater than or equal to 3 indicates to proceed to the CAM-ICU scale (Table 1).

Table 1: RASS worksheet for delirium assessment

The Richmond Agitation–Sedation Scale		
Score	Term	Description
+4	Combative	Overtly combative or violent; immediate danger to staff
+3	Very agitated	Pulls on or removes tube(s) or catheter(s) or has aggressive behaviour toward staff
+2	Agitated	Frequent non purposeful movement or patient–ventilator dyssynchrony
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	Spontaneously pays attention to caregiver
-1	Drowsy	Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice
-2	Light sedation	Briefly (less than 10 seconds) awakens with eye contact to voice
-3	Moderate sedation	Any movement (but no eye contact) to voice
-4	Deep sedation	No response to voice, but any movement to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

1. Observe patient. Is patient alert and calm (score 0)?
▪ Does patient have behavior that is consistent with restlessness or agitation (score +1 to +4 using the criteria listed at the Richmond Agitation–Sedation Scale table, under Description)?
2. If patient is not alert, in a loud speaking voice state patient's name and direct patient to open eyes and look at speaker. Repeat once if necessary. Can prompt patient to continue looking at speaker.
▪ Patient has eye opening and eye contact, which is sustained for more than 10 seconds (score-1).
▪ Patient has eye opening and eye contact, but this is not sustained for 10 seconds (score -2).
▪ Patient has any movement in response to voice, excluding eye contact (score -3).
3. If patient does not respond to voice, physically stimulate patient by shaking shoulder and then rubbing sternum if there is no response to shaking shoulder.
▪ Patient has any movement to physical stimulation (score -4).

The most widely used scale for assessing delirium in critically ill patients is Confusion Assessment Method for Intensive Care Unit (CAM-ICU) which can be used at beside in nonverbal mechanically ventilated patients. Four main features that are important for assessing delirium in CAM-ICU are: Acute Onset or Fluctuating Course, Inattention, altered level of Consciousness, Disorganized Thinking. Few studies indicate different sensitivities for

the CAM-ICU. This difference in sensitivities can be illustrated by a wide range of heterogeneity seen in the patients included in the study but mainly by a different level of training and experience among the assessors involved in the reviews. Thus, it is difficult to demonstrate with what efficacy these instruments work without adequate preparation, but it is sensible to state that a considerable proportion of critically ill patients with delirium remain undiagnosed if these instruments are applied without proper training to the health care providers. In recent times, two systematic reviews evaluated the accuracy of CAM-ICU [11,12] and concluded that it is an accurate instrument for the diagnosis of delirium in critically ill patients. However, in the only study which was conducted in a non-research setting, most of the delirious patients were not detected by CAM-ICU [11,13].

The NEECHAM (Neelon and Champagne) Confusion Scale (Table 2) contains nine scaled parameters divided into three levels. Each level provides three characteristic parameters. Level-I deals with information processing and orientation (score ranging from 0 – 14 points). It evaluates components of cognitive status: attention and alertness, verbal and motor response, and memory and orientation. Level-II deals with behaviour (score ranging from 0 – 10 points). It evaluates behaviour and performance ability: general appearance and posture, sensory-motor performance, and verbal responses. Level-III deals with physiological control (score ranging from 0 – 6 points). It evaluates vital function stability: vital signs, oxygen saturation stability and urinary continence control. The total NEECHAM scale score is the product sum of the scores on the three scales. The scale can be rated in 5-10 minutes from observations and measurements of vital signs. The ratings may range from 0-30 where zero indicates minimal function and 30 means normal function; the threshold point is 24. The score from 0–24 points indicates delirium as three types: mild, moderate and severe [14].

Table 2: NEECHAM worksheet for delirium assessment

NEECHAM Confusion Scale	Score
Subscale I :	
• Level of responsiveness-information processing	(0 – 4 points)
• Attention and alertness	(0 – 5 points)
• Verbal and motor response	(0 – 5 points)
• Memory and orientation	
Subscale II :	
• Level of behaviour	
• General behaviour and posture	(0– 2 points)
• Sensory motor performance	(0– 4 points)
• Verbal responses	(0– 4 points)
Subscale III :	
• Vital functions	
• Vital signs	(0– 2 points)
• Oxygen saturation level	(0– 2 points)
• Urinary continence	(0– 2 points)

Scores: 0 – 19 points = moderate to severe confusion
20 – 24 points = mild or early development of delirium
25 – 30 points = not confused or normal function

II. OBJECTIVE

To assess and evaluate the correlation of RASS and NEECHAM scales in delirium assessment in a tertiary care hospital, specifically in the critically ill patients. To evaluate and provide management approaches to overcome this hurdle and to achieve better therapeutic outcomes.

III. METHODOLOGY

This is a prospective observational cohort study conducted at Gleneagles Aware Global Hospitals, L.B Nagar, Hyderabad. for a study period of six months. 200 patients admitted with the hospitalization in the Intensive Critical Care Unit, Medical Intensive Care Unit, Cardiac Intensive Care Unit, Respiratory Intensive Care Unit were enrolled as study population. Subjects with age limit greater than or equal to 18 years with history of hospitalization into critical care for at least 24 hours were included in the study. Pregnant and lactating women, pediatric patients and patients with history of psychological illness & dysfunctions were excluded from the study. Patient data collection form, contains the socio-demographic details of the patients and Observational study Informed Consent form was prepared for patients understanding for agreeing to participate in the study. The drugs suspected for inducing delirium and delirium assessment was done using CAM-ICU Worksheet and NEECHAM Confusion Scale. Patient relevant data for the study was obtained from patient case records, ICU charts, medication charts, directly from patient/ attenders. The NEECHAM and RASS correlation with ICU delirium was estimated using probability coefficient, the correlation between NEECHAM and RASS by Correlation Coefficient (ρ) statistically.

IV. RESULTS AND DISCUSSION

Among 200 patients admitted into the ICU, 19 patients were found to be in between -5 to -4 scale readings (9.50%),in which 19 couldn't be assessed accurately due to current medical conditions. Out of 26 patients found to be in between -3 to -2 scale readings (13.00%), 5 developed mild, 8 developed moderate, 12 developed severe type of delirium and 1 was non-delirious. Out of 96 patients found to be in between -1 to 0 scale readings (48.00%), 15 developed mild, 10 developed moderate, 3 developed severe and 68 were assessed to be non-delirious. Out of 48 patients found to be in between 1 to 2 scale readings (24%), 13 developed mild, 14 developed moderate, 13 developed severe delirium and 8 were non-delirious. Among the 11 patients found between 3 to 4 scale readings (5.50%), 3 developed moderate and 8 developed severe delirium. From the ρ-value <0.0001 the correlation

between RASS scores and delirium is significant (Table 3, Figure 3).

Table 3: Correlation of ICU delirium with RASS score

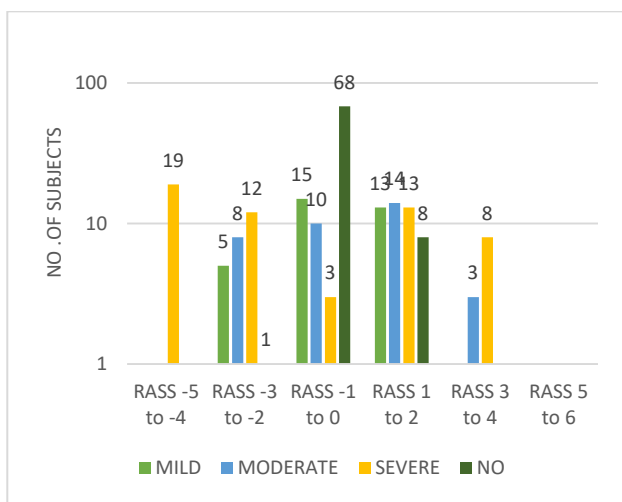| RASS	Delirious				Total	ρ-value
	Mild	Moderate	Severe	No		
-5 to -4	0	0	19	0	19	
-3 to -2	5	8	12	1	26	
-1 to 0	15	10	3	68	96	<0.0001
1 to 2	13	14	13	8	48	
3 to 4	0	3	8	0	11	
5 to 6	0	0	0	0	0	
Total	33	35	55	77	200	

Figure 3: Correlation of ICU delirium with RASS score

Among 200 patients admitted into the ICU, 4 patients were found to be in between 1-5 scale readings (2.0%) in which 3 developed severe delirium and 1 was non-delirious. Out of 7 patients were found to be in between 6-10 scale readings (3.50%), 7 developed severe type of delirium. Among 26 patients found to be in between 11-15 scale readings (13.00%), 1 developed moderate and 25 developed severe type of delirium. Out of 44 patients found to be in between 16-20 scale readings (22.00%), 3 developed mild, 24 developed moderate, 15 developed severe types of delirium and 2 were assessed to be non-delirious. Among 26 patients found to be in between 21-25 scale readings (13.00%), 18 developed mild, 2 developed moderate, 1 developed severe delirium and 5 were non-delirious. Out of 19 patients found to be in between 26-30 scale readings (9.50%), 7 developed mild delirium and 12 were non-delirious. Among 74 patients found to be not passing the screening criteria (Nil) 5 were assessed to be mild delirious, 8 moderate, 4 severe delirious and 57 non-delirious. From the ρ-value <0.0001, there is significant correlation between NEECHAM score (Table 4, Figure 4).

Table 4: Correlation of ICU delirium with NEECHAM scores

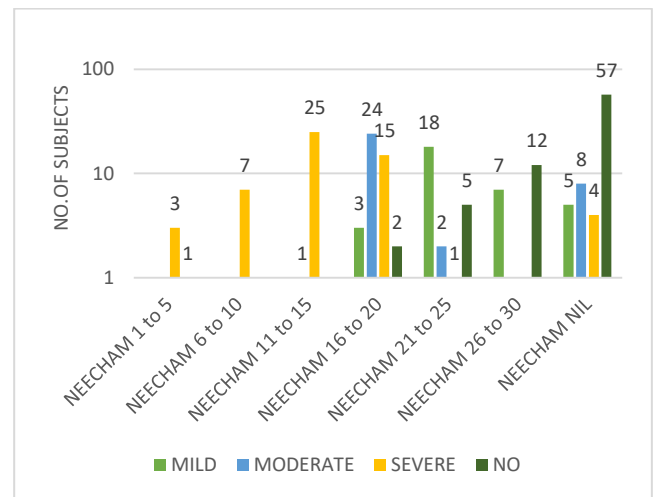| NEECHAM	Delirious				Total	ρ-value
	Mild	Moderate	Severe	No		
1 to 5	0	0	3	1	4	
6 to 10	0	0	7	0	7	
11 to 15	0	1	25	0	26	
16 to 20	3	24	15	2	44	< 0.0001
21 to 25	18	2	1	5	26	
26 to 30	7	0	0	12	19	
NIL	5	8	4	57	74	
Total	33	35	55	77	200	

Figure 4: Correlation of ICU delirium with NEECHAM scores

Among 200 patients admitted into the ICU, 28 patients were assessed to be mild delirious as per NEECHAM and 33 patients as per RASS, 27 patients were assessed to be moderate delirious as per NEECHAM and 35 patients as per RASS and 51 patients were assessed with severe delirium as per NEECHAM and 55 patients as per RASS. However, 29 patients were assessed with no delirium as per NEECHAM and 77 patients as per RASS, whereas 74 patients were found to be not passing the screening criteria (Nil) for NEECHAM. From the ρ-value –0.7003, there is significant negative correlation between NEECHAM score and RASS score (Table 5, Figure 5).

Table 5: Correlation between the NEECHAM and RASS scores

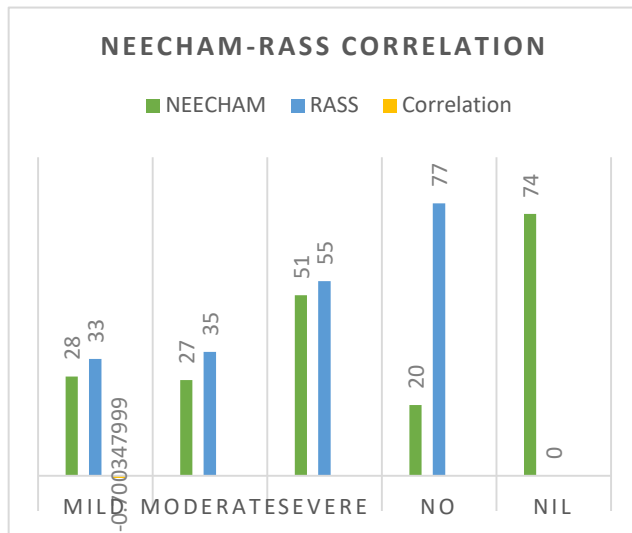| Delirious	NEECHAM	RASS	Correlation Coefficient (ρ)
Mild	28	33	
Moderate	27	35	
Severe	51	55	-0.7003
No	20	77	
Nil	74	0	
Total	200	200	

Figure 5: Correlation between the NEECHAM and RASS scores

V. CONCLUSION

According to RASS scoring, it is concluded that the majority of the delirious patients were assessed to be mild to moderate sedated (96.1%), followed by agitated to irritated (100%) when correlated with ρ-value <0.0001 (clinically significant). Out of 200 study population, only 126 patients passed the NEECHAM screening criteria. According to NEECHAM scoring, majority were assessed to be moderately confused 95.4% (16-20), followed by severe confusion 100% (11-15) when correlated with delirium (ρ-value <0.0001). From the ρ-value –0.7003, there is a significant negative correlation between NEECHAM score and RASS score. When ρ is -1, the relationship is said to be perfectly negatively correlated. This negative correlation signifies that as the NEECHAM score decreases, the RASS increase (and vice versa). However, the degree to which these two scales are negatively correlated might vary over time (and they are almost never exactly correlated all the time). Hence it indicates that the patients admitted in the units of intensive care are more susceptible to ICU delirium, which is usually temporary and resolves with patient specific management. Whereas there is significant inverse correlation between the NEECHAM and RASS scales indicating two different criteria of assessment for the same perceptions of delirium developing in the ICUs is possible.

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The authors, Dr. N. Revathi, Dr. K. Sai Sriram and Dr. V. Vasanth Kumar are pursued Pharm D from Avanthi Institute of Pharmaceutical Sciences, Hyderabad. The authors have conducted certain research studies to study and explore the aspects of delirium especially in the critical care units. They have published a detailed descriptive handbook on assessment, evaluation and management of delirium "INTENSIVE CARE UNIT SYNDROME, Omniscriptum, Scholarly Press; ISBN 978-613-8-93336-6" and various other research papers specifically on delirium in the department of critical care psychology. Their recent work published "EVIDENCE BASED PHARMACOTHERAPY AGAINST THE COVID-19 PANDEMIC: A TARGETED HYPOTHESIS-DRIVEN DRUG DEVELOPMENT," International Journal of Recent Scientific Research Vol. 11, Issue, 05(D), pp. 38622-38628, May, 2020; DOI: http://dx.doi.org/10.24327/ijrsr.2020.11 05.5348. emphasizes on the possible pharmacotherapeutic approaches towards the global pandemic.