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FREQUENCY OF DEVELOPMENT OF POST-OPERATIVE DELIRIUM IN ADULT CARDIAC SURGERY PATIENTS IN A SINGLE CENTRE

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Abstract

The study is an appraisal of postoperative delirium of grown-up patients who undergo cardiac heart surgery in an institution run by a cardiac care unit. Postoperative delirium is a neuropsychiatric disease with dire outcomes and impacts on the results of a patient, the days of hospital stay, and the health expenditure. This was a cross-sectional observational study conducted in the Cardiac Family Pvt. Limited and Cardiac ICU in Cardiac Family, Peshawar, whereby it involved a total of 167 patients aged between 18-75 years who were being operated on to undergo elective and emergency cardiac surgical procedures. The inclusion criteria consisted of patients who had subjected themselves to coronary artery bypass grafting (CABG), valve repair/valve replacement, and the combination of both operations. The notable finding was the occurrence of postoperative delirium tested by the Confusion Assessment Method in the ICU (CAM-ICU) less than 72 hours after the surgery. The results showed that 28.1 percent (47 of 167) of the patients underwent postoperative delirium. The lengthy course of cardiopulmonary bypass (more than 120 minutes), early cognitive impairment, advanced age (more than 65 years), and long extended periods of mechanical ventilator use were determined as determining risk factors. The median time to the occurrence of delirium was 18.4 hours post-operatively. The length of stay in the ICU and the total hospital stay of delirium patients was longer than that of controls (4.8 vs. 2.1 days, $p < 0.001$; 12.3 vs. 7.6 days, $p < 0.001$). The study is a great avenue to learn more about the incidence and risk factors of postoperative delirium in cardiac surgery patients and the fact that there is a

need to discover the predisposing individuals early enough to tell them through early prevention methods.

INTRODUCTION

Cardiac surgery is the most complex surgical procedure, and it means high physiological stress and complications are quite possible, implying almost any system of the human organism [1]. Postoperative delirium is one of the most frequent and clinically essential complications developing after cardiac surgery; this complication is characterized by the emergence of confusion suddenly, a shift in the level of consciousness, and cognitive disruptiveness after cardiac surgery [2]. It is differentiated by its symptoms that usually manifest at the early stage of 24-72 hours following the surgery. They can also influence the process of recovery, the standard of life, and the use of medical resources of a patient noticeably[3].

Postoperative delirium in patients has been reported as a range of 15-50 percent after cardiac surgery with a profusion of variations, depending on the kind of patient undergoing surgery, the procedure, and its compatibility to the criteria therein [4,5]. Mechanism pathophysiology of the occurrence of delirium after cardiac surgery is multifactorial, and it involves cerebral hypoperfusion during cardiopulmonary support, inflammatory processes, metabolism disorder, and the consequences of anesthetics and sedative medications [6]. A prolonged surgical process, its complications, and not being young have already been mentioned as severe risk factors repeatedly[7].

The post-surgery delirium has clinical implications considered not only at the initial stages. Delirious patients have a prolonged period of mechanical ventilation, longer length of stay in intensive care and during their hospitalization, increased medical expense, and acquire a predisposition to cognitive impairment later in their life-long years of life span[8]. Also, a negative relationship is described between the rates of mortality and delirium, as well

as the rates of functional independence upon discharge. The impact on the caregivers and families is equally massive, as in the majority of delirium cases, there should be high levels of distress and concern [9].

Postoperative delirium is highly essential to be identified and addressed quickly to improve patient outcomes [10]. The Confusion Assessment Method for ICU (CAM-ICU) has been proven as a gold standard in the screening of delirium in patients of different types of UCC, such as cardiac surgical ICUs. The tool is a validated tool that allows the healthcare givers to carry out a systematic evaluation of the existence and monitoring of the likelihood occurrence of the development of delirium even as it went on with time [11].

In spite of the fact that postoperative delirium is clinically essential, data concerning its prevalence, correlates, and predictors have been published, but little is known locally about these issues in our health system. This recognition is the fact that awareness regarding the epidemiology of postoperative delirium among patients in cardiac surgeries marks the first step towards establishing specific prevention plans, appropriate allocation of the available resources, and eventual improvements in the overall quality of treatment[12]. Our medical professionals will also be able to learn more about the extent of the scope of this issue and act efficiently when using evidence-based solutions to prevent its development and reduce its effect due to the results of the conducted study.

Purpose: To determine the rate of development of postoperative delirium among adults who received cardiac surgery and identify the risk factors.

OPERATIONAL DEFINITIONS

Postoperative Delirium: It is the appearance of sodium-acute mistaking as well as alteration of the level of wakefulness as well as intelligence dysfunction assessed with the CAM-ICU rating scale within 3 days after the conduction of

the cardiothoracic procedure. In a case where the CAM-ICU score is positive, it would indicate that this individual is going through delirium.

Cardiac surgery: possesses coronary artery bypass grafting (CABG) surgery, valve repair surgery or valve replacement surgery, combined CABG and valve surgery, and other core cardiac surgery procedures that require cardiopulmonary bypass.

CAM-ICU ASSESSMENT: A validated screening tool consisting of four features:

- Feature 1: Acute onset or fluctuating course
- Feature 2: Inattention
- Feature 3: Altered level of consciousness
- Feature 4: Disorganized thinking

Delirium occurs when Features 1 and 2 are present, accompanied by either Feature 3 or Feature 4.

RISK FACTORS: The factors that can cause patients to develop postoperative delirium are:

- **Advanced Age:** ⩾65 years
- **Prolonged CPB Time:** >120 minutes
- **Pre-existing Cognitive Impairment:** History of dementia or mild cognitive impairment
- **Prolonged Mechanical Ventilation:** >24 hours post-operatively
- **ICU Length of Stay:** Days spent in intensive care unit
- **Hospital Length of Stay:** Total days from admission to discharge

MATERIAL AND METHODS:

STUDY DESIGN: Cross-Sectional Observational Study.

STUDY SETTING: Cardiac Family Pvt. Limited and Cardiac ICU in Cardiac Family, Peshawar.

STUDY DURATION: 8 months, after approval from the institutional ethics committee.

SAMPLE SIZE: Sample size calculated using WHO sample size calculator.

- Expected frequency of postoperative delirium: **(30%)**[13]
- Confidence interval: **(95%)**
- Absolute precision: **(7%)**
- Determined sample size: **167**

SAMPLING TECHNIQUE: Non-Probability Consecutive Sampling.

SAMPLE SELECTION

INCLUSION CRITERIA

Age 18-75 years

Both sexes (Male and Female)

• Patients who undergo elective/emergency cardiac operations (CABG, valve functions, combined operations)

• Anticipated length in ICU >24 h

• Capability of being evaluated in an attempt to determine delirium (not in a coma)

EXCLUSION CRITERIA

• Patients having delirium or acute confusional states before the operation

• Depression or other serious mental disorders in the past

• Severe deficient hearing or eye vision, not allowing CAM-ICU evaluation

• Patients under the ECMO or other life support mechanical circulating support

• Hemodynamically unstable emergency surgery

• Language barriers that do not allow proper assessment

PROCEDURE OF DATA COLLECTION

The experiment, with the assistance of the hospital's ethics review board, commenced. Patients were recruited by obtaining informed written consent from all those who met the inclusion criteria. Demographic data, including age, gender, Body Mass Index, level of education, presence of comorbidities, and surgical type, were acquired.

Cognitive screening using the Mini-Mental State Examination (MMSE) was performed as part of the pre-operative evaluation, as well as to assess functional status and review the list of medications. The intraoperative data were the type of surgery, cardiopulmonary bypass time, cross-clamp time, and intraoperative complications.

CAM-ICU assessment of delirium was done by the competent nursing staff at a turnoff of 8hr over the initial 72 hours of postoperative care. Further tests were done when the medical issues emerged. All positive CAM-ICU scores were validated by a consultant intensivist who had experience in delirium assessment.

Mechanical ventilation time, hospital length of stay, ICU length of stay, complications, and discharge disposition were recorded as postoperative variables. All information was recorded in a pre-structured pro forma.

STEP OF ANALYZING DATA

The analysis of data was carried out with the help of IBM SPSS v.25. Tests of normality for continuous variables were performed using the Shapiro-Wilk test, and results were analyzed by mean and standard deviation or median and interquartile range. Frequencies and percentages of categorical variables were used to analyze the data.

The first measure was the frequency of postoperative delirium. Secondary outcomes included the time of delirium development, the duration of delirium, and delirium-related outcomes. Univariate and multivariate logistic regression analyses were conducted to investigate risk factors.

A stratification was performed based on age groups, gender, and type of surgery, among other pertinent variables, to identify high-risk populations. The $p<0.05$ was defined as statistical significance, and the chi-square or the Fisheries exact test was employed in the evaluation of a categorical variable. In contrast, the t-test or the Mann-Whitney U test was used to assess a continuous variable.

DATA ANALYSI

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

This cross-sectional observational study involved 167 patients undergoing cardiac surgery at the Cardiac Family Pvt. Limited and Cardiac ICU in Cardiac Family, Peshawar. The inclusion criteria encompassed all patients aged 18-75 years undergoing major cardiac surgical procedures with an expected ICU stay of more than 24 hours.

TABLE 4.1: DEMOGRAPHIC CHARACTERISTICS OF STUDY POPULATION (N=167)

Variable	Category	Frequency (n)	Percentage (%)
Age Groups	18-40 years	23	13.8
	41-60 years	78	46.7
	61-75 years	66	39.5
Gender	Male	109	65.3
	Female	58	34.7
BMI Categories	Underweight (<18.5)	12	7.2
	Normal (18.5-24.9)	89	53.3
	Overweight (25-29.9)	51	30.5
	Obese (⩾30)	15	9.0
Education Status	Illiterate	45	26.9
	Primary	38	22.8
	Secondary	52	31.1
	Higher	32	19.2

According to the demographic features, 46.7% of patients were aged 41-60 years, and the elderly category comprised 39.5% (61-75 years). The population was 65.3 percent male patients. There was a favorable distribution of

education among the majority of patients with a normal BMI (53.3%), and BMI levels were evenly distributed across the groups. The average age was 58.3 ± 12.4 years, and the average BMI was 24.2 ± 3.8 kg/m².

TABLE 4.2: CLINICAL AND SURGICAL CHARACTERISTICS (N=167)

Variable	Category	Frequency (n)	Percentage (%)
Type of Surgery	CABG only	89	53.3
	Valve surgery only	45	26.9
	Combined procedures	33	19.8
Surgery Priority	Elective	134	80.2
	Emergency	33	19.8
Comorbidities	Diabetes Mellitus	78	46.7
	Hypertension	123	73.7
	COPD	34	20.4
	Previous stroke	18	10.8
	Renal disease	23	13.8

Table 4.2 presents the clinical and surgical profiles of 167 individuals who underwent cardiac surgery. The most prevalent surgery performed was Coronary Artery Bypass Grafting (CABG) alone, which accounted for 53.3 percent of the procedures. Valve surgeries constituted 26.9, whereas combined procedures constituted 19.8. The elective type (80.2%) of surgery predominated, which means that the procedure was planned and not an emergency measure. The comorbidities were common, with 73.7 percent of the patients having hypertension and 46.7 having diabetes mellitus. Such a table highlights the demographics of patients and surgical circumstances that influence post-operative outcomes.

POST-OPERATIVE DELIRIUM FREQUENCY AND CHARACTERISTICS

TABLE 4.3: FREQUENCY OF POST-OPERATIVE DELIRIUM (N=167)

Delirium Status	Frequency (n)	Percentage (%)
Delirium Present	47	28.1
Delirium Absent	120	71.9
Total	167	100.0

The occurrence of post-operative delirium is presented in Table 4.3, according to the study participants. Forty-seven patients amongst 167 experienced delirium, and this was a prevalence rate of 28.1%. On the other hand, 120 individuals did not experience delirium, and that is 71.9 percent of the cohort. Such a high rate implies that delirium is a serious complication after cardiac surgery, which is consistent with the state of the literature regarding post-operative complications. The importance of knowing the frequency of delirium is to put up prevention and management measures to counter the problem in surgical-related cases.

TABLE 4.4: DELIRIUM CHARACTERISTICS AND TIMING (N=47)

Variable	Mean ± SD	Range
Time to onset (hours)	18.4 ± 12.6	4-48
Duration of delirium (days)	2.8 ± 1.9	1-8

Table 4.4 presents the features and the schedules of delirium onset in the group of patients who had developed this condition. The average time to delirium occurred was 18.4 hours after the operation, with the majority at the initial 24 after the operation. The mean duration of delirium was 2.8 days, ranging from one to eight days. Additionally, the average score was 4.2 on the Confusion Assessment Method for the ICU (CAM-ICU), with optimistic estimations. These results provide valuable information on the persistence and occurrence of delirium, which is crucial for effective clinical care..

RISK FACTOR ANALYSIS

TABLE 4.5: UNIVARIATE ANALYSIS OF RISK FACTORS FOR POST-OPERATIVE DELIRIUM

Risk Factor	Delirium Present (n=47)	Delirium Absent (n=120)	p-value
Age ⩾65 years	34 (72.3%)	32 (26.7%)	<0.001
Male gender	32 (68.1%)	77 (64.2%)	0.634
Pre-existing cognitive impairment	18 (38.3%)	12 (10.0%)	<0.001
Emergency surgery	15 (31.9%)	18 (15.0%)	0.012
CPB time >120 minutes	28 (59.6%)	34 (28.3%)	<0.001
Prolonged ventilation >24h	35 (74.5%)	23 (19.2%)	<0.001

Table 4.5 presents a univariate analysis of factors associated with post-operative delirium. The major ones were individuals aged 55 years and above, where 72.3 percent ($p < 0.001$) of delirium cases were identified. Delirium was strongly correlated with pre-existing cognitive impairment and >120 minutes of the cardiopulmonary bypass (CPB) time. More delirium (31.9%) was found among patients undergoing emergency surgery. These results highlight the main risk factors that care professionals must monitor to mitigate the effects of delirium in post-operative conditions.

TABLE 4.6: CLINICAL OUTCOMES BY DELIRIUM STATUS

Outcome	Delirium Present (n=47)	Delirium Absent (n=120)	p-value
ICU LOS (days)	4.8 ± 2.3	2.1 ± 1.2	<0.001
Hospital LOS (days)	12.3 ± 4.8	7.6 ± 2.9	<0.001

Mechanical ventilation (hours)	48.2 ± 36.4	18.3 ± 12.1	<0.001
ICU readmission	8 (17.0%)	6 (5.0%)	0.018
In-hospital mortality	3 (6.4%)	2 (1.7%)	0.126

Table 4.6 compares the clinical outcomes in patients with and without post-operative delirium. The Intensive Care Unit (ICU) stay was significantly more extended (4.8 days vs. 2.1 days) as well as total days in the hospital (12.3 days vs. 7.6 days) in patients experiencing delirium. Additionally, the period of mechanical ventilation was longer in the delirium category (48.2 hours vs. 18.3 hours). Delirious patients also had increased ICU readmission (17.0 percent vs. 5.0 percent). These consequences reiterate the deleterious effect of delirium on recovery and the use of resources during surgeries.

STRATIFIED ANALYSIS BY DEMOGRAPHICS

TABLE 4.7: DELIRIUM FREQUENCY STRATIFIED BY AGE GROUPS (N=167)

Age Group	Delirium Present	Total	Frequency (%)	p-value*
18-40 years (n=23)	2	23	8.7%	<0.001
41-60 years (n=78)	11	78	14.1%	
61-75 years (n=66)	34	66	51.5%	

Table 4.7 shows the frequency of post-operative delirium by age group. Severe cases of delirium were also very evident among the old group of individuals who had the highest case of delirium (51.5 percent) as compared to individuals under age forty and above (8.7 percent) ($p<0.001$). The trend signifies that the bigger chances of developing delirium are exposed to older patients after the surgery. This knowledge is vital in customizing preventive

measures and surveillance practices in the post-operative management of age-related risks.

TABLE 4.8: DELIRIUM FREQUENCY STRATIFIED BY SURGERY TYPE (N=167)

Surgery Type	Delirium Present	Total	Frequency (%)	p-value*
CABG only (n=89)	20	89	22.5%	0.032
Valve surgery (n=45)	15	45	33.3%	
Combined procedures (n=33)	12	33	36.4%	

Table 4.8 illustrates the stratification of post-operative delirium frequency by surgery type. Most prevalent (22.5 percent) among patients not taking CABG were those patients who developed delirium, compared with 33.3 percent in those who had valve surgery. The highest incidence was present in combined procedures at 36.4%. These varieties highlight the fact that the complexity of surgical procedures can be a determinant of delirium rates, and there is a strong need to closely monitor patients and adopt interventions that consider the individual needs of those undergoing more complex surgeries.

MULTIVARIATE ANALYSIS

TABLE 4.9: MULTIVARIATE LOGISTIC REGRESSION FOR POST-OPERATIVE DELIRIUM

Variable	Odds Ratio	95% CI	p-value
Age ⩾65 years	4.23	1.89-9.47	<0.001
Pre-existing cognitive impairment	3.67	1.52-8.86	0.004
CPB time >120	2.45	1.18-5.09	0.016

minutes			
Emergency surgery	2.12	0.94-4.78	0.071
Combined procedures	1.89	0.81-4.41	0.142

Table 4 9 features the multivariate logistic regression analysis offered in the identification of post-operative delirium predictors. A significant odds ratio of 4.23 was found, with an age of 65 years or greater representing a fourfold increase in risk. Pre-existing cognitive deficiency also had a substantial probability of predicting delirium (odds ratio 3.67). Another vital risk factor (odds ratio 2.45) was prolonged CPB time (>120 minutes). The odds were higher in emergency surgery and combined, but the p-values were not very high, indicating that they were not statistically significant. These data will enable clinicians to identify high-risk patients and prevent the issue effectively.

DISCUSSION AND ANALYSIS

OVERVIEW OF KEY FINDINGS

The frequency and related factors of postoperative delirium after cardiac surgery were examined among 167 adult patients at a tertiary care center in Peshawar, Pakistan, through a cross-sectional observational study. The experiment shed light on some crucial discoveries that can help us better understand this serious healthcare condition in the local health setting.

The main conclusion of the research was that 28.1 percent (47 of 167) of patients developed postoperative delirium within 72 hours of cardiac surgery. This rate falls within the reported 15-50% range documented in the international literature, indicating that our patient group has a normal delirium rate according to global trends. Nevertheless, the fact that our result of 28.1 percent falls right on this continuum suggests that various factors, such as patient demographics, the complexity of the surgery, and hospital practices, may influence results at the high end of the spectrum.

The average time to have delirium was 18.4 hours after surgery, with the majority happening in the initial period of 24 hours. This early onset type is in line with the past evidence that suggests that cardiac surgery-related delirium often presents in early postoperative time when patients are at the highest risk of the physiological conditions of surgery, anesthesia, and intensive care control.

DEMOGRAPHIC AND CLINICAL NODES

AGE AS A MAJOR RISK FACTOR

Our analysis revealed that the best-founded conclusion was that there is a strong correlation between old age and the development of postoperative delirium. The likelihood of patients aged 65 years and older developing delirium was 4.23 times higher compared to younger patients (95% CI: 1.89-9.47, $p < 0.001$). The stratified analysis portrayed a clear age dependence, with the frequency of delirium rising to 8.7 percent in patients aged 18-40 years and hitting the lion's share of 51.5 percent in the age group 61-75 years.

It is this physiological and pathological susceptibility connected with advancing age that may be attributed to many factors. Aging entails a decrease in cognitive reserve, increased susceptibility to inflammation, changes in the pharmacokinetics and pharmacodynamics of pharmaceutical agents, and a decline in physiological adaptation to surgical conditions. The brain of an aging person is susceptible to the influence of anesthesia, metabolic disorders, and the inflammatory cascade that can occur in cases of cardiopulmonary bypass.

A clinical perspective of the study is that the delirium prevalence rate of 51.5 percent in elderly patients is indeed alarming, and this means that the risk is high that more than half of older adults who will undergo cardiac surgery will develop this condition. This discovery will have a significant impact on pre-anesthesia care and preparation processes, resource allocation,

and specifically on the development and planning of preventive measures for high-risk groups.

GENDER DISTRIBUTION AND IMPLICATION

Although 65.3% of our study population were male patients, gender has not emerged as a major independent risk factor for the development of delirium (p=0.634). This observation contrasts with evidence on the increase of delirium observed in male patients reported in some studies, and this may be due to comorbidity patterns, type of medication combination, or physiological adaptation to surgery.

This male predominance in our cardiac surgery patients is consistent with the normal epidemiological trends of cardiovascular disease in South Asian people, in that men are more often at younger ages presenting with coronary artery disease and possibly more likely to receive operative treatment. Nevertheless, the absence of gender differences in the ability to develop delirium implies that the prevention strategies can target other modifiable risks rather than gender-specific interventions.

The patient population has a high comorbidity rate (including hypertension (73.7%) and diabetes mellitus (46.7%)), which are common characteristics of cardiac surgery patients. Although in our multivariate analysis, individual presence of comorbidity was not related to delirium, these conditions probably lead to patient frailty and risk to surgery as a whole.

The independent risk factor as a causative agent was the existing cognitive impairment of the patients, as they were 3.67-fold more at risk of developing postoperative delirium with a p-standard of 0.004 with an alpha confidence interval of 1.52 to 8.86. This finding proves the significance of preoperative cognitive screening and the fragility of patients with initial cognitive deficits to new neurological problems.

PERIOPERATIVE AND SURGICAL FACTORS

CPB TIME AND SURGICAL COMPLEXITY

It was also identified that a long cardiopulmonary bypass (CPB) of more than 120 minutes was an independent risk factor for delirium as it raised the risk of patients developing delirium 2.45 times higher (95% CI: 1.18-5.09, p = 0.016). This necessity can be justified by a massive set of published data confirming the neurological threat of prolonged extracorporeal circulation.

CPB-related delirium has multifactorial mechanisms, encompassing cerebral hypoperfusion, the development of microemboli, and the triggering of inflammatory responses, as well as the disruption of the blood-brain barrier. CPB predisposes the brain to non-pulsatile perfusion, possible hypotension, and embolic events that can interfere with cerebral perfusion and performance. Such risks have a direct dependence on the CPB exposure length, and this is why long bypass duration is always a factor that leads to neurological complications.

Therefore, a difference of 31.3% between patients with long bypass times (59.6%) and those with short bypass times (28.3%) is clinically significant and should be considered in surgical planning and counseling for patients. Some techniques can help surgeons reduce the time under cardiopulmonary bypass (CPB), allowing them to consider off-pump coronary artery bypass grafting or optimal perfusion strategies when lengthy procedures are necessary.

TYPE AND COMPLEXITY OF SURGERY

We found that there are also significant differences in rates of delirium between different types of surgeries, with combined operations having the highest rate of delirium (36.4%), followed by valve operations (33.3%) and isolated CABGs (22.5%). This gradient is indicative of greater complexity in surgery, as well as longer operating times for more complex operations.

Combined procedures are typically associated with an increase in operative time, cardiac manipulation, and a higher frequency of simultaneous coronary and valvular procedures. These aspects are causing more physiological stress, prolonged exposure to anesthesia, and the possibility of requiring more complicated postoperative healing. The increased rates of delirium after valve surgery compared to isolated CABG can be attributed to the technical demands of valvular surgery and the ability of these procedures to cause greater hemodynamic shifts during the perioperative period.

EMERGENCY AND ELECTIVE SURGERY

Emergency surgery tended to increase delirium risk (OR 2.12, 95% CI:0.94-4.78, p=0.071), and it also did not achieve statistical significance in our multivariate analysis. The rate of delirium in emergency surgery patients, at 31.9%, compared to the general rate of the phenomenon's occurrence, implies that acute presentation and acute surgical intervention may be factors contributing to delirium susceptibility.

Hemodynamically unstable patients, acute myocardial infarction, or some other severe conditions often presenting with emergency cardiac surgery patients may affect cerebral perfusion and elevate the levels of stress hormones. Moreover, such patients do not always have an opportunity to optimize in the preoperative period, and they are likely to have postoperative complications.

POSTOPERATIVE COURSE AND OUTCOMES

MECHANICAL VENTILATION AND RESPIRATORY SUPPORT

The incidence of delirium was found to be correlated with long-term mechanical ventilation over 24 hours, with three-quarters of the patients having delirium being on ventilation, whereas one-fifth of the non-delirious ones were put under ventilation in the long term ($p < 0.001$). It is considered a risk factor for delirium since it is independent of delirium and an outcome of this condition.

Delirium can be caused by various aspects of the mechanical ventilation process, including the necessity of sedation, sleep impairment, communication impediments, and the psychological impact of being intubated. Delirium, in turn, has the potential to affect the respiratory process, slow down weaning, and increase the risk of associated complications that may occur after using the ventilator.

A mechanical ventilation length of 48.2 hours versus 18.3 hours in delirious patients and non-delirious patients, respectively, implies an enormous clinical and economic cost. Prolonged ventilation causes a risk of occurrence of ventilator-associated pneumonia, lengthens the ICU stay, and raises medical expenses.

RESOURCE UTILIZATION AND LENGTH OF STAY

Our study showed that the effects of delirium on healthcare resources were significant. At the ICU, patients who developed delirium had substantially longer ICU stays (4.8 vs. 2.1 days, $p < 0.001$) and overall hospital stays (12.3 vs. 7.6 days, $p < 0.001$). The differences result in a twofold increase in both ICU and hospital stays, and the implications of this difference, which is reflected in the utilization of healthcare costs and resources, are considerable.

Long durations related to delirium indicate a variety of processes, such as slow recovery, increased complications, a slower mobilization process, and greater monitoring and involvement. From a medical perspective, healthcare systems view such prolonged durations as incurring significant financial expenses and can also impact the availability of beds for other patients requiring cardiac therapy.

READMISSIONS AND COMPLICATIONS

Patients with delirium were also found to have a significantly higher ICU readmission rate (17.0% vs 5.0%, $p=0.018$), and this could indicate that delirium might be a predisposing condition to postoperative complications leading to intensive care readmission. This observation suggests that close

monitoring of patients with delirium should be continued even after the patient's discharge from the ICU and not just upon initial discharge.

Even though the in-hospital death rate was numerically higher in the delirium group (6.4% vs 1.7%), the difference was not significant (p = 0.126), probably because of the relatively low overall mortality rate and the small number of cases. Nevertheless, this upsurge in mortality aligns with the literature, which has identified delirium as an independent risk factor of poor outcomes.

PRACTICE IMPLICATIONS AND IMPLICATIONS IN CLINICAL PRACTICE

PRE-OPERATIVE RISK ASSESSMENT

Validating the presence of significant risk factors in our research will facilitate the development of a pre-operative risk categorization strategy for heart surgery patients. Routine pre-operative assessments should also include age, cognitive status, and expected surgical complexity to identify high-risk patients who can receive targeted interventions.

The consideration of pre-operative cognitive screening with recognized tools, such as the Mini-Mental State Examination or Montreal Cognitive Assessment, is a common practice, especially in patients like the elderly. When cognitive impairment is diagnosed early enough, proper family counseling can be done, and this could have an impact on the planning of surgery and strategies for managing the patient after the surgery has been done.

PERIOPERATIVE MANAGEMENT MEASURES

The relationship between long CPB time and delirium suggests that methods of surgical intervention aimed at decreasing bypass time can produce neurologically favorable outcomes. Off-pump coronary artery bypass grafting can be performed when appropriate candidates are suitable, especially elderly patients or patients with other risk factors of having delirium.

The key factors during intraoperative management should be appropriate cerebral perfusion, reduction of embolic mechanisms, and prevention of

prolonged hypotension. Post-operative management must focus on aspects such as early mobilization, adequate sedation control, and regular sleep-wake cycles to reduce the risk of delirium.

MONITORING AND EARLY DETECTION

The fact that delirium started very early in our study, as noted by the mean time of onset at 18.4 hours, is a notable factor, as it underscores the need to begin systematic screening as soon as possible in the post-operative stage. By trained and skilled nursing staff, the CAM-ICU should be performed frequently, with positive screens verified by trained clinicians.

As soon as it is detected, further interventions can be promptly introduced, and the progression to more severe variants of delirium may be avoided. Medical staff is to be trained regarding delirium identification and the necessity of systematic screening guidelines.

FINDINGS AND CONCLUSION

SUMMARY OF MAJOR FINDINGS

The study is a cross-sectional observational research project conducted at the Department of Cardiac Surgery, Khyber Teaching Hospital-MTI, Peshawar, providing an in-depth understanding of the prevalence and causes of post-operative delirium in adult cardiac surgery patients at a tertiary care center. A study of 167 patients undergoing various cardiac surgical procedures has enabled the identification of several important observations that contribute to understanding those above crucial clinical consequences in the local healthcare environment.

FINAL RESULT: DELIRIUM FREQUENCY

The main result of this research was that 28.1 percent (47 out of 167) of the patients suffered post-operative delirium 72 hours after cardiac surgery. This prevalence rate places our patient population within the range of 15% to 50%, which is comparable to the prevalence rates reported worldwide. Therefore, delirium is indeed a significant clinical challenge in our healthcare facility. The

given rate of incidence (28.1%) is especially noteworthy because it indicates that, among patients who have undergone cardiac surgery, approximately 25 percent will develop this complication, which illustrates the extent of the clinical issue and the necessity of introducing systematic approaches to its prevention and treatment.

Time-related delirium showed a mean development time of 18.4 hours (+/-12.6) post-operatively, with a range of 4-48 hours. The fact that such an onset pattern is early, with most cases manifesting within the first 24 hours after surgery, highlights the vital importance of close observation during the immediate post-operative period. Delirium persisted for an average of 2.8 ± 1.9 days, with patients having an average of 4.2 ± 2.3 positive CAM-ICU evaluations during delirium.

DEMOGRAPHIC RISK WAGGING

The demographic functionality revealed impressive age trends in susceptibility to delirium. Analysis by stratification into age groups showed a significant increase in the frequency of delirium: 8.7% in patients aged 18-40 years, 14.1% in patients aged 41-60 years, and an impressive 51.5% in patients aged 61-75 years. It is a strong indication of the connection between this age-related gradient and the vulnerability of older patients to post-operative delirium, as well as an indication of the need to use age-specific risk assessments and countermeasures.

Male patients comprised 65.3 percent of the study participants; however, the results showed that gender was not independently associated with the development of delirium ($p = 0.634$). This observation suggests that non-gender-based interventions should incorporate other modifiable risk factors as part of their prevention efforts. There was an even distribution of the educationally challenged patient categories, with 26.9 percent of patients being illiterate. These factors indicate the varied socio-economic background of patients received by the institution.

DELIRIUM RISK AND SURGICAL COMPLEXITY

The groups of surgical types showed a considerable difference in the share of delirium. There was the highest rate of delirium among the combined cardiac procedures, which was 36.4%, valve surgery at 33.3%, and isolated coronary artery bypass grafting (CABG) at 22.5 (P=0.032). Such increased complexity and time are a gradient associated with greater cardiac procedures. They are beneficial in themselves, providing pre-operative information that can be used in the risk counseling and resource-planning process.

There was also a trend toward increased incidence of delirium among emergency surgery patients (31.9%, compared to elective procedures) that did not demonstrate statistical significance in multivariate analysis. The trend indicates that acute presentation and emergency surgery are potential factors that predispose a patient to delirium, perhaps as the result of hemodynamic instability, failure to optimize pre-operative status, or hyperphysiologic load adequately.

INDEPENDENT RISK FACTORS IDENTIFICATION

The multivariate logistic regression analysis proposed three statistically significant independent risk factors of post-operative delirium development:

Advanced age (65 years): Patients aged 65 years and above showed a 4.23 times higher risk of experiencing delirium (95% CI: 1.89-9.47, $p < 0.001$). This is the best predictor we found in our study, which affirms age as the most significant non-modifiable risk factor for post-operative delirium in patients undergoing cardiac surgery.

Pre-existing Cognitive Impairment: Patients with baseline cognitive impairment had a 3.67-fold increased risk (95% CI: 1.52-8.86, p=0.004). This observation underlines the fragility of a patient with a weakened cognitive reserve. It reinforces the interventional significance of pre-operative cognitive screenings in identifying individuals who may be at risk of complications.

Long CPT (>120): there was a 2.45-fold higher danger (95%CI: 1.18-5.09, p = 0.016) of long CPT. This risk factor, which can be mitigated, highlights the importance of efficiency and surgical technique in minimizing the likelihood of neurological complications.

HEALTHCARE AND CLINICAL OUTCOMES

Post-operative delirium had dramatic and complicated clinical outcomes. There was a tremendous increase in the recovery time of the patients who developed delirium measured in several dimensions:

ICU Length of Stay: Patients who were deliriously stayed in ICU an average of 4.8 +/- 2.3 days as opposed to 2.1 +/- 1.2 days by non-delirious patients ($p<0.001$). Such a two-fold increase in the duration of stay in the ICU is indeed a matter of critical care resources being overwhelmed by an excessive burden, as well as a significant expense in healthcare.

Length of Stay in Hospital: The overall hospital stay was increased to 12.3 ± 4.8 days in patients with delirium, compared to 7.6 ± 2.9 days in those without delirium ($p < 0.001$). This 4.7-day total mean increase in hospital stay has profound implications for bed occupancy, healthcare costs, and patient outcomes.

Mechanical Ventilation: Delirious patients spent an average of 48.2 ± 36.4 hours on mechanical ventilation, compared to 18.3 ± 12.1 hours for non-delirious patients ($p < 0.001$). This lengthy stay on the ventilator exposes the individual to more risks of developing ventilator-related complications and prolongs the time of their ICU stays.

ICU Readmission Rates: The readmission rate of ICU patients who developed delirium was found to be significantly higher (17.0% vs. 5.0%, p = 0.018), indicating possible post-operative complications that require close monitoring and treatment.

ASSOCIATION OF PERIOPERATIVE FACTORS AND DELIRIUM

Analysis of perioperative variables revealed several significant associations. Delirium was highly associated with prolonged mechanical ventilation lasting more than 24 hours, as its incidence was 74.5% among delirious patients and 19.2% among non-delirious patients ($p < 0.001$). Such an association is likely both a cause and an effect of delirium, forming an intertwined loop that perpetuates the condition and hinders recovery.

Urgent surgery demonstrated a numerical enhancement of delirium cases (31.9% vs. 15.0% during elective surgery, $p = 0.01$, which, which can be explained by the presence of a greater level of objectives and physiological stress when conducting urgent cardiac procedures. The fact that emergency cases do not allow for re-operative optimization is a factor that increases the risk of post-operative complications.

NAME AND COMORBIDITY PROFILE AND CLINICAL CONTEXT

A majority of individuals in the study population had a severe load of cardiovascular comorbidities reflective of a patient who needs cardiac surgery. The prevalence of hypertension was 73.7 percent, diabetes mellitus 46.7 percent, chronic obstructive pulmonary disease 20.4 percent, and previous stroke 10.8 percent. However, the single measures of these comorbidities were not independently related to delirium in multivariate analysis; however, they do play a role, as these factors all combine to make up the complexity and frailties of the group of patients being treated.

Notably, one of the most notable prevalence rates is attributed to diabetes mellitus, considering that the patients are more likely to experience perioperative complications. The high percentage of the number of patients with hypertension indicates the predominant role of atherosclerotic cardiovascular disease in the cohort of patients who are supposed to be under the cardiac surgery procedure.

PRACTICE AND IMPLICATIONS OF CLINICAL SIGNIFICANCE

PRE-OPERATIVE ASSESSMENT AND RISK STRATIFICATION

Certain risk factors have been identified, allowing for the development of feasible risk stratification tools that can be applied in a clinical setting. All patients over 65 years old, with pre-existing cognitive impairment or needing complex operations or more than 2 hours of cardiopulmonary bypass, should be considered to be at risk when developing delirium. It is due to this risk stratification that targeted prevention strategies can be employed, along with family counseling and the optimal use of resources.

Pre-operative cognitive testing should be integrated into standard cardiac surgery-related assessments, particularly in the elderly population. Assessment using established screening instruments, such as the Mini-Mental State Examination or the Montreal Cognitive Assessment, will reveal patients with a pre-existing cognitive susceptibility that could lead to increased vigilance and enhanced disease prevention efforts.

SURGERY PLANNING AND TECHNICAL CONSIDERATIONS

The established relationship between prolonged cardiopulmonary bypass duration and delirium occurrence has direct implications for surgery planning and methodology. Surgeons, such as those who perform effective surgical procedures and efficiently schedule cases, should discuss approaches to reducing bypass time. In cases of mild patients, off-pump heart procedures for coronary artery bypass may also be considered.

More frequent delirium rates in combined procedures and valve surgery indicate that more complicated cases necessitate some improvements in terms of perioperative monitoring and may require a special protocol when it comes to delirium deterrence and treatment. These should be used to offer counseling to the patients about the likely results and timelines of recovery.

POST-OPERATIVE CARE PROTOCOLS

Not only is the occurrence of delirium early in the post-operative period (usually within the first 24 hours), but the severity of its onset also underscores the importance of implementing systematic screening procedures as soon as the patient recovers from the operation. Assessment using the CAM-ICU should be regularly conducted by trained personnel in the nursing field, and a positive screen case requires urgent attention and treatment.

The protocols of post-operative care should focus on measures known to reduce the risk of delirium, such as optimizing sleep-wake schedules, early mobilization whenever possible, limiting the use of sedatives and analgesics, and providing comfort and familiar surroundings whenever feasible. The strong relationship with protracted mechanical support suggests that weaning may involve a compromise between respiratory protection, isolation, and minimal sedation, as well as early extubation.

FUTURE RESEARCH DIRECTIONS

Long-term Outcomes Research

Skillful longitudinal assessments of the lasting impact of post-operative delirium on cognition, quality of life,, and functional autonomy are also urgently required. The long-term fate of patients experiencing delirium would be helpful in the discussion of prognosis and use of rehabilitation techniques.

BIOMARKER AND MECHANISTIC STUDIES

Studies on potential biomarkers for delirium prediction and monitoring may enable more individualized delirium risk assessment and timing of intervention. Religious researchers of the mechanism by which delirium occurs, especially the involvement of neuroinflammation and neurotransmitter abnormalities, can reveal new targets of therapy.

CONCLUSION

The present study is a comprehensive investigation of post-operative delirium in cardiac surgical patients, providing valuable insights into a significant

clinical issue that affects at least one in every four individuals under our care. The frequency of 28.1 percent of delirium development, alongside other risk factors that the researchers identified as having advanced age, pre-existing cognitive impairment, and long cardiopulmonary bypass time, provides a solid basis to develop specific prevention and management procedures.

The fact that ICU stay increased more than 2-fold, whereas the hospital length of stay, duration of mechanical ventilation, and rates of readmission raised drastically highlights the clinical significance of the complication that delirium is beyond its direct and neuropsychiatric expression. Such results are significant regarding healthcare resource use, patient outcomes, and healthcare expenditure.

The fact that delirium is rated to make an early onset, based on which the majority of cases develop within the first 24 hours of surgery, is yet another sign of the utter importance of close monitoring and screening procedures during the immediate aftermath of the surgery. The delirium is most vulnerable in the aged, with the highest rates of over 50% in the oldest patients. This shows that this vulnerable population is at risk and should be treated with age-specific measures.

Clinically speaking, these results suggest that regular pre-operative cognitive screening should be conducted in elderly patients and that they should create risk-stratified pairs for the prevention of delirium. The correlation with surgical complexity suggests that patients undergoing combined procedures or those with valve surgery may be advised to be monitored more closely and may even be offered care specifications.

As future steps, the findings of this work should contribute to the development of clinical practice guidelines, quality improvement programs, and research priorities related to this issue. Evidence-based protocol development for the prevention, detection, and management of delirium in

cardiac surgery patients should be regarded as a priority for healthcare institutions offering cardiac care.

Not only does this study contribute to the existing global body of literature on the subject, but it also sheds light on the issues specific to the local healthcare setting. The results confirm the need for further investigation into prevention methods and the role of the approach system in managing this multifaceted and clinically significant complication. With awareness of the frequency, risk factors, and outcomes/consequences of post-operative delirium, healthcare practitioners may begin to consider how to change the present situation to one where cardiac surgery patients do not experience a prolonged post-operative state of delirium and where healthcare resources are best used in providing medical care to this complex population.

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