

Incidence of Postoperative Delirium among Elderly Patients after Elective Surgeries under Anesthesia in the Charity Services of the Philippine General Hospital

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ABSTRACT

Background. Due to the increasing number of elderly patients being referred to anesthesia for surgical procedures, there is a growing interest with regard to the incidence of postoperative delirium and its contributing factors.

Objectives. The primary objective of this study is to determine the incidence of postoperative delirium in the charity elderly patients at the Philippine General Hospital (PGH).

Methods. The incidence of postoperative delirium was assessed in an analytic prospective study conducted at the PGH among elderly patients undergoing elective surgeries. Through interviews and chart reviews, the collected data focused on baseline intellectual status, age, gender, ASA classification, level of education, comorbidities, vices, previous surgeries, maintenance medications, preoperative diagnostics, duration of surgery, duration of anesthesia, type of anesthetic technique, and pain scores at the recovery room and 24 hours postoperatively. Responses to the Short Portable Mental Status Questionnaire (SPMSQ), the Preoperative and Postoperative assessment forms and the Confusion Assessment Method (CAM) instrument were analyzed.

Results. It was observed that there was a 2.5% incidence of postoperative delirium in the study population and among the risk factors assessed, polypharmacy and presence of moderate to severe pain scores on the first day following surgery were significant contributors in its occurrence.

Conclusion. In this preliminary study, the incidence of postoperative delirium as well as the significant contributing factors were described. In succeeding investigations, it is recommended to extend the observation and follow-up periods.

Keywords: postoperative delirium, elderly, incidence



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INTRODUCTION

Interest in the detection of postoperative delirium, an acute cognitive decline in response to noxious stimuli, has become relevant in light of the increasing number of elderly patients being referred to anesthesia for surgical procedures. Postoperative delirium may be prevalent in the elderly resulting in longer hospital stay, more costly hospital bills, poor functional recovery, and increased morbidities. If persistent, it may lead to dementia or even permanent cognitive impairment.

Delirium is an acute condition with a fluctuating course of symptoms characterized by inattention, change in the level

of consciousness, and disturbances of cognition which may be exemplified by disorientation, memory impairment, or language deviations.¹ Incidence rates are noted to be highest among elderly patients in the intensive care unit (ICU) and in both postoperative and palliative care settings.^{2,3}

The importance of early detection of delirium especially in elderly patients is often under emphasized. Its economic burden can stem from either an increase in hospital stays or medical directives to conduct costly diagnostic assessments, as it can be a herald of a medical emergency such as an atypical presentation of myocardial infarction.³ It can likewise lead to a chronic state like dementia, necessitating lifetime health care.

Among healthy patients, delirium was noted to develop only after exposure to a series of noxious stimuli such as the surgery itself and anesthesia.^{2,3} However, there is a reported incidence of delirium in as much as 50% of elderly patients in hospitals in the United States purportedly linked to multiple factors.⁴ The ISPOCD1 study cited increasing age, duration of anesthesia, little education, a second operation, postoperative infections and respiratory complications as risk factors for early postoperative cognitive dysfunction.⁴ Age was specifically tagged as an additional risk factor for late onset postoperative cognitive decline.¹

The diagnosis of delirium starts with the patient's history taken by an informed observer, followed by a brief cognitive assessment. This can establish the patient's baseline mental status as well as acuity and fluctuation in cognition. Cognitive screening tests, like short portable mental status questionnaire, the Mini-Cog, or the Montreal cognitive assessment, can also be conducted to verify the presence of preoperative delirium.⁵⁻⁷

Healthcare workers and researchers commonly use the Short Portable Mental Status Questionnaire (SPMSQ, Appendix A) to assess cognitive impairment among elderly patients. It is fairly easy to accomplish and interpret, compared to the Mini-Mental State Examination (MMSE) or other cognitive screening tests. With regard to its validity and reliability, studies have so far indicated that it can distinguish between patients with or without cognitive impairment especially among those with at least six years of education. A cut-off score of 5 or more errors is noted to maximize both its sensitivity (78%) and specificity (75%).^{7,8}

Similarly, there are a number of well documented delirium instruments in assessing patients' cognitive decline postoperatively. Among the most widely used instrument is the Confusion Assessment Method (CAM) which has been validated in high quality studies, exhibiting a sensitivity of 94%, specificity of 89%, and a high inter-rater reliability.^{3,9-11}

As of this writing, the authors know of no published data that established the incidence of delirium among post-surgery elderly patients in the Philippines. This study aimed to determine the incidence of postoperative delirium in elderly patients in the charity wards at the Philippine General Hospital (PGH). Specifically, this study aimed to determine

which among the surgical subspecialties demonstrate the highest incidence of immediate postoperative delirium, and to identify possible factors (e.g., age, presence of comorbidities, previous surgery, anesthetic technique, etc.) that may be contributory to or associated with its occurrence.

METHODS

Upon approval by the University of the Philippines - Philippine General Hospital Ethics Review Board and following informed consent from participants, this analytic prospective study was conducted at the surgical charity wards of the PGH from July to October 2019.

Based on the study's objectives as well as the intended data analyses, the minimum sample size was set. A power analysis was conducted using a software called G*Power Version 3.1.9.2, focusing on a logistic regression model. The parameters used for this analysis were largely derived from the study of Raats et al., entitled "Risk Factors and Outcomes for Postoperative Delirium after Major Surgery in Elderly Patients."¹² Specifically, the incidence of postoperative delirium among elderly patients who underwent major surgery was estimated at 15% (35 out of 232), and indicated as predictors were advancing age (per 10 years) with an odds ratio of 2.0 (1.1-3.8; 95% CI) and ASA score (≥ 3) with an odds ratio of 2.6 (1.1-5.9; 95% CI). Assuming an alpha level of 0.05, a power of 0.80, and a moderate association between covariates (R^2 value of 0.25), the required minimum sample size was calculated as 179.

Data collection was conducted solely by the primary researcher. The study included patients aged 65 and above who were referred for anesthesia for elective procedures in various surgical specialties. Exclusion criteria included those patients with the following: (1) poor vision or hearing, (2) chronic cognitive decline or those with score of 5 or above in the SPMSQ, (3) history of epilepsy, (4) intake of cognitive-affecting medications, (5) known congenital, traumatic, neoplastic or vascular brain affectations, and (6) medical history of neurosurgery and/or neurologic disease. Participants who developed any cognitive decline prior to the induction of anesthesia or surgical procedure, as well as those who developed any complications from the operation, were withdrawn from the study.

Eligible patients, identified using the SPMSQ tool (Appendix A), underwent thorough history-taking, physical examination, and preoperative interview. This process culminated in the completion of the Preoperative Patient Assessment Form (Appendix B) after securing informed consent. Patients were followed up until postoperative day 1. CAM (Appendix C) was performed via patient interviews and review of operative records. After accomplishment of the Postoperative Assessment Form (Appendix D), results from Appendices C and D were analyzed using the Confusion Assessment Method Diagnostic Algorithm (Appendix E). Responsible companions of the patients who developed

delirium were informed of the results, and these cases were duly referred to neurologists for management.

Descriptive and inferential statistics were employed for post-data collection analysis. Frequency distribution and summary statistics were presented and statistical analyses were performed using Chi-square Test of Association, Fisher's Exact Test, t-test for Independent Samples and Logistic Regression. The results of these tests were then tabulated and summarized accordingly.

RESULTS

A total of 209 patients participated in the study, seven of whom were withdrawn due to complications which arose preoperatively or postoperatively. Data from the preoperative and postoperative forms, SPMSQ and CAM tools, were manually entered into an encrypted electronic spreadsheet and subsequently analyzed after being authenticated.

Both descriptive and inferential statistics were calculated. For nominal and ordinal variables, frequent distributions were determined; and for discrete and continuous variables, summary statistics were computed.

Statistical analyses were performed using Chi-square Test of Association (or Fischer's Exact Test), t-test for Independent Samples and Logistic Regression.

Tables 1 and 2 illustrate data obtained from the SPMSQ. It revealed that 93% of the participants possessed baseline intact intellectual impairment. Approximately one fourth (25.74%) underwent procedures under the General Surgery service. The mean age of the participants was 65 years old, 36.63% were males while 63.37% were females. With regard to educational attainment, 38.6% had primary education while only 26% was able to reach tertiary education. Majority of the elderly patients were ASA II (67.82%). Notably, despite being elderly, 53 participants (26.24%) were not known to have co-existing diseases while majority (32.67%) reported multiple comorbidities, predominantly hypertension coupled with diabetes. Majority of the participants claimed to have no vices (72.28%) and with previous surgical operations (55.45%). More than a third (37.62%) presented with normal diagnostic test results. Although majority of the participants logged maintenance medications, only a few were maintained on polypharmacy (5.45%).

General anesthesia was the most common anesthetic technique (44.06%) employed in this population, with the median surgery duration recorded at 160 minutes and median anesthesia duration of 205 minutes. Most of the patients received omeprazole and metoclopramide as premedicants. Post op medications consisted of NSAIDs with or without low dose synthetic opioids (i.e. Ketorolac round the clock plus Tramadol given as needed for breakthrough pain). Mild pain scores (NRS 0-1) at the recovery room and 24 hours post op (NRS 1-2) were conveyed by 98%.

Data in Table 3 shows that among the 202 participants of this study, 5 were diagnosed with postoperative delirium

(2.48%). It was also noteworthy that 7.92% of the participants manifested memory impairment 24 hours post-surgery and 2.97% exhibited altered sleep-wake cycle which they attributed to postoperative pain experience occurring in between their stay at the recovery room and in the wards on postoperative day 1. The pain was reported to range from NRS 4-6 with an isolated occurrence of NRS 8.

Table 4 chronicles that among those who developed postoperative delirium, majority were from the orthopedic service, were ASA II-III, females, grade school finishers, with comorbidities and vices, without history of previous surgeries, kept on more than five maintenance medications, without preoperative intellectual impairment, received general anesthesia and pre-medications, received NSAIDs with opioids postoperatively, and registered higher postoperative pain scores. To determine statistical significance, data from Table 4 were analyzed using the Chi-square Test of Association or Fischer's Exact Test. The result is noted to be significant if the p-value of the Chi-square Test or Fischer's Exact Test is less than the set level of significance ($\alpha=0.05$). The statistical tests indicated that the presence of more than five maintenance medications and high pain scores 24 hours post-surgery were the significant risk factors in the occurrence of postoperative delirium for this study population. With a p value = .001, the proportion of elderly patients who experienced postoperative delirium was significantly higher among those who were maintained on at least five medications than those who were taking fewer than five. Moreover, with a p value = 0.003, the proportion of elderly patients who experienced postoperative delirium was significantly higher in those with moderate to severe pain (NRS 6-10), on postop day 1.

Data shown in Table 4 were analyzed using t-test for independent samples and the results were summarized in Table 5. It can be inferred that the study population was fairly homogenous in the aforementioned characteristics as there were no statistical difference with respect to age, weight, duration of surgery, and anesthesia.

Table 6 illustrates the distribution of patients across assessed variables in this study along with the incidence of postoperative delirium within category. For example, among 52 general surgery patients, not one developed postoperative delirium; while among 47 gynecology patients, two patients (4.26%) had postoperative delirium, and so forth. Comparing the incidence measures across the different categories, analysis revealed that the patients who exhibited the highest incidence of postoperative delirium were those who underwent orthopedic surgeries, were classified as ASA III, females, completed primary education only, had multiple comorbidities, were concurrent smokers and alcohol consumers, without history of previous operations, possessed multiple diagnostic abnormalities, were on preoperative maintenance polypharmacy, administered combined general and regional anesthesia, received multiple pre-medications, prescribed NSAIDs combined with opioids for postoperative pain

Table 1. Demographic Characteristics of the Study Population

Characteristics	Frequency	Percentage
Baseline Mental Status		
<i>Intact Intellectual Functioning</i>	188	93.07
<i>Mild Intellectual Impairment</i>	13	6.44
<i>Moderate Intellectual Impairment</i>	1	0.50
<i>Severe Intellectual Impairment</i>	0	0
Preoperative Data		
Surgical Service		
General Surgery	52	25.74
Gynecology	47	23.27
Orthopedic Surgery	37	18.32
Otorhinolaryngology	21	10.40
Plastic and Reconstructive Surgery	5	2.48
Urology	40	19.80
ASA Classification		
ASA 1	16	7.92
ASA 2	137	67.82
ASA 3	49	24.26
Gender		
Male	74	36.63
Female	128	63.37
Level of Education		
No formal education	1	0.50
Primary education	78	38.61
Secondary education	70	34.65
Tertiary education or higher	53	26.24
Presence of Comorbidities		
Asthma	1	0.50
Diabetes mellitus	9	4.46
Hypertension	63	31.19
Dyslipidemia	3	1.49
Thyroid disease	1	0.50
Other diseases	6	2.97
Multiple comorbidities	66	32.67
No comorbidities	53	26.24
Presence of Vices		
No vices	146	72.28
Smoking	30	14.85
Alcoholic beverage drinking	3	1.49
Smoking and Alcoholic beverage drinking	23	11.39
Presence of Previous Operation/s		
With previous operation	112	55.45
Without previous operation	90	44.50

Characteristics	Frequency	Percentage
Presence of Diagnostic Abnormality		
Anemia	46	22.77
Cardiac abnormality	8	3.96
Electrolyte imbalance	5	2.48
Elevated blood glucose	5	2.48
Hypoalbuminemia	3	1.49
Respiratory abnormality	4	1.98
Multiple abnormalities	55	27.23
Normal diagnostic tests results	76	37.62
Presence of Maintenance Medications		
None	60	29.70
≤5 maintenance medications	131	64.85
More than 5 maintenance medications	11	5.45
Postoperative Data		
Type of Anesthesia		
General Anesthesia	89	44.06
Regional Anesthesia	80	39.60
General Anesthesia + Regional Anesthesia	30	14.85
Peripheral Nerve Block	1	0.50
Sedation/Monitored Anesthesia Care	2	0.99
Presence of Premedications		
Antiemetic	6	2.97
Antifibrinolytic	8	3.96
Benzodiazepines	9	4.46
Bronchodilator	1	0.50
Proton Pump Inhibitor	31	15.35
Steroids	3	1.49
Multiple premedications	101	50.00
None	43	21.29
Post op Pain Medication		
NSAIDs only	3	1.49
NSAIDs + Opioids	47	23.27
NSAIDs + Synthetic Opioids/ Opiates	88	43.56
Paracetamol + Opioids	29	14.36
Paracetamol + Synthetic Opioids/Opiates	35	17.33
Pain Assessment at RR		
Mild (NRS 0-5)	196	97.03
Moderate (NRS 6-7)	5	2.48
Severe (NRS 8-10)	1	0.50
Pain Assessment 24 hours post op		
Mild (NRS 0-5)	198	98.02
Moderate (NRS 6-7)	3	1.49
Severe (NRS 8-10)	1	0.50

Table 2. Summary Statistics on Age and Weight, Duration of Surgery, Duration of Anesthesia, Pain Assessment Scores at PACU and 24 hours Post op

Variable	Mean	Standard Deviation	Median	Minimum value	Maximum Value
Preoperative Data					
Age	66.60	5.44	65	60	84
Weight (kg)	59.68	10.62	60	32.5	95
Postoperative Data					
Duration of Surgery (minutes)	181.95	117.76	160	13	724
Duration of Anesthesia (minutes)	222.95	128.93	205	15	780

management, and registered moderate to severe pain scores immediately and 24 hours postoperatively.

Identification of Possible Risk Factors for the Occurrence of Postoperative Delirium

In order to identify possible risk factors and confounders for the occurrence of postoperative delirium, univariate analyses were done for factors considered to be relevant in building a logistic regression model which will predict postoperative delirium. Shown in Table 7 is the result of the univariate logistic regression analysis of the different variables

Table 3. Distribution of Elderly Patients who Underwent Elective Surgery according to Results of Confusion Assessment Method (CAM)

Variable	Frequency	Percentage
Parameters		
Acute Onset		
Present	5	2.48
Absent	197	97.52
Inattention		
Not Present	197	97.52
Present at some time during the interview	5	2.48
Present at some time during the interview but in marked form	0	0
Disorganized thinking		
Present	2	0.99
Absent	200	2.48
Altered level of consciousness		
Alert	201	99.50
Vigilant	1	0.50
Lethargic	0	0
Stupor	0	0
Coma	0	0
Disorientation		
Present	1	0.50
Absent	201	99.50
Memory impairment		
Present	16	7.92
Absent	186	92.08
Perceptual disturbances		
Present	0	0
Absent	202	100
Psychomotor agitation		
Present	1	0.50
Absent	201	99.50
Psychomotor retardation		
Present	0	0
Absent	202	100
Altered sleep-wake cycle		
Present	6	2.97
Absent	196	97.03
Diagnosis of Delirium by CAM		
With Delirium	5	2.48
Without Delirium	197	97.52

assessed in this study. It is noteworthy that only polypharmacy (taking more than five maintenance medications) and pain assessment 24 hours post operation were identified as significant variables for the occurrence of postoperative delirium.

Identification of Risk Factors for the Occurrence of Postoperative Delirium

Shown in Table 8 is the subsequent multiple logistics regression analysis of the variables considered in this study and the occurrence of postoperative delirium. All variables were considered in the full model, and for the succeeding steps, the variable with the highest p value (i.e., not significant) was disregarded. Based on this statistical analysis, the significant predictors for the occurrence of postoperative delirium were preoperative maintenance polypharmacy and presence of moderate to severe pain scores on postop day 1.

DISCUSSION

Postoperative delirium, being multi factorial, was shown to have an occurrence of 15 to 53 percent in patients with low vulnerability in the face of severe medical conditions and/or strong precipitants.¹³ It is very likely that for highly vulnerable patients, this disorder will ensue even with the mildest of precipitating events. This is evident in some findings that high ASA scores, which correlate with severe comorbidities, were associated in the occurrence of delirium.^{13,14} The relatively low incidence of dementia observed in this study might be attributed to the generally healthy characteristics of the participants despite their age. Furthermore, it is vital to consider that they were worked-up, medically cleared, optimized, prescheduled, and underwent elective or non-emergent procedures. As mentioned earlier, a good number of them did not even present with co-morbidities. Raats et al. proposed that the elective nature of the surgical intervention was associated with a lower incidence of delirium.¹²

The risk factors explored here were previously cited in international journals. This study failed to demonstrate any correlation of anemia and alcohol consumption to delirium as deduced in an investigation conducted among general medicine patients.¹⁴ In fact, research on anemia as a risk factor in the development of cognitive dysfunction has generated mixed and debatable results.^{12,15} Advancing age has been mentioned as the most important risk factor in the development of postoperative delirium.⁴ This was not evident in this study, probably because those belonging in the older bracket aged 70 and above had intact pre-surgery intellectual functioning, with only a few classified as ASA III. With regard to past surgery as a risk factor, there is no conclusive evidence as yet linking this to the occurrence of postoperative delirium in subsequent surgeries.

This current investigation underscored two statistically significant risk factors for postoperative delirium, namely, maintenance polypharmacy and moderate (NRS 6-7) to

severe (NRS 8-10) pain scores on the first postoperative day. The American Geriatrics Society Expert Panel has in fact included these two risk factors as highly contributory to this condition.

There are guidelines which urge minimizing the number of maintenance medications for the elderly to prevent cognitive disturbance in the intensive and oncology units. Among the maintenance medications being taken by those who developed postoperative delirium in this study population, beta blockers, alpha blockers, lipid-lowering agents, and antimicrobials have been cited in some literature as having possible delirogenic effects.¹⁶ There is no causal relation that links angiotensin converting enzyme inhibitors to psychiatric adverse drug reactions.¹⁷ Anti hyperglycemic agents generally reduce the prevalence of delirium because of better control of blood sugar fluctuations in diabetes. Multiple vitamins were being taken by some of these patients. Although vitamins per se are not known to cause delirium, the lack of vitamins can. It was uncertain whether those who were taking vitamins were indeed still vitamin deficient or were deficient to begin with, hence prescribed to take these supplements. It was also difficult to say if it was one particular medication, or a combination of medications with possible drug interactions which increased the risk for

postoperative dementia. Furthermore, being maintained on more than five medications is usually indicative of a sicker elderly, with consequently higher ASA classification and thus a predisposition to postoperative dementia.

Several published journals determined a definite correlation between postoperative pain at rest and mental status decline after surgery.^{18,19} Lynch et al. discussed how pain at rest leads to alteration in the sleep-wake cycle and hormonal disruption often resulting in delirium.¹⁸ It is thus imperative to optimize pain management to lessen its occurrence. In 2015, the American Geriatrics Society published a practice guideline for the prevention of postoperative delirium in older adults where they recommended the use of regional anesthesia postoperatively and optimization of pain control using non opioid regimens.²⁰

Aging per se is associated with cognitive decline. This prospective study highlights additional risk factors which can make the elderly more prone to develop this condition. It can be of assistance to the clinician in making preoperative predictions to identify the more vulnerable patients, henceforth facilitating early recognition of the disorder. Proactive steps can be undertaken not only to address these identified risk factors but also to tailor suit anesthetic management or employ preventive anesthetic strategies at the outset. For

Table 4. Distribution of Elderly Patients who Underwent Elective Surgery according to Occurrence of Postoperative Delirium (POD), Surgical Service, ASA Classification, Sex, Level of Education, Occurrence of Comorbidity, Mental Status, Type of Anesthesia, Premedications Given and Post-op Pain Medications Given (Row Percentages)

Variable	Postoperative Delirium		Overall	p-value
	With POD Frequency (percentage)	Without POD Frequency (percentage)		
Baseline Mental Status				1
Intact Intellectual Functioning	5 (2.66)	183 (97.34)	188 (100)	
Mild Intellectual Impairment	0 (0)	14 (100)	14 (100)	
Preoperative Data				
Surgical Service				1
General Surgery	0 (0)	52 (100)	52 (100)	
Gynecology	2 (4.26)	45 (95.74)	47 (100)	
Orthopaedic Surgery	3 (8.11)	34 (91.89)	37 (100)	
Otorhinolaryngology	0 (0)	21 (100)	21 (100)	
Plastic and Reconstructive Surgery	0 (0)	5 (100)	5 (100)	
Urology	0 (0)	40 (100)	40 (100)	
ASA Classification				1
ASA 1	0 (0)	16 (100)	16 (100)	
ASA 2	2 (1.46)	135 (98.54)	137 (100)	
ASA 3	3 (6.12)	46 (93.88)	49 (100)	
Gender				0.654
Male	1 (1.35)	73 (98.65)	74 (100)	
Female	4 (3.13)	124 (96.88)	128 (100)	
Level of Education				0.381
No formal education	0 (0)	1 (100)	1 (100)	
Primary education	3 (3.85)	75 (96.15)	78 (100)	
Secondary education	1 (1.43)	69 (98.57)	70 (100)	
Tertiary education and above	1 (1.89)	52 (98.11)	53 (100)	

Table 4. Distribution of Elderly Patients who Underwent Elective Surgery according to Occurrence of Postoperative Delirium (POD), Surgical Service, ASA Classification, Sex, Level of Education, Occurrence of Comorbidity, Mental Status, Type of Anesthesia, Premedications Given and Post-op Pain Medications Given (Row Percentages) (continued)

Variable	Postoperative Delirium		Overall	p-value
	With POD Frequency (percentage)	Without POD Frequency (percentage)		
Presence of Comorbidities				0.329
With comorbidity	5 (3.36)	144 (96.64)	149 (100)	
Without comorbidity	0 (0)	53 (100)	53 (100)	
Presence of Vices				0.619
Neither smoking nor alcoholic beverage drinking	3 (2.05)	143 (97.95)	146 (100)	
Smoking and/or alcoholic beverage drinking	2 (3.57)	54 (96.43)	56 (100)	
Presence of Previous Operation/s				0.658
With previous operation	2 (1.79)	110 (98.21)	112 (100)	
Without previous operation	3 (3.33)	87 (96.67)	90 (100)	
Presence of Diagnostic Abnormality				0.652
Normal diagnostic tests	1 (1.32)	75 (98.68)	76 (100)	
With diagnostic result/s abnormality	4 (3.17)	122 (96.83)	126 (100)	
Presence of Maintenance Medications				0.001
0 to less than 5 maintenance medications	2 (1.05)	189 (98.95)	191 (100)	
More than 5 maintenance medications	3 (27.27)	8 (72.73)	112 (100)	
Postoperative Data				
Type of Anesthesia				1
General Anesthesia	2 (2.25)	87 (97.75)	89 (100)	
Regional Anesthesia	1 (1.25)	79 (98.75)	80 (100)	
General Anesthesia + Regional Anesthesia	2 (6.67)	28 (93.33)	30 (100)	
Peripheral Nerve Block	0 (0)	1 (100)	1 (100)	
Sedation/ Monitored Anesthesia Care	0 (0)	2 (100)	2 (100)	
Presence of Premedications				0.288
With premedications	3 (1.89)	156 (98.11)	159 (100)	
Without premedications	2 (4.65)	41 (95.35)	43 (100)	
Post-op Pain Medication				0.653
NSAIDs only	0 (0)	3 (100)	3 (100)	
NSAIDs + Opioids	3 (6.38)	44 (93.62)	47 (100)	
NSAIDs + Synthetic Opioids/ Opiates	0 (0)	88 (100)	88 (100)	
Paracetamol + Opioids	0 (0)	29 (100)	29 (100)	
Paracetamol + Synthetic Opioids/ Opiates	2 (5.71)	33 (94.29)	35 (100)	
Pain Assessment at RR				1
Mild (0-5)	5 (2.55)	191 (97.45)	196 (100)	
Moderate to Severe (6-10)	0 (0)	6 (100)	6 (100)	
Pain Assessment 24 hours post op				0.003
Mild (0-5)	3 (1.52)	195 (98.48)	198 (100)	
Moderate to Severe (6-10)	2 (50)	2 (50)	4 (100)	

Table 5. Distribution of Elderly Patients who Underwent Elective Surgery according to Occurrence of Postoperative Delirium, Age, Duration of Surgery and Duration of Anesthesia

	Post-operative Delirium				Overall (SD)	p-value
	With POD		Without POD			
	Mean	SD	Mean	SD		
Age	67.40	5.94	66.58	5.44	66.6 (5.44)	0.7396
Weight	61.00	13.67	59.65	10.58	59.68 (10.62)	0.7795
Duration of Surgery	193.60	86.46	181.65	118.60	181.95 (117.76)	0.8234
Duration of Anesthesia	239.20	90.60	222.54	129.89	222.95 (128.93)	0.7762

Table 6. Cumulative Incidence of Postoperative Delirium among Elderly Patients who Underwent Elective Surgery according to Surgical Service, ASA Classification, Sex, Level of Education, Occurrence of Comorbidity, Mental Status, Type of Anesthesia, Premedications Given, Post-op Pain Medications Given, Age, Duration of Surgery and Duration of Anesthesia

Variable	Number of Patients	Incidence Frequency (Percentage)	Variable	Number of Patients	Incidence Frequency (Percentage)
Preoperative Data			Postoperative Data		
Surgical Service			Type of Anesthesia		
General Surgery	52	0	General Anesthesia	89	2 (2.25)
Gynecology	47	2 (4.26)	Regional Anesthesia	80	1 (1.25)
Orthopedic Surgery	37	3 (8.11)	General Anesthesia + Regional Anesthesia	30	2 (6.67)
Otorhinolaryngology	21	0	Peripheral Nerve Block	1	0
Plastic and Reconstructive Surgery	5	0	Sedation/Monitored Anesthesia Care	2	0
Urology	40	0	Presence of Pre medications		
ASA Classification			Antiemetic	6	0
ASA 1	16	0	Antifibrinolytic	8	2 (25)
ASA 2	137	2 (1.46)	Benzodiazepines	9	0
ASA 3	49	3 (6.12)	Bronchodilator	1	0
Gender			Proton Pump Inhibitor	31	0
Male	74	1 (1.35)	Steroids	3	0
Female	128	4 (3.13)	Multiple pre medications	101	1 (0.99)
Level of Education			None	43	2 (4.65)
No formal education	1	0	Post op Pain Medication		
Primary education	78	3 (3.85)	NSAIDS only	3	0
Secondary education	70	1 (1.43)	NSAIDS + Opioids	47	3 (6.38)
Tertiary education and above	53	1 (1.89)	NSAIDS + Synthetic Opioids/Opiates	88	0
Presence of Comorbidities			Paracetamol + Opioids	29	0
Asthma	1	0	Paracetamol + Synthetic Opioids/Opiates	35	2 (5.71)
Diabetes mellitus	9	0	Pain Assessment at RR		
Hypertension	63	1 (1.59)	Mild (NRS 0-5)	196	5 (2.55)
Dyslipidemia	3	0	Moderate (NRS 6-7)	5	0
Thyroid disease	1	0	Severe (NRS 8-10)	1	0
Others diseases	6	0	Pain Assessment 24 hours post op		
Multiple comorbidities	66	4 (6.06)	Mild (NRS 0-5)	198	3 (1.52)
No comorbidities	53	0	Moderate (NRS 6-7)	3	1 (33.33)
Presence of Vices			Severe (NRS 8-10)	1	1 (100)
No vices	146	3 (2.05)			
Smoking	30	1 (3.33)			
Alcoholic beverage drinking	3	0			
Smoker and Alcoholic beverage drinking	23	1 (4.76)			
Presence of Previous Operation/s					
With previous operation	112	2 (1.79)			
Without previous operation	90	3 (3.33)			
Presence of Diagnostic Abnormality					
Anemia	46	0			
Cardiac abnormality	8	0			
Electrolyte imbalance	5	0			
Elevated blood glucose	5	0			
Hypoalbuminemia	3	0			
Respiratory abnormality	4	0			
Multiple abnormalities	55	4 (7.27)			
Normal diagnostic tests results	76	1 (1.32)			
Presence of Maintenance Medications					
None	60	0			
Less than or equal to 5 maintenance medications	131	2 (1.53)			
More than 5 maintenance medications	11	3 (27.27)			

instance, the clinician can be mindful when to aggressively avoid or minimize anesthetic drugs and pharmacologic agents already known to aggravate the condition, when to aggressively withhold specific anesthetic techniques, or address certain perioperative events. Active prevention is the key.

CONCLUSION

Among the elderly charity patients who underwent elective surgical procedures at the PGH, there were five among the 202 patients who developed postoperative delirium. The incidence of postoperative delirium occurred mostly among patients in the orthopedic service. No anesthetic technique was established as contributory to its occurrence. The preoperative intake of more than five maintenance medications and high NRS pain scores 24 hours postoperatively were found to be predisposing factors for its occurrence.

Table 7. Univariate Logistic Regression Analysis on the Occurrence of Postoperative Delirium

Variable	Odds Ratio	Standard Error	95% CI	p-value
Preoperative Data				
Age	1.03	0.08	0.88-1.20	0.739
Weight	1.01	0.04	0.99-1.01	0.822
Surgical Service				
General Surgery/ Orthopedic Surgery/ Otorhinolaryngology/ Plastics and Reconstructive Surgery (Reference)	-	-	-	-
Gynecology/Urology	0.88	0.81	0.14-5.37	0.888
ASA Classification				
ASA1 (Reference)	-	-	-	-
ASA 2/3	1	-	-	-
Gender				
Male (Reference)	-	-	-	-
Female	2.35	2.66	0.26 - 21.5	0.448
Level of Education				
At Most Primary Education (Reference)	-	-	-	-
At Least Secondary Education	0.42	0.39	0.07-2.56	0.346
Presence of Comorbidities				
Without Comorbidity (Reference)	-	-	-	-
With Comorbidities	1	-	-	-
Presence of Vices				
Neither smoking nor alcoholic beverage drinking (Reference)	-	-	-	-
Smoking and alcoholic beverage drinking	1.77	1.64	0.29 - 10.86	0.540
Presence of Previous Operation/s				
Without previous operation (Reference)	-	-	-	-
With previous operation	0.53	0.49	0.09 - 3.23	0.489
Presence of Diagnostic Abnormalities				
Normal diagnostic tests (References)	-	-	-	-
With diagnostic result/s abnormality	2.46	2.77	0.27 - 22.42	0.425
Presence of Maintenance Medications				
0 to less than 5 maintenance medications (Reference)	-	-	-	-
More than 5 maintenance medications (Polypharmacy)	35.44	34.79	5.17-242.68	<0.001
Postoperative Data				
Duration of Operation	1.00	0.004	0.99-1.01	0.822
Duration of Anesthesia	1.00	0.03	0.99-1.01	0.775
Type of Anesthesia				
General Anesthesia/ General Anesthesia + Regional Anesthesia (Reference)	-	-	-	-
Regional Anesthesia/ Peripheral Nerve Block/ Sedation/ Monitored Anesthesia Care	1	-	-	-
Presence of Pre medications				
Without pre medications (Reference)	-	-	-	-
With pre medications	0.39	0.37	0.06 - 2.44	0.317
Post op Pain Medication				
Paracetamol + Opioids/ Paracetamol + Synthetic Opioids/ Opiates (Reference)	-	-	-	-
NSAIDs only/ NSAIDs + Opioids/ NSAIDs + Synthetic Opioids/ Opiates	0.69	0.64	0.11 - 4.23	0.687
Pain Assessment at RR				
Mild (Reference)	-	-	-	-
Moderate to Severe (6-10)	1	-	-	-
Pain Assessment 24 hours post op				
Mild (Reference)	-	-	-	-
Moderate to Severe (6-10)	65	75.20	6.73 - 627.6	<0.001

Table 8. Summary of Multiple Logistic Regression Analysis on the Occurrence of Post-operative Delirium

Variable	Full Model	Reduced Model1	Reduced Model2	Reduced Model3	Reduced Model4	Reduced Model5	Reduced Model6	Reduced Model7	Reduced Model8	Reduced Model9	Reduced Model10	Reduced Model11	Reduced Model12
	(All Predictors)	(Surgical Service omitted)	(Surgical Service and Weight omitted)	(Surgical Service, Weight and Age omitted)	(Surgical Service, Weight, Age and Laboratory Results omitted)	(Surgical Service, Weight, Age, Laboratory Results and Education omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education and Previous Operation omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education, Previous Operation and Duration of Operation omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education, Previous Operation, Duration of Operation and Post-op Medications omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education, Previous Operation, Duration of Operation, Post-op Medications and Pre medications Given omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education, Previous Operation, Duration of Operation, Post-op Medications, Pre medications Given, Duration of Anesthesia omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education, Previous Operation, Duration of Operation, Post-op Medications, Pre medications Given, Duration of Anesthesia and Personal/ Social History omitted)	(Surgical Service, Weight, Age, Laboratory Results, Education, Previous Operation, Duration of Operation, Post-op Medications, Pre medications Given, Duration of Anesthesia, Personal/ Social History and Sex omitted)
	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)
Age	1.114 (0.554)	1.100 (0.551)	1.089 (0.576)	-	-	-	-	-	-	-	-	-	-
Weight	1.031 (0.669)	1.030 (0.683)	-	-	-	-	-	-	-	-	-	-	-
Duration of Operation	0.979 (0.451)	0.980 (0.458)	0.981 (0.452)	0.981 (0.421)	0.982 (0.395)	0.982 (0.416)	0.972 (0.330)	-	-	-	-	-	-
Duration of Anesthesia	1.032 (0.307)	1.031 (0.302)	1.030 (0.290)	1.030 (0.267)	1.028 (0.261)	1.025 (0.291)	1.039 (0.241)	1.009 (0.121)	1.006 (0.178)	1.005 (0.318)	-	-	-
Surgical Service													
General Surgery/ Orthopaedic Surgery/ Otorhinolaryngology/ Plastics and Reconstructive Surgery (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
Gynecology/ Urology	1.277 (0.882)	-	-	-	-	-	-	-	-	-	-	-	-
Gender													
Male (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
Female	2,626.833 (0.143)	2,450.217 (0.137)	2,888.607 (0.134)	1,187.690 (0.125)	1,016.413 (0.132)	258.710 (0.129)	856.816 (0.122)	152.614 (0.105)	81.824 (0.140)	16,990 (0.181)	18,099 (0.163)	5,187 (0.315)	-
Level of Education													
At Most Primary Education (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
At Least Secondary Education	3.113 (0.556)	2.910 (0.570)	4.092 (0.424)	3.043 (0.487)	3.485 (0.433)	-	-	-	-	-	-	-	-
Presence of Vices													
Neither smoking nor alcoholic beverage drinking (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
Smoking and alcoholic beverage drinking	7.336 (0.299)	7.955 (0.259)	10.029 (0.191)	9.439 (0.196)	10.847 (0.179)	6.863 (0.216)	15.959 (0.117)	12.434 (0.112)	8.080 (0.156)	5.660 (0.206)	6.263 (0.172)	-	-
Previous Operation													
Without previous operation (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
With previous operation	0.211 (0.350)	0.224 (0.349)	0.231 (0.355)	0.222 (0.341)	0.247 (0.366)	0.399 (0.474)	-	-	-	-	-	-	-
Presence of Diagnostic Abnormalities													
Normal results (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
Abnormal results	0.311 (0.526)	0.306 (0.521)	0.331 (0.537)	0.313 (0.507)	-	-	-	-	-	-	-	-	-
Presence of Maintenance Medications													
0 to <5 meds (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
≥5 meds	122.436 (0.024)	117.983 (0.022)	113.532 (0.021)	90.383 (0.023)	51.541 (0.016)	32.185 (0.010)	44.043 (0.019)	29.718 (0.011)	23.993 (0.011)	22.830 (0.009)	19.314 (0.010)	19.767 (0.007)	20.411 (0.006)
Pre medications Given													
Without premeds (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
With premeds	0.038 (0.193)	0.042 (0.186)	0.040 (0.175)	0.045 (0.172)	0.056 (0.188)	0.073 (0.182)	0.021 (0.170)	0.700 (0.171)	0.172 (0.240)	-	-	-	-
Post-op Pain Medications													
Paracetamol + Opioids/ Paracetamol+ Synthetic Opioids/ Opiates (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
NSAIDS only/ NSAIDS+ Opioids/ NSAIDS+ Synthetic Opioids/ Opiates	0.239 (0.302)	0.237 (0.300)	0.228 (0.277)	0.214 (0.254)	0.291 (0.325)	0.298 (0.323)	0.127 (0.173)	0.172 (0.199)	-	-	-	-	-
Pain Assessment 24 Hours Post-op													
Mild (Reference)	-	-	-	-	-	-	-	-	-	-	-	-	-
Moderate to Severe	685.586 (0.048)	635.060 (0.044)	732.478 (0.043)	607.800 (0.042)	388.048 (0.042)	139.641 (0.029)	442.722 (0.031)	166.538 (0.014)	93.677 (0.029)	62.305 (0.021)	44.343 (0.021)	42.721 (0.016)	25.326 (0.024)

Limitations and Recommendations

This was a preliminary descriptive study which was limited to monitoring the incidence of delirium up to 24 hours post-surgery only. In subsequent studies, the follow-up period can be extended since postoperative delirium has been mentioned by some researchers to occur for as long as seven days. Potential contributory intraoperative events such as hypoxemia, hypotension, and blood loss were not included in the scope of this pilot study. Also excluded in the scope was delving into the use of common anesthetic agents which were generally known in literature to cause postoperative delirium. This would entail a more controlled and randomized type of investigation conducted in a homogenous population.

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Statement of Authorship

Both authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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APPENDICES

Appendix A. Short Portable Mental Status Questionnaire

INSTRUCTIONS: Ask the subject questions 1-10, record answer and enter as "1" under appropriate column (correct/error). All responses, to be scored correct, must be given by subject without reference to calendar, newspaper, birth certificate or other memory aid.	Control Number:	
	CORRECT	ERROR
1. WHAT IS THE DATE TODAY? Month _____ Day _____ Year _____ (Score correct only when the exact month, day and year are given correctly)		
2. WHAT DAY OF THE WEEK IS IT? Day _____		
3. WHAT IS THE NAME OF THIS PLACE? _____ (Score correct if any correct description of the location is given: "My home" accurate name of town, city or name of residence, hospital or institution (If subject is institutionalized) are all acceptable)		
4. WHAT IS YOUR TELEPHONE NUMBER? (if none, see 4A below) (Score correct when the correct number can be verified or when subject can repeat the same number at another point in question) # _____		
4A. WHAT IS YOUR STREET ADDRESS? (ask only if subject does not have a telephone) _____		
5. HOW OLD ARE YOU? AGE: _____ (Score correct when stated age corresponds to date of birth)		
6. WHEN WERE YOU BORN? Month _____ Day _____ Year _____ (Score correct only when exact month, date and year are all given)		
7. WHO IS THE PRESIDENT OF THE PHILIPPINES NOW? _____ (Only the last name of the President is required)		
8. WHO WAS THE PRESIDENT BEFORE HIM? _____ (Only the last name of the previous President is required)		
9. WHAT IS YOUR MOTHER'S MAIDEN NAME? _____ (Does not need to be verified. Score correct if a female plus last name other than subject's is given.)		
10. SUBTRACT 3 FROM 20 AND KEEP SUBTRACTING 3 FROM EACH NEW NUMBER ALL THE WAY DOWN. ____ (The entire series must be performed correctly in order to be scored correctly. Any error in series or unwillingness to attempt series is scored as incorrect)		
TOTAL NUMBER OF ERRORS		
*ADJUSTMENT FACTOR		
A) SUBTRACT 1 FROM ERROR SCORE IF SUBJECT HAS HAD ONLY A GRADE SCHOOL EDUCATION		-
B) ADD 1 TO ERROR SCORE IF SUBJECT HAS HAD EDUCATION BEYOND HIGH SCHOOL		+
TOTAL ADJUSTED ERRORS		

INFORMATION OBTAINED BY:

SCORING KEY: 0-2 errors = intellectually intact; 3-4 errors = mildly impaired; 5-7 errors = moderately impaired; 8-10 = errors severely impaired

REFERENCE: Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. J Am Geriatr Soc. 1975 Oct;23(10):433-41. doi: 10.1111/j.1532-5415.1975.tb00927.x. PMID: 1159263.

Appendix B. Preop Visit Patient Assessment Form

Control Number			
Location (Ward-Bed)		Surgical Service	
Age/Sex			
ASA Classification		Level of Education	
Weight (kg)			
Past Medical History	HTN DM Asthma Brain tumors	Epilepsy Congenital brain problems Trauma involving the head Vascular brain affectations	
Personal and Social History	Smoker _____ pack years	Alcoholic beverage drinker (indicate frequency)	History of drug use (indicate drugs used if any)
Preoperative Diagnosis			
Previous Operation (pls. specify)			
Laboratory Results	Hgb: _____ Na: _____ Mg: _____ FBS: _____ Hct: _____ K: _____ BUN: _____ WBC: _____ Cl: _____ Crea: _____ Plt: _____ Ca: _____ Albumin: _____ CXR: _____ ECG: _____ 2D Echo: _____ PT: _____ PTT: _____		
Current Medications			

Appendix C. Confusion Assessment Method Instrument

Control Number: _____

Acute Onset

1. Is there evidence of an acute change in mental status from the patient's baseline?
 Yes ___ No ___

Inattention

- 2A. Did the patient have difficulty focusing attention, for example, being easily distractible, or having difficulty keeping track of what was being said?
 ___ Not present at any time during interview
 ___ Present at some time during the interview, but in mild form
 ___ Present at some time during the interview, in marked form
 ___ Uncertain
- 2B. (If present or abnormal) Did this behavior fluctuate during the interview, that is, tend to come and go or increase or decrease in severity?
 Yes ___ No ___ Uncertain ___ Not applicable ___
- 2C. (If present or abnormal) Please describe this behavior.

Disorganized thinking

3. Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas or unpredictable switching from subject to subject?
 Yes ___ No ___

Altered level of consciousness

4. Overall, how would you rate this patient's level of consciousness?
 ___ Alert (normal)
 ___ Vigilant (hyperalert, overly sensitive to environmental stimuli, startled very easily)
 ___ Lethargic (drowsy, easily aroused)
 ___ Stupor (difficult to arouse)
 ___ Coma (unarousable)
 ___ Uncertain

Disorientation

5. Was the patient disoriented at any time during the interview, such as thinking that he or she was somewhere other than the hospital, using the wrong bed, or misjudging the time of the day?
 Yes ___ No ___

Memory impairment

6. Did the patient demonstrate any memory problems during the interview, such as inability to remember events in the hospital or difficulty remembering instructions?
 Yes ___ No ___

Perceptual disturbances

7. Did the patient have any evidence of perceptual disturbances, for example, hallucinations, illusions, or misinterpretations (such as thinking something was moving then it was not)?
 Yes ___ No ___

Psychomotor agitation

8. (Part1) At any time during the interview, did the patient have an unusually increased level of motor activity, such as restlessness, picking at bed clothes, tapping fingers or making frequent changes in position?
 Yes ___ No ___

Psychomotor retardation

8. (Part2) At any time during the interview, did the patient have an unusually decreased level of motor activity, such as sluggishness, staring into space, staying in one position for a long time or moving very slowly?
 Yes ___ No ___

Altered sleep-wake cycle

9. Did the patient have evidence of disturbance of the sleep-wake cycle, such as excessive day-time sleepiness with insomnia at night?
 Yes ___ No ___

Appendix D. Post Op Visit Patient Assessment Form

Control Number		Location (Ward-Bed)	
Surgical Service		Type of Anesthesia	
Duration of Surgery		Duration of Anesthesia	
Surgical Operation done			
Premedications given			
Post op Pain Medication/s			
Pain Assessment at PACU	Upon receiving at PACU:		
	At 15 minutes:		
	At 30 minutes:		
	At 45 minutes:		
	At 1 st hour:		
	Prior to transout:		
	24 hours post op:		

Appendix E. Confusion Assessment Method Diagnostic Algorithm

Feature 1	Acute Onset and Fluctuating Course This feature is usually obtained from a family member or nurse and is shown by positive responses to the following questions: Is there evidence of an acute change in mental state from the patient's baseline? Did the (abnormal) behavior fluctuate during the day, that is, tend to come and go, or increase and decrease in severity?
Feature 2	Inattention This feature is shown by a positive response to the following questions: Did the patient have difficulty focusing attention, for example, being easily distractable, or having difficulty keeping track of what was being said?
Feature 3	Disorganized thinking This feature is shown by a positive response to the following questions: Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject?
Feature 4	Altered Level of Consciousness This feature is shown by any answer other than "alert" to the following question: Overall, how would you rate this patient's level of consciousness? [alert (normal), vigilant (hyperalert), lethargic (drowsy, easily aroused), stupor (difficult to arouse), or coma (unrousable)]

*The diagnosis of delirium by CAM requires the presence of Features 1 and 2 and either 3 or 4.

REFERENCE: Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegel AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med.* 1990 Dec 15;113(12):941-8. doi: 10.7326/0003-4819-113-12-941. PMID: 2240918.