Role of Comorbidity Polypharmacy Score in Prediction of Post-Operative Outcome in Geriatric Patients - A Prospective Observational Study in a Tertiary Care Hospital in Mysore

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ABSTRACT

BACKGROUND

Comorbidity in elderly has negative impact on physiological and cognitive functions, the prevalence of which is increasing. Management of multiple comorbidities has resulted in polypharmacy in elderly. Comorbidity Polypharmacy Score (CPS) is a clinical tool to quantify severity of comorbidities using polypharmacy as surrogate for intensity of treatment required to adequately manage comorbidities. We wanted to evaluate CPS as predictor of post-operative outcomes in geriatric patients undergoing elective surgeries.

METHODS

A prospective observational study was conducted in a tertiary care centre among elderly patients (more than 65 years) undergoing elective surgeries satisfying inclusion criteria. Calculated sample size was 250. CPS was calculated by assigning one point to each comorbidity and medication taken and sum calculated was categorised. Primary outcomes were defined by hospital length of stay and Barthel index at day 3 and day 5.

RESULTS

We found moderate positive correlation using Pearson Correlation with CPS and Barthel index at day 3 (p - value = 0.0024, correlation coefficient = - 0.191) and day 5 (p - value = 0.0013, correlation coefficient= -0.202). ANOVA test was applied to compare age with Barthel index at day 3 (p - value = 0.0005) and day 5 (p - value < 0.0001) which was statistically significant. Advanced age was not associated with longer Length of Stay (LOS) (p - value = 0.32). CPS was also not associated with longer LOS (p - value = 0.821).

CONCLUSIONS

CPS is an easy to measure tool for the evaluation of elderly surgical patients. CPS can be used to predict recovery in terms of activities of daily living (ADL) after surgery thereby preparing patient and family to cope up with stress of surgery and its financial and psychological outcomes.

KEYWORDS

Geriatric Anaesthesia, Comorbidity-Polypharmacy Score, Activities of Daily Living, Length of Stay, Barthel Index

BACKGROUND

Aging is a natural physiological process characterised by deterioration of structural and functional capacity of tissues and organs. There is variable progression of loss of functional reserve. Often the loss is compensated, but during stressful perioperative period, the compensations fall short.[1]

Recent demographic data globally is indicative of an increased life expectancy over the age of 65 years. Estimated prediction of life expectancy suggests that 25 % population will be senior citizens by year 2040. The recent census of India indicates that 9.30 % of Indian population is above 60 years of age[2] approximating to around 140 million people. The demographical shift in developing countries such as India has created a major challenge for healthcare providers in areas of medical and surgical management of illnesses.[3]

An individual is more likely to remain physically active and productive even in later years of life. Progress in technology and medicine has allowed a large number of elderly patients to survive illness[4] and are more likely to visit health care providers for various types of surgeries.[5]

One of the hallmark features of modern healthcare system is the ability to manage the comorbidities with multiple medications i.e., polypharmacy. Predictably, a highly morbid condition would require more medications for treatment than a less severe condition.[6] Polypharmacy may be used as a surrogate to measure severity of comorbid conditions that the elderly individual has been suffering. Although a necessity, the use of multiple medications itself pose some potential threats to patients. These include adverse drug reactions and interactions, medication errors, falls, poor patient adherence, cognitive and functional decline.[7]

Comorbid conditions, in a way, allow estimation of overall health status of the individual. Polypharmacy allows gauging the severity of the comorbidity. However, neither correlates well with mortality and morbidity when examined separately with confounding factor being chronological age does not necessarily correlate with physiological age.[6] To overcome the epiphenomenon of comorbidity and polypharmacy, Comorbidity Polypharmacy Score (CPS) was devised to use as simple clinical tool that quantifies overall severity of comorbidities using polypharmacy as surrogate indicator of severity of such comorbid conditions. CPS is intended to be a super-score which is easy to calculate, derived by counting all known pre-hospital comorbid conditions and medications.[7] Patients with more comorbidities on admission have a higher risk of post-operative complications and mortality.

Although intuitively one can suggest the outcome of a patient after surgery, fewer tools are available to quantify the risk involved and to predict outcomes. In elective geriatric surgery, adverse outcomes are associated with frailty measures that include loneliness, poor nutritional status, functional status, cognitive impairment and depression. Comorbidity and medications constitute a part of measurement of frailty. Even though negative impact of surgical stress in the elderly is a known entity, studies to validate the same are lacking. This study is an effort to establish the association between CPS and post-operative outcomes in this vulnerable group of patients.

We wanted to evaluate CPS as a predictor of post-operative outcomes in geriatric patients undergoing elective surgeries.

METHODS

This prospective observational study was conducted from November 2016 through July 2018 in JSS Hospital and Medical College, Mysore. Sample size was calculated as 250 considering 10 % incidence of Intensive Care Unit (ICU) admission (which usually translates to longer Length of Stay in hospital with low Activities of daily living (ADL) for all geriatric post-operative patients in our hospital and anticipated odds ratio of 2 for higher CPS having longer length of stay, power of study as 0.9, confidence interval of 95 % and alpha error of 0.05. Sample size was calculated using SPSS v.22 software.

Patients included were above 65 years of either sex undergoing elective non cardiac, intermediate and major risk surgeries, who were mobile and without any neuropsychiatric illnesses. Emergency surgeries were excluded.

Following the approval of Institutional ethics committee, informed consent was taken from patients satisfying inclusion criteria.

Preoperative Assessment and Procedure

Preoperative assessment was done by listing the comorbidities and medications of the patient. Comorbidities were confirmed by relevant investigation reports. Each comorbidity was assigned a score of 1 and each drug taken by the patient was assigned a score of 1. Previous surgeries were assigned a score of 1 for each surgery. CPS = Number of comorbidities + number of medications. Patients group were categorised as mild (CPS 0 - 4 points), moderate (CPS 5 - 7 points), severe (CPS 8 - 10 points) and morbid (CPS > 10 points).[8]

A surgery was considered major if it exceeded more than 2 hours or blood loss of more than 500 ml. Rest were considered as intermediate risk surgeries.[9] Basal vitals were recorded and anaesthesia administered based on type of surgery. General endotracheal anaesthesia and regional anaesthesia were administered as per standard hospital protocol. Standard ASA monitoring of Spo2, ECG, nasopharyngeal or skin temperature, non-invasive blood pressure (NIBP) and End tidal carbon dioxide (EtCo2) were recorded intraoperatively.

Post-operative outcomes were Post-operative morbidity, Post Anaesthesia Care Unit (PACU) admission and length of stay in hospital (LOS) post-surgery, ICU admission and LOS in ICU. Post-operative morbidity included disability at post-operative day 3 and day 5. Disability is defined as help for ADL such as walking, bathing, personal grooming, dressing, eating, getting from bed to chair, using the toilet.[10] Quantitative assessment was done using Barthel Index

(Table 5). Barthel Index is a questionnaire by Collins et al. to assess the physical dependency.

Statistical Analysis

Descriptive and inferential statistics were used in our study. Data analysed using SPSS v22.0 software. Age groups, ASA classification, comorbidities and type of surgeries were described using percentage. Continuous variables which are CPS, ADL, Length of Stay were described using mean and standard deviation. Pearson's correlation was used to assess correlation of CPS with LOS and ADL. ANOVA was applied to test the dependence of the average values against groups. For study variables on categorical scale, Chi square test was used to find the p value. The associations, differences and correlation are interpreted statistically significant at P < 0.05.

RESULTS

Demographics

Minimum age for inclusion was 65 years. Maximum age of the patient who met inclusion criteria was 90 years, giving a range of 35 years. Mean age was 69.86 years with an SD of 5.10 years with subgroups as shown in Table 1. ASA Classification of the patients were as shown in Table 2.

Age Group(Yrs.)	N = 251	Percentage
65 - 70	162	64.54 %
71 - 74	37	14.74 %
75 - 80	40	15.94 %
> 80	12	4.78 %
Table 1. Distribution of Age in Patients of Study		

ASA Classification	N = 251	Percentage
1	28	11.16 %
2	148	58.96 %
3	73	29.08 %
4	2	0.80 %
Table 2. ASA - PS Classification in Patients of Study		

Comorbidities

Hypertension (52.9 %) was highest among the patients followed by diabetes mellitus (46.6 %). Chronic obstructive pulmonary disease (COPD) was the next highest with 21.1 % patients. Rest of the comorbidities are depicted in Figure 1.
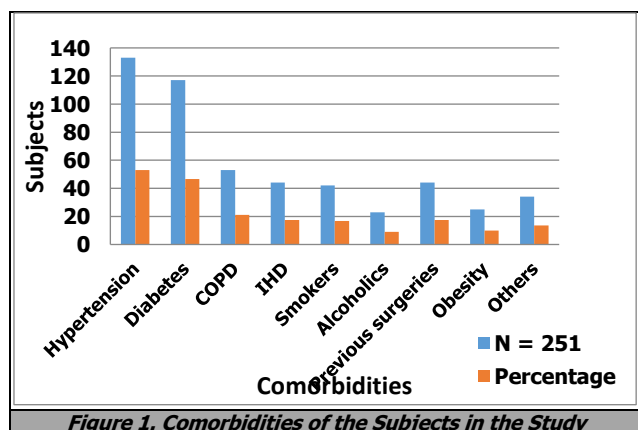

Figure 1. Comorbidities of the Subjects in the Study

Distribution of Cases

85 % of subjects underwent general anaesthesia and rest regional anaesthesia. 101 surgeries were major surgeries and 150 were intermediate risk surgeries with specialties ranging as in figure 2.
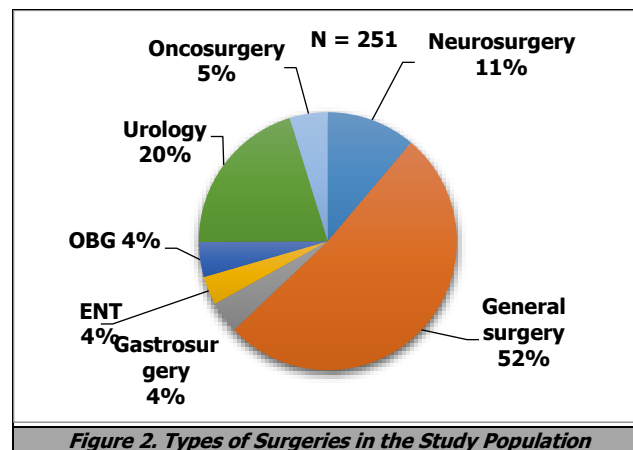

Figure 2. Types of Surgeries in the Study Population

Comorbidity Polypharmacy Score

Average CPS of study population was 4.9 with a standard deviation of 3.97. 102 patients were in mild group and 87 had moderate CPS. Age of the patient did not have any correlation with CPS (P = 0.0745) (Table 3).

Age Group in Years	AVERAGE of CPS	STDEV of CPS	AVERAGE of Barthel Index Day 3	STDEV of Barthel Index - Day 3	AVERAGE of Barthel Index - Day 5	STDEV of Barthel Index - Day 5	Average Length of Stay (days)
65 - 70	4.74	3.87	16.06	3.12	16.69	3.1313	7.46
71 - 74	4.73	4.58	13.97	3.25	15	3.266	8.59
75 - 79	4.83	3.59	16.1	2.46	16.75	2.619	9.82
> 80	7.83	3.88	13.73	5.37	14.18	5.8791	6
P-value	0.0745		0.00059		0.00377		0.32
Table 3. A Comparison of Age Group with Average CPS, Barthel Index at Day 3, Barthel Index at Day 5 and LOS							

Length of Hospital Stay

CPS was compared with Hospital LOS. Average LOS after completion of surgery was 7.9 days, with a SD of 8.24. A comparison of CPS and LOS done using Pearson correlation test found to be - 0.017 and p - value = 0.82 and was not significant as shown in Table 4.

Activities of Daily Living

ADL was measured using Barthel index of ADL (Table 5) at post-operative day 3 and day 5 and were compared. Age and ADL had negative correlation and were significant as shown in table 3. There was a negative correlation between CPS and Barthel index at day 3 as well as day 5 and it was statistically significant (P value - 0.0024 and P = 0.0013 resp.) shown in Table 4. Both were compared using Pearson correlation test.

CPS	N = 251	AVERAGE of Barthel Index-Day 3	STDEV of Barthel Index - Day 3	AVERAGE of Barthel Index-Day 5	STDEV of Barthel Index-Day 5	Average LOS
0 – 3	102	16.03	3.0988	16.77	3.1869	8.088
04 - 07	87	15.83	2.799	16.51	2.706	7.44
08 - 10	39	15.56	2.9806	16.28	2.9996	8.89
> 10	23	13.31	5.0369	13.72	5.1194	7.52
p - Value		0.002419		0.001316		0.821

Table 4. Comparison of CPS Groups with Barthel Index at Day 3 and Day 5 and Average LOS

Bowels 0 = Incontinent or needs enemas 1 = Occasional accident (1x / wk.) 2 = Continent	**Transfer (bed to chair and back)** 0 = Unable, no sitting balance 1 = Major help (1 or 2 people), can sit 2 = Minor help (verbal or physical) 3 = Independent
Bladder 0 = Incontinent or needs enemas 1 = Occasional accident (1x / wk.) 2 = Continent	**Mobility** 0 = Immobile 1 = Wheelchair independent (including corners) 2 = Walks with the help of 1 person (Physical or verbal help) 3 = Independent (may use aid)
Grooming 0 = Needs help with personal care 1 = Independent (including face, hair, teeth, shaving	**Dressing** 0 = Dependent 1 = Needs help – can do ~ ½ unaided 2 = Independent (including buttons, zips, laces, etc.)
Toilet Use 0 = Independent 1 = Needs some help 2 = Independent	**Stairs** 0 = Unable 1 = Needs help (verbal or physical) 2 = Independent
Feeding 0 = Unable 1 = Needs help, e.g. cutting 2 = Independent	**Bathing** 0 = Dependent 1 = Independent (bath or shower)
Note: < 15 – usually represents moderate disability, · < 10 – usually represents severe disability	

Table 5. Barthel Index for Activities of Daily Living

DISCUSSION

The impact of anaesthesia and surgery on elderly patients is profound. It can lead to a vicious cycle of dependency, depression and neglect from family members. The standard risk assessment i.e., ASA - PS alone cannot predict the risk involved in geriatric patients as it is an extrapolated assessment. We used CPS to predict the post-operative outcomes in the elderly patients undergoing elective surgeries and were able find a correlation between CPS and ADL at day three and day five.

CPS was developed to facilitate the rapid assessment of elderly patients in emergency settings. The use of CPS in trauma is well established by various studies. A study by Evans et al.[11] in 2011 evaluated CPS in trauma patients for outcomes and found that higher CPS is associated with longer hospital stay, increased risk of complications and lower functional outcomes. However, all studies were retrospective studies and in trauma settings.[6,8,11,12,13]

There were no studies done prospectively and in elective surgeries to assess the utility of CPS score to predict the outcomes. We undertook this study with an alternate hypothesis that CPS can be used to predict the surgical outcomes in elderly patients undergoing elective surgeries.

CPS was calculated based on the number of comorbidities and polypharmacy. Average CPS of the patients recorded was 4.9 with SD of 3.9. Meerani et al. conducted a study of predictors of in-house mortality and complications of patients undergoing emergency surgery in 2014. They used the classification of CPS as follows- 0 - 3, 4 - 7, 8 - 10, and more than 10.[8] We adopted this classification in our study as mild, moderate, severe and very severe respectively. Accordingly, elderly patients with mild CPS were 40.64 % whereas very severe were 9.6 %. When CPS was compared with different age groups of our study, we found that advanced age was not associated with higher CPS scores. This was in contrast with the findings of study conducted by Evans et al.[6] where they found that advanced age was associated with higher CPS. However, the relation of age and CPS might be biased considering the healthcare access of our elderly population for availing medications, not to mention the neglect of patients themselves and by their family members.

Hospital LOS is a surrogate for recovery of patient and return of ability to perform ADL. Age was not associated with longer LOS in our study. However, LOS was surprisingly less for age group of > 75 years. Similar results were seen in the study by Evans et al. with 6 days of LOS.[6] Both study values were comparable. Statistical predictions suggest that advanced age should be associated with longer LOS. However longer LOS translates to financial burden onto family, forcing them to take the patient out of hospital care. In our study, there were 30 such patients who were discharged against medical advice (DAMA).

There was statistically no significant relationship between LOS and CPS. This is in contrast to the studies done by Evans et al..[6] Mubang et al.[12] where they found that CPS positively correlated with hospital LOS. However, study by Holmes et al.[13] found no correlation between CPS and LOS. If we exclude the patients with discharge at request or DAMA, we might have found similar correlation.

We used Barthel Index to quantify the ADL which has a total score of 20. Barthel index at day three and day five after surgery was recorded. Average Barthel index in age group of 71 - 74 showed significant improvement of two points. There was a negative correlation between CPS and Barthel Index as shown by Pearson correlation test. As CPS increased, Barthel index of patients decreased at both days three and day five of post-surgery. There has been only one study by Evans et al.[6] that compared CPS and ADL in trauma patients. However, they found no correlation between CPS and functional outcome measures.

Higher CPS could indicate lower physiological reserve and in turn delay in recovery. Most of the studies which compared ADL either did with isolated comorbidity or polypharmacy but never together.[14,15] However we were able to find moderate correlation between CPS and ADL post-operatively.

Observational studies require large study population. Our sample size is one of the strengths of the study. As it was a prospective observational study, our study population was large enough to arrive at conclusions. We compared CPS with ADL which was not done in any similar study, but one.[6] Our study identified CPS as a predictor of improvement of ADL in elderly patient undergoing elective surgeries, which, to the best of our knowledge, has not been done before. The advantage of CPS lies in its simplicity to assess quickly the severity of the comorbidities at the bedside.

CONCLUSIONS

CPS can be used to predict the ADL which in turn is a surrogate for recovery after surgery and anaesthesia. However, CPS did not correlate well with age and LOS. Surgical complications in the elderly involve a complex relationship between baseline vulnerability and precipitating insults that occur preoperatively. Identifying high risk geriatric patients and developing tailored preventive strategies should be a focus to improve care and reduce dependency.

Limitations

Undiagnosed chronic illnesses might result in low CPS. Good health care access and aggressive primary preventive care services can result in higher polypharmacy whereas the opposite can lead to lower scores. All comorbidities are treated equal and are assigned equal importance. But practically, all comorbidities do not have equal impact on surgical outcomes. Similarly, all the medications are given equal importance. We did not exclude the patients who left the hospital against medical advice.

In future, one could combine various comorbidity indices available and prove the temporal causation of the outcomes with the indices. Studies comparing the ADL before the surgery are lacking. A comparative study with ADL preoperatively and improvement in ADL post-operatively, or interventions to reduce the severity of the comorbidity, thereby decreasing the polypharmacy and consequently decreasing the CPS may foster better post-op outcomes.

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