

## Influence of changing trends in anaesthetic practice on morbidity and mortality in elderly patients undergoing lower limb surgery

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### ABSTRACT

**Background and Aims:** Several changes in the management protocols of anaesthesia for geriatric patients were introduced into clinical practice to improve the outcome. Very few studies have evaluated the impact of these management protocols. The aim of our study was to evaluate impact of some of the changes in the peri-operative management protocols of geriatric patients undergoing elective orthopaedic lower limb surgeries on the outcomes. **Methods:** A retrospective chart review of thirty-eight surgical patients from 1999 (Group 1999) before the introduction of changes and 107 patients from 2007 (Group 2007) after establishing changes was performed and data of peri-operative variables were collected and analysed. The primary outcome measured was in-hospital mortality. The secondary outcomes were occurrence of intra-operative and post-operative complications. Comparison of continuous variables between the two groups was performed using independent sample T test and categorical variables using Chi-square test. Multivariate logistic regression was done to identify independent predictors of mortality.

**Results:** The use of beta blockers, deep vein thrombosis prophylaxis with low molecular weight heparin and epidural technique for post-operative analgesia was higher in group 2007. Despite higher prevalence of patients with electrocardiographic changes and anaemia, the incidence of intra-operative or post-operative complications was lower in 2007, though the mortality rate in both the groups was comparable. The independent risk factors for mortality in these geriatric patients were intra-operative hypotension (Odds Ratio (OR) = 11.33) and post-operative myocardial ischaemia (OR = 34.5), pulmonary embolism (OR = 17.1) and neurologic changes (OR = 17.1).

**Conclusions:** Implementation of new management practices had significantly reduced the incidence of intra- and post-operative complications.

**Key words:** Anaesthesia, beta-2 adrenergic blocking agents, deep vein thrombosis, epidural, geriatrics, in hospital mortality, lower extremity, peri-operative complications

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### INTRODUCTION

There are an increasing number of elderly patients undergoing orthopaedic procedures.<sup>[1]</sup> The incidence of post-operative morbidity and mortality is higher in geriatric patients owing to the increased incidence of complications such as myocardial ischaemia (MI), stroke, dementia, renal dysfunction, pulmonary embolism (PE) and other respiratory complications.<sup>[2]</sup> Beta blocker usage,<sup>[3]</sup> deep vein thrombosis (DVT) prophylaxis and

use of regional anaesthesia (RA) have been shown to improve the outcome.<sup>[4]</sup> However, intra-operative hypotension, intra-operative bleeding and neurological complications like stroke resulting from these management strategies may adversely affect the outcome.<sup>[5]</sup> Very few studies have evaluated the overall impact of these management practices on the outcome of geriatric patients. Frequent use of beta blockers, DVT prophylaxis and combined spinal and epidural (CSE) anaesthesia in place of spinal anaesthesia alone were

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introduced into clinical practice in our institute from the year 2000 and were established by the year 2006. We aimed to evaluate the impact of these factors on the peri-operative management of geriatric patients undergoing elective orthopaedic lower limb surgeries by comparing the patients operated before and after the establishment of these changes in practice.

## METHODS

After Institutional Ethics Committee's approval, a retrospective comparative study was undertaken on patients aged over 65 years who underwent elective lower limb orthopaedic procedures in the years 1999 and 2007. The major changes in the management since 2000 included use of perioperative low molecular weight heparin (LMWH) for DVT prophylaxis, perioperative beta-blocker in patients with high cardiac risk, regional anaesthesia by CSE and post-operative pain management by epidural analgesia. The year 2007 was chosen as most of the management changes were established and implemented by then. Data were obtained from anaesthesia records and medical records. Patients with incomplete case records were excluded. Thirty-eight patients operated in the year 1999 (group 1999) were compared with 107 patients operated in the year 2007 (group 2007). The chart review focused on pre-operative co-morbid diseases, intra-operative events, post-operative complications and post-operative mortality. Pre-operative factors noted included demographic information (such as age and gender), diabetes, hypertension, beta blocker usage, cardiac problems (abnormal echocardiography findings, coronary artery disease (CAD), valvular heart disease, arrhythmias, conduction blocks), neurologic disorders, respiratory disorders, renal disease, abnormal electrolyte findings, history of smoking, history of fever and DVT prophylaxis with LMWH.

The intra-operative variables noted were the type of anaesthesia, occurrence of episodes of hypotension, hypertension and cardiac ischaemia. Hypotension in the peri-operative period was defined as systolic blood pressure (SBP) 25% lower than the baseline value for 5 or more minutes, patients requiring fluid boluses, vasopressors or inotropes for management of haemodynamics. Cardiac ischaemia was diagnosed when the new ST-T changes were more than 1mm for more than 15 minutes, elevation of Troponin T enzyme levels and/or associated hypotension or hypertension. Hypertension was labelled when the SBP was >160 mmHg and / or diastolic blood pressure >110 mmHg

for more than 10 minutes in the intra-operative period, requiring boluses or continuous infusion of vasodilators like nitroglycerin. The post-operative complications of cardiac ischaemia, deep vein thrombosis (DVT)/pulmonary thromboembolism (PTE), fluid and electrolyte abnormalities, gastrointestinal complications, respiratory complications, neurologic complications, wound infections and other complications were noted until discharge or death. DVT was assessed clinically by symptoms and signs of lower limb swelling, localised tenderness along the lower limb veins, calf tenderness and calf swelling. The diagnosis was confirmed by Doppler examination. Patients having nausea, vomiting, diarrhoea and abdominal pain were considered to have gastrointestinal complications. Patients presenting with delirium, stroke or transient ischaemic attack were considered to have neurologic complications. Patients having cough with expectoration, crepitations, new infiltrates on chest radiograph and inadequate respiratory effort were considered to have respiratory complications. Hyponatraemia was defined as sodium levels less than 130 mEq/ml. The length of post-operative hospital stay (LPOHS) (interval between surgery and discharge from the hospital or death) was noted. The occurrence of intra-operative and post-operative complications was considered as a surrogate measure of outcome of the anaesthetic protocols and in-hospital mortality as a final measure of anaesthetic management. The peri-operative variables were noted and the measures of outcomes were compared between the two groups. Although not considered during the initial planning of the study, independent risk factors for intra-operative and post-operative complications and mortality were determined post-hoc from the total data set.

Statistical analysis was performed using SPSS13. Comparison of continuous variables like age, serum sodium levels (mEq/dl), haemoglobin (Hb gm%), blood urea (mg/dl), serum creatinine, SBP, fasting blood sugar (FBS) and LPOHS between the two groups- group 1999 and group 2007 was made using independent sample T test. Comparison of categorical variables like hypertension, diabetes, presence of hyper/hyponatraemia, coronary artery disease, use of beta blockers, X-ray changes, abnormal echocardiography findings, valvular heart disease (VHD), arrhythmias, conduction block defects, neurological disorders, respiratory disorders, smoking, bed sore, fever, DVT prophylaxis, abnormal renal findings and hyperkalaemia were compared between the two groups using Chi-square test. A *P* value < 0.05 was considered as significant for all tests.

Linear correlation between the variables was noted and the outcome measure - mortality was determined using non-parametric Spearman's test on the total data set. A multivariate logistic regression was done using the pre, intra and post-operative variables with significant association on univariate analysis, to identify independent predictors of mortality. Results are presented as odds ratio (>1) for the variables which were found to be significant. The variables with odds ratio values >1 were considered significant.

## RESULTS

The number of cases in group 1999 was 38 and 107 in group 2007. The mean age in the group 1999 was  $73.53 \pm 6.96$  and in group 2007 was  $71.6 \pm 6.32$ . The male:female ratio in the group 1999 was 23:15 and 98:9 in the group 2007. The surgical indications in both the groups were: out of 38 patients in Group 1999 and 107 in 2007, hip surgeries – 33/81, femur surgeries – 4/5, leg surgeries – 1/10 and other degenerative conditions – 0/11. The type of anaesthesia in both the groups are compared and listed in Table 1. There was a statistically significant increase in the incidence of CSE anaesthesia in group 2007 compared to that in the year 1999. The numbers of patients who had epidurals for management of post-operative pain were significantly greater in 2007. Among the pre-operative variables tested in both the groups, male gender, use of beta blockers, DVT prophylaxis with LMWH and electrocardiographic (ECG) changes were found to be comparatively higher in group 2007 [Table 2]. The pre-operative Hb levels were comparatively lower and SBP was better controlled in group 2007 [Table 3].

The intra-operative and post-operative complications between 1999 and 2007 are compared in Tables 4 and 5. The number of patients who did not develop any intra-operative or post-operative complications was higher in 2007. The incidence of intra-operative hypotension was found to be significantly lower in the year 2007. The LPOHS was comparable in both the groups. The mean LPOHS was 12.26 days in Group 1999 and 11.1 days in Group 2007 ( $P = 0.38$ ). The mortality rate in groups 1999 and 2007 was 5.4% and 2.8%, respectively [Table 6]. Two patients in group 1999 and three patients in group 2007 had mortality and this was not significant between the two groups. Out of two patients in group 1999, one patient had received epidural anaesthesia with stable haemodynamics but had post-operative pulmonary thromboembolism and finally succumbed. The other patient had

**Table 1: Comparison of type of anaesthesia in both the groups**

Type of anaesthesia	Group 1999 (%)	Group 2007 (%)
Spinal	24 (64.9)	53 (49.5)
Epidural	5 (13.5)	15 (14)
CSE	3 (8.1)	31 (29)*
GA+RA	1 (2.7)	1 (0.9)
GA	4 (10.8)	6 (5.6)
Regional blocks	0 (0)	1 (1)
PO analgesia with epidural	9 (24.3)	47 (43.9)†

\*0.005, †0.026. CSE – Combined spinal epidural; GA – General anaesthesia; RA – Regional anaesthesia; PO – Post-operative

**Table 2: Comparison of pre-operative categorical variables between the groups**

Pre-operative parameters	Group 1999 (%)	Group 2007 (%)	P value
Male gender	23 (60.5)	98 (91.6)	<0.001*
Diabetes	7 (18.4)	28 (26.2)	0.2
Hypertension	19 (50)	67 (62.6)	0.12
On Beta blockers	5 (13.2)	34 (31.8)	0.02*
CAD	7 (18.4)	6 (12)	0.29
Abnormal ECG	4 (10.5)	26 (24.3)	0.05*
Abnormal ECHO	4 (10.5)	13 (12.1)	0.5
Other cardiac findings‡	2 (5.3)	14 (13.1)	0.15
Neurological	2 (5.3)	10 (9.3)	0.34
Respiratory‡	5 (13.2)	10 (9.3)	0.35
Smoking	2 (5.3)	10 (9.3)	0.35
DVT prophylaxis	1 (2.6)	96 (89.7)	<0.001*
Renal§	7 (18.4)	9 (8.4)	0.09
Miscellaneous	1 (2.6)	3 (2.8)	0.7

CAD – Coronary artery disease; ECG – Electrocardiographic; ECHO – Echocardiographic; DVT – Deep vein thrombosis; \*Statistically significant, †Includes valvular heart disease, arrhythmias and conduction blocks, ‡Includes both abnormal respiratory and chest X ray findings, §Includes both abnormal renal changes and hyperkalaemia, ||Includes alcohol intake, bed sore and fever

**Table 3: Comparison of pre-operative continuous variables in both the groups**

Pre-operative variables	Group 1999 mean	95% C.I. for the mean		Group 2007 mean	95% C.I. for the mean		P value
		LL	UL		LL	UL	
Age (years)	73.53	71.24	75.8	71.6	70.4	72.8	0.12
S.Na* (mEq/dl)	137.1	135.2	138.9	138.2	137	139	0.36
Hb (gm %)	11.7	11.1	12.3	10.9	10.5	11.2	0.01*
Bl.Urea (mg/dl)	39.2	32.8	45.7	36.2	33.7	38.6	0.19
S. Creatinine (mg/dl)	1.2	0.9	1.4	1.07	1	1.2	0.39
SBP (mmHg)	148.2	141.6	154.8	136.2	133.2	139.2	0.0*
Fast BS (mg/dl)	110.6	101.8	119.3	123	114	132.5	0.13

S. – Serum; Na\* – Sodium; Bl – Blood; SBP – Systolic blood pressure; BS – Blood sugar. \*Statistically significant

**Table 4: Comparison of intra-operative parameters in both the groups**

Intra-operative parameters	Group 1999 (%)	Group 2007 (%)	P value
Stable	34 (89.5)	106 (99.1)*	0.014
Hypotension	3 (7.9)	1 (0.9)*	0.05
Cardiac ischaemia	1 (2.6)	0 (0)	0.26

\*Statistically significant

**Table 5: Comparison of post-operative parameters and mortality in both the groups**

Post-operative parameters	Group 1999 (%)	Group 2007 (%)	P value
None	30 (78.9)	87 (89.7)	0.08
Cardiac	0 (0)	2 (1.9)	0.54
PTE	1 (2.6)	2 (1.9)	0.6
GI tract infection	0 (0)	2 (1.9)	0.54
Fluid/electrolyte/renal changes	1 (2.6)	0 (0)	0.26
Neurological changes	2 (5.3)	1 (0.9)	0.17
Respiratory problems	1 (2.6)	0 (0)	0.26
Wound infection	1 (2.6)	1 (0.9)	0.46
Others	2 (5.3)	3 (2.8)	0.4
Mortality	2 (5.4)	3 (2.8)	0.38

PTE – Pulmonary thromboembolism; GI – Gastrointestinal

**Table 6: Odds ratio for significant variables which correlated with the outcome**

	Odds ratio	95% C.I	
		Lower limit	Upper limit
i/o hypotension	11.33	0.96	134.25
p/o PTE	17.125	1.27	230.15
p/o cardiac complications	34.5	1.815	655.66
p/o neurological complications	17.125	1.27	230.15

i/o – Intra-operative; p/o – Post-operative; PTE – Pulmonary thromboembolism

intraoperative hypotension with spinal anaesthesia and treated but finally had stroke in the post-operative patient. In Group 2007, out of 3 patients with mortality, one patient received spinal anaesthesia with stable intraoperative period, but he had severe inferior wall myocardial infarction and finally died with uncontrolled CVS instability. The second patient had received general anaesthesia but finally succumbed with stroke and its complications. The other patient had undergone surgery under spinal anaesthesia with stable haemodynamics but had massive pulmonary embolism and died.

The factors which were found to be significant for the mortality on univariate analysis were presence of intra-and post-operative complications. The independent risk factors associated with mortality for the entire set of patients included in the study were occurrence of intra-operative complications like hypotension (Spearman Rho ( $\Omega$ ) = 0.2,  $P$  = 0.017) and post-operative complications like cardiac ischaemia ( $\Omega$  = 0.3,  $P$  = 0), DVT ( $\Omega$  = 0.38,  $P$  = 0.0) and neurologic changes ( $\Omega$  = 0.24,  $P$  = 0.004). Odds ratio for these variables are depicted in Table 6.

## DISCUSSION

The factors like intra-operative hypotension, post-operative cardiac changes, DVT and neurological

changes were found to have significant association with mortality. The incidence of pulmonary thromboembolism is quite high in orthopaedic patients. There is evidence that the use of protocols that have included use of DVT prophylaxis, beta blockers and regional anaesthesia have improved the outcome.<sup>[6]</sup> The implementation of these protocols is likely to result in complications like intra-operative bleeding, hypotension and neurological effects. The impact of the use of these protocols on peri-operative management has not been evaluated. Hence, the peri-operative anaesthetic management and the complications in both the group were studied and compared. There was no significant difference in mortality between the time periods. The incidence of ischaemic ECG changes and the use of beta blockers in the pre-operative period were significantly high in 2007. Though there was significantly higher proportion of patients with both ECG changes and clinical CAD in 2007, there was no significant difference in the incidence of peri-operative ischaemia. The incidence of intra-operative hypotension was significantly lower in the year 2007 than in the year 1999 despite higher incidence of use of beta-blockers. Post-operative cardiac complications had a significant correlation with the outcome. The decreased incidence of cardiac complications in 2007 again may be attributed to the increased use of beta blockers. Randomised clinical trials which evaluated the effects of beta-blockers on all-cause mortality in patients undergoing non-cardiac surgery have yielded conflicting results.<sup>[7,8]</sup> Pre-operative detection of coronary insufficiency and optimisation of such cases with beta blockers and modification in the anaesthetic management could have also resulted in lowering the post-operative cardiac risk in our study. This was an indirect evidence that beta blockers had a protective effect in high cardiac risk patients. Though the current data is insufficient to demonstrate benefits of beta-blockers, the literature suggests that peri-operative beta-blockers provide a benefit which is usually restricted to patients undergoing high-risk surgery.<sup>[3,9,10]</sup>

Compared to the mean Hb levels preoperatively in the year 1999, the levels in the year 2007 were lower, indicating changing acceptable thresholds preoperatively.<sup>[11]</sup> This shows changing anaesthetic practice. Mantilla and colleagues have shown that existing co-morbidities rather than pre-operative anaemia were independently associated with major morbidity and mortality in patients undergoing major orthopaedic arthroplasty.<sup>[12]</sup>

The post-operative neurological changes were found to have significant correlation with the outcome. Evidence has shown stroke as an important limitation for the use of beta blockers.<sup>[13]</sup> However, our data reveal that there was no difference in the neurological complications between the two time periods. The sample size was small to draw definitive conclusions.

There was an increasing emphasis on controlling the systolic hypertension in addition to diastolic hypertension in geriatric patients.<sup>[14]</sup> Several studies have evaluated the relative risk of specific components of blood pressure (e.g. SBP, diastolic blood pressure, pulse pressure and mean arterial pressure) in high-risk, older patients and showed that increased SBP has been associated with increased cardiovascular adverse outcomes.<sup>[15,16]</sup> In the year 2007, pre-operative blood pressure was more stringently controlled when compared to that in the year 1999. This also correlates with the beta blocker usage in 2007 and indirectly would attribute to the lesser incidence of post-operative cardiac changes.

Post-operative PTE had a significant positive correlation with the outcome. The incidence of clinical PTE was not significantly different between both the groups despite the increased use of DVT prophylaxis with LMWH in 2007. Absence of surveillance using sensitive monitors could have resulted in low reported incidence of DVT. The time of ambulation following surgery was varied as this study involved a heterogeneous group of orthopaedic patients. Therefore, the role of ambulation on DVT cannot be commented from this study.

The major differences in anaesthetic care were greater use of regional anaesthetic techniques like CSE and epidurals for post-operative analgesia. There was a significant increase in the use of regional anaesthesia with CSE in the year 2007 compared to the group 1999. Administration of regional anaesthesia in patients with DVT prophylaxis was in accordance with the American Society of Regional Anesthesia guidelines for placement and removal of epidural catheters.<sup>[17]</sup> There was no significant difference in the incidence of intra-operative hypotension due to bleeding. This shows that DVT prophylaxis was not associated with any significant increase in bleeding. Post-operative neurological changes due to epidural haematoma or excessive bleeding were not seen in the same group of patients, thus establishing that strict adherence to guidelines significantly mitigates the side effects.

There was a considerable increase in the number of patients undergoing CSE anaesthesia. The early onset of anaesthesia with spinal and increased satisfaction with post-operative epidural analgesia has greatly favoured the increased use of CSE. There were less of intra-operative and post-operative complications in the year 2007 compared to the year 1999. This can be attributed to the increased use of post-operative epidural analgesia. Recent literature has shown that epidural analgesia provides superior pain relief, thus facilitating early post-operative mobilisation of patients<sup>[18,19]</sup> which explains the improved outcome.

Regional anaesthesia attenuates peri-operative stress response and improves myocardial oxygen supply. Evidence has shown the beneficial effects of regional anaesthesia in reducing the incidence of intra and post-operative ischaemic events, especially in CAD patients.<sup>[4]</sup> Distinct benefits like lower incidence of respiratory infections, lesser transfusion requirements, lower incidence of graft failure in vascular surgery patients, etc. was seen with epidural anaesthesia compared with GA.<sup>[20,21]</sup> Though there was no statistically significant difference, there was a trend towards reduction in the intra-operative and post-operative complications in group 2007. It has been shown that presence of peri-operative complications was associated with adverse outcomes. However, there was no significant difference in the in-hospital mortality. The changes in anaesthetic practice did not have any impact on the length of post-operative hospital stay.

The gastrointestinal fluid and electrolyte changes, renal, respiratory, infectious and other complications were comparable in both the groups. Hyponatraemia is a common finding in geriatric patients and studies have shown its deterioration with stress and surgery. Our study has not shown any significant difference in both the groups.

Beaupre *et al.* implemented an evidence-based scientific conduit for nursing of elderly patients with a hip fracture.<sup>[22,23]</sup> Post-operative morbidity was reduced and it did not have any impact on in-hospital mortality or overall costs of inpatient care. The varying trends in health care and its effect cannot be ruled out, but it had a positive impact in decreasing the complications in some subset of population.<sup>[23]</sup> There was no difference in post-operative length of stay. The overall incidence of peri-operative complications that were likely to prolong the post-operative stay was low

in both the the groups and the current sample size is small to draw conclusions regarding this.

There are certain limitations to this study. The retrospective data collection, the discrepancy in the number of patients operated in the years 1999 and 2007 and the heterogeneity of the surgical procedures are the major limitations. The increased awareness and affordability are the main reasons for such an increase in the number of geriatric patients undergoing orthopaedic surgeries. Despite the apparent heterogeneity of the surgical procedures, there was no statistically significant difference in the complications observed. The influence of variation in anaesthetic management, the surgical technique and expertise on the inferences drawn from this study is also a limitation.

Factors that were contributing to the mortality in this study were found to be DVT, cardiac ischemia and neurologic changes. Use of epidural anaesthesia with extended management of post-operative pain and beta blockers in high-risk cardiac cases was effective in reducing the complications in geriatric patients undergoing surgery. DVT prophylaxis with LMWH was safe and reduced the incidence of disastrous complication of PTE.

## CONCLUSION

The use of DVT prophylaxis, beta blockers in high-risk cases and use of epidural analgesia for post-operative pain management influence the outcome of geriatric patients undergoing lower limb surgery.

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