Original Article

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Anaesthesia Section

Evaluation of Modified Frailty Index-5 as a Predictor of 60-day Perioperative Morbidity and Mortality in Geriatric Patients Presenting for Orthopaedic Surgery: A Prospective Cohort Study

APARNA ASHAY NERURKAR[1], AMREEN FATIMA[2]

ABSTRACT

Introduction: Frailty indices predicting perioperative adverse outcomes have been used predominantly in retrospective studies for prediction of surgical adverse outcomes.

Aim: To evaluate the modified 5-item Frailty Index (mFI-5) as a predictor of anaesthetic and surgical complications up to 60 days in geriatric patients presenting for orthopaedic surgery.

Materials and Methods: The prospective cohort study was conducted at Lokmanya Tilak Municipal General Hospital, Mumbai, Maharashtra, India, from December 2019 to December 2020. Details of participants and caregivers, mFI-5 scores and surgical details of 62 patients aged >65 years undergoing orthopaedic surgeries were studied. The mFI-5 score was calculated based on the presence of five co-morbidities: Congestive Heart Failure (CHF), Diabetes Mellitus (DM), Chronic Obstructive Pulmonary Disease (COPD) or pneumonia, functional health status and hypertension, as defined in NSQIP database. Complications of perioperative bleeding and inotropic support, along with others mentioned in the National Surgical Quality Improvement Program (NSQIP) database, were noted up to 60 days, with milestones of 48 hours, seven days and 30 days. The data were analysed for association between mFI-5 and complications by applying t-test, Chi-square test and multivariate analysis using the Statistical Package for the Social Sciences (SPSS) 20.0 version.

Results: Mean age was 71.44±6.70 years, with 26 patients having an mFI-5 >3 (mean 2.33±0.96). Forty-five patients had at least one complication (mean 2.39±2.59). Mortality was observed in three out of 26 patients with an mFI-5 >3 (11.54%), while one in 36 patients (2.78%) died with mFI-5 <3. No association with mortality was observed with either unit increase in mFI-5 scores or mFI-5 >3. Complications included use of blood and blood products, inotropes and postoperative ventilation in the first 48 hours (mean 0.73±0.75), respiratory complications and blood and blood product transfusions in the 48 hours to seven days period (mean 0.65±1.13), Surgical Site Infections (SSIs) and reoperations between 8-30 days (mean 0.74±1.41) and renal insufficiency and death in the 30-60 days period (mean 0.27±0.61). Age (p-value=0.315), gender (p-value=0.635), scheduling (p-value=0.530), site (p-value=0.077) and nature of surgery (p-value=0.172) were not statistically significant, while mFI scores ≥3 (p-value <0.001), American Society of Anaesthesiologists (ASA) grades (p-value=0.016), surgical duration (p-value=0.012), CHF (p-value=0.003) and DM (p-value=0.002) were statistically significant.

Conclusion: Patients aged >65 years with mFI-5 scores ≥3, having CHF, DM, ASA grades >2, undergoing orthopaedic surgeries of duration up to three hours, had statistically significant chance of developing postoperative complications, other than death, up to 60 days. A randomised controlled trial with mFI-5 cut-off of ≥3 and longer follow-up periods would yield better results.

Keywords: American society of anaesthesiologists status, Congestive heart failure, Diabetes mellitus, Functional health status, Hypertension

INTRODUCTION

Safer surgical and anaesthesia techniques with enhanced life expectancy, have led to increase in geriatric orthopaedic surgeries. Frailty, a common clinical syndrome in older adults, increases the risk of falls, disability, hospitalisation and mortality. Frailty indices can predict perioperative adverse outcomes and aid in decision-making. Rockwood frailty index, with 70 clinical deficits; the Edmonton frail scale, with 17 clinical deficits; and modified 11-item frailty index (mFI-11), with 16 variables, are some of the tools used in the past [1-3]. The mFI-5, introduced in 2017, has been extensively studied as a predictor of adverse outcomes [4-12]. However, many of these studies are retrospective analyses and primarily used the indices to predict mainly surgical outcomes and mortality. There are very few prospective studies related to perioperative anaesthesia-related concerns, like perioperative bleeding, use of inotropes, in addition to unplanned intubation, respiratory complications, cardiac arrest, myocardial infarction, stroke, sepsis and septic shock, or hepato-renal complications [13-18].

The authors decided to evaluate mFI-5 as predictor of anaesthetic and surgical complications in geriatric patients presenting for orthopaedic surgery. The primary objective was to determine association between mFI-5 and the incidence of perioperative complications up to 60 days. As a secondary objective, the authors intended to find association if any, of the incidence of perioperative complications with other independent risk factors, such as age, gender, ASA status, scheduling, site, nature and duration of surgery.

MATERIALS AND METHODS

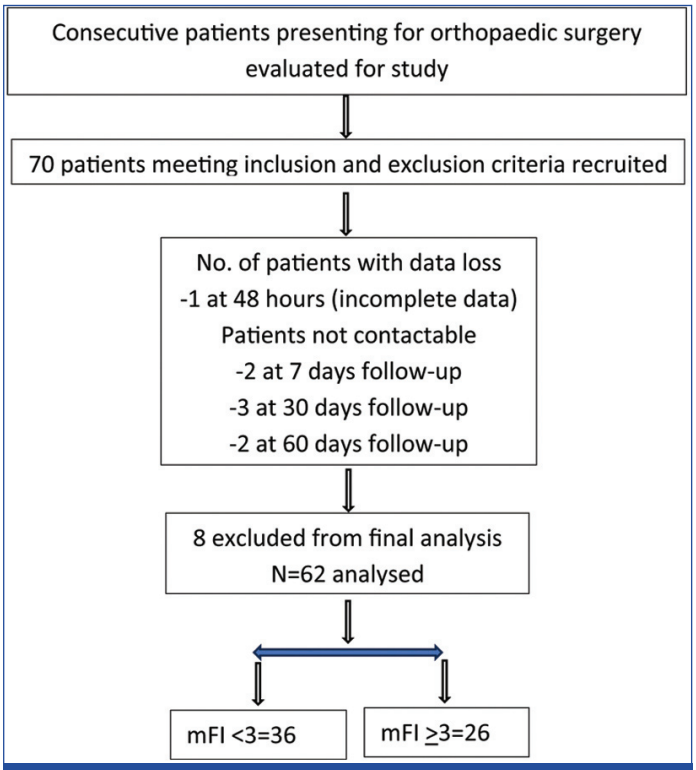
The prospective cohort study was conducted at Lokmanya Tilak Municipal General Hospital in Mumbai, Maharashtra, India, from

December 2019 to December 2020, after approval from the Institutional Ethics Committee (IEC/531/19).

Inclusion criteria: Patients aged >65 years, of either gender, presenting to hospital for orthopaedic surgery were included in the study.

Exclusion criteria: Non consenting patients; patients in whom reliable history could not be obtained (due to cognitive dysfunction, dementia, associated head injury, caregiver absent/not aware etc.); and patients in whom 60-day follow-up not possible (lack of reliable means of communication, caregiver unavailability, etc.) were excluded from the study.

Sample size calculation: Sample size was calculated using the online sample size calculator software of Cleveland Clinic Department of Quantitative Health Sciences for cohort studies. Based on a previous study which found the incidence of 30-day mortality of elderly patients with mFI5 greater than 0 to be 0.42%, a sample size of 69 was obtained considering an alpha error of 5% and beta error of 20% with 10% expected loss to follow-up [18]. Seventy patients meeting the study criteria were recruited by consecutive convenience sampling method. A total of 62 patients were analysed, as eight patients were excluded due to incomplete data or loss to follow-up [Table/Fig-1].



[Table/Fig-1]: Flowchart of methodology.

Study Procedure

Informed consents were obtained with explanation of perioperative data collection, ethical concerns and privacy protection for the patient and the caregiver. Participants' demographic details, name, relationship and phone number of the caregiver for follow-up, components of mFI-5 and surgical details were noted. The mFI-5 score was calculated based on the presence of five co-morbidities defined as per the NQSIP database:

1. CHF within 30 days prior to surgery;
2. Insulin-dependent or non insulin-dependent DM;
3. COPD or pneumonia;
4. Partially or totally dependent Functional Health Status (FHS) at time of surgery;
5. Hypertension (HT) requiring medication.

Each co-morbidity was scored as 1 in the dataset and mFI-5 score was calculated by summation of factors, with lowest being 0 and highest being 5 [12]. Surgical factors like waiting time after presentation to the hospital were noted: less than six hours was defined as emergency, within 48 hours defined as urgent and more than 48 hours defined as elective. Additional details such as the surgical site and primary or redo surgery were noted [19,20].

Complications were documented by in-person follow-up until discharge and in readmitted patients. The follow-up of discharged patients was via telephonic interview at intervals of seven days, 30 days and/or 60 days, accounting for time from discharge. Complications were noted based on the answers given to the investigator's questions and any available documentation. The following complications- bleeding requiring blood and blood products transfusion, the use of inotropes, unplanned intubation, respiratory complications, postoperative ventilatory support, postoperative Intensive Care Unit (ICU) care, sepsis and septic shock, progressive renal insufficiency, urinary tract infection, acute renal failure, jaundice, SSIs, unplanned reoperation, stroke, myocardial infarction and death, up to 60 days, with milestones of 48 hours, seven days and 30 days were noted.

STATISTICAL ANALYSIS

Data were compiled using a Microsoft Excel sheet and analysed using statistical SPSS 20.0 version. Quantitative variables were expressed as means with standard deviations and proportions. An Independent samples t-test was used for comparison of the mean mFI-5 with complications. Chi-square test and multivariate analysis was used to assess the relationship between the mFI-5 and other variables with overall postoperative complications and dire complications within 60 days postoperatively.

RESULTS

The majority of patients in the study were 65-69 years, with an equal male-to-female ratio and had ASA II physical status. The surgical procedures were primary, elective surgeries on the lower limb, lasting less than three hours [Table/Fig-2]. Based on previous studies that considered patients with mFI-5 scores >3 as highly frail, this score was used as a cut-off for comparison [9,21,22]. It was observed that 41.9% of the study population had mFI-5 scores >3, with functional dependence at time of surgery, hypertension requiring medication and DM being major contributors. The mortality in the patients with mFI-5 >3 was 11.54%, contributing to three out of four deaths during the study period [Table/Fig-2]. However, there was no association between mFI-5 scores >3 and mortality [Table/Fig-3]. Almost 72.58% of study patients suffered at least one complication in 60 days [Table/Fig-4]. The requirement of blood and blood products was the most

Characteristic	Value
Mean age (years)	71.44±6.70 (65-89)
Gender-Male/Female	32 (51.6%)/30 (48.4%)
ASA grade- I/II/III/IV	4 (6.4%)/43 (69.4%)/ 13 (21%)/2 (3.2%)
Scheduling of surgery- emergency/urgent/elective	13 (21%)/13 (21%)/36 (58%)
Primary or redo surgery	55 (88.7%)/7 (11.3%)
Site of surgery- lower limb/upper limb/spine	45 (72.6%)/13 (21%)/4 (6.4%)
Mean duration of surgery (hours)	3.21±1.35 (min 1 hour, max 9 hours)
Modified frailty index 5 scores 1/2/3/4/5	13/23/18/7/1 Mean 2.33±0.96
Modified frailty index 5 components	**n (%)**
Congestive Heart Failure (CHF)	5 (8.1)
Diabetes Mellitus (DM)	25 (40.3)
Chronic Obstructive Pulmonary Disease (COPD)	16 (25.8)
Partial/total functional dependence at surgery	55 (88.7)
Hypertension (HT) requiring medication	45 (72.6)

[Table/Fig-2]: Study population characteristics.

common perioperative complication, followed by SSIs, reoperation and respiratory complications. The use of blood and blood products, inotropes and postoperative ventilation were common in the first 48 hours, while respiratory complications and blood and blood product transfusions dominated the 48 hours to seven days period. SSIs and reoperations were common between 7-30 days, while progressive renal insufficiency and death were seen in the 30-60 day period [Table/Fig-5].

mFI-5 score	No. of deaths	Survivors	Test characteristic	value
1	1	12	Chi-square p-value	3.048 0.549
2	0	23		
3	2	16		
4	1	6		
5	0	1		
<3 (N=36)	1	35		
≥3 (N=26)	3	23		
Total	4	58	Chi-square p-value	1.918 0.165

[Table/Fig-3]: Association between mFI-5 score and mortality.

Number/ Nature of complications	0-48 hours N (%)	48 hours-7 days N (%)	8-30 days N (%)	31-60 days N (%)	Complications (0-60 days) N (%)
0	26 (41.9)	42 (67.7)	44 (71.0)	49 (79.0)	17 (29.0)
1	29 (46.8)	8 (12.9)	7 (11.3)	10 (16.1)	17 (29.0)
2	5 (8.1)	7 (11.3)	1 (1.6)	2 (3.2)	5 (8.1)
3	2 (3.2)	3 (4.8)	5 (8.1)	1 (1.6)	4 (6.5)
4	-	1 (1.6)	4 (6.5)	-	5 (8.1)
5	-	1 (1.6)	0	-	6 (9.7)
6	-	-	1 (1.6)	-	1 (1.6)
7	-	-	-	-	4 (6.5)
8	-	-	-	-	1 (1.6)
9	-	-	-	-	2 (3.2)
Mean+SD	0.73±0.75	0.65±1.13	0.74±1.41	0.27±0.61	2.39±2.59
Total	62 (100)	62 (100)	62 (100)	62 (100)	62 (100)
Dire	9 (14.6)	15 (24.1)	12 (19.2)	4 (6.4)	18 (29.03)

[Table/Fig-4]: Number of complications in the study period.
Dire complications=Use of inotropes, unplanned intubation, postoperative ventilation, sepsis, septic shock, acute renal failure, liver failure, myocardial infarction, death

Type of complication	0-48 hours N (%)	48 hours-7 days N (%)	8 to 30 days N (%)	31-60 days N (%)	Total no. of complications N (%)
Use of inotropes	5 (8.1)	1 (1.6)	1 (1.6)	0	7 (11.29)
Unplanned intubation	0	2 (3.2)	3 (4.8)	0	5 (8.06)
Postoperative ventilation	4 (6.5)	3 (4.8)	1 (1.6)	1 (1.6)	9 (14.52)
Blood/Blood product use	36 (58.1)	9 (14.5)	0	0	45 (72.58)
Respiratory complications	0	9 (14.5)	4 (6.5)	0	13 (20.97)
Sepsis	0	3 (4.8)	2 (3.2)	0	5 (8.06)
Septic shock	0	0 (0.0)	1 (1.6)	0	1 (1.61)
Acute renal failure	0	6 (9.7)	2 (3.2)	0	8 (12.90)
Progressive renal insufficiency	0	0	1 (1.6)	3 (4.8)	4 (6.45)
Urinary tract infection	0	1 (1.6)	1 (1.6)	0	2 (3.22)
Myocardial infarction	0	0	0	1 (1.6)	1 (1.61)
Surgical site infections	0	4 (6.5)	9 (14.5)	1 (1.6)	14 (22.58)
Re-operation	0	2 (3.2)	11 (17.7)	1 (1.6)	14 (22.58)
Unplanned readmission	0	0	6 (9.7)	1 (1.6)	7 (10.20)
Jaundice	0	0	1 (1.6)	0	1 (1.6)
Liver failure	0	0	0	0	0
Any other	0	0	0	6 (9.7)	6 (9.7)
Death	0	0	2 (3.2)	2 (3.2)	4 (6.45)
Total	45	40	45	16	146

[Table/Fig-5]: Type of complications in the study period.

Patients with mFI-5 score ≥3 were at higher risk of developing complications mentioned at all time intervals, except for 31-60 days. The incidence of various dire complications was higher in patients with mFI-5 ≥3 across all time intervals, except for 31-60 days, with no overall statistical significance [Table/Fig-6]. Patients with history of Congestive Heart Failure (CHF) in past 30 days and DM had significantly higher number of complications [Table/Fig-7]. The authors found that mFI-5 scores ≥3 were strong predictor of overall complications [Table/Fig-8-10] and fair predictor of dire complications [Table/Fig-11]. The cut-off value for dire complications was found to be ≥4, unlike our assumed cut-off of ≥3 [Table/Fig-12]. Higher ASA

Complications	mFI <3	mFI ≥3	Total	Chi-square value	p-value
0-48 hours					
Use of inotropes	3	2	5	2.505	0.286
Postoperative ventilation	1	3	4	7.713	0.021
Blood/blood product use	18	18	36	3.43	0.121
48 hours to 7 days					
Use of inotropes	0	1	1	3.83	0.147
Unplanned Intubation	0	2	2	7.79	0.020
Postoperative ventilation	0	3	3	11.88	0.003
Blood/blood product use	3	6	9	9.00	0.011
Respiratory complications	5	4	9	5.69	0.05
Sepsis	1	2	3	4.21	0.122
Acute renal failure	2	4	6	8.87	0.012
Urinary tract infection	0	1	1	3.83	0.147
Surgical site infections	2	2	4	2.89	0.235
Reoperation	1	1	2	1.40	0.497
8 days to 30 days					
Use of inotropes	0	1	1	3.83	0.147
Unplanned intubation	0	3	3	11.88	0.003
Postoperative ventilation	0	1	1	3.83	0.147
Respiratory complications	3	1	4	1.66	0.436
Sepsis	0	2	2	7.79	0.020
Septic shock	0	1	1	3.83	0.147
Acute renal failure	0	2	2	7.79	0.020
Progressive renal insufficiency	0	1	1	3.83	0.147
Urinary tract infection	0	1	1	3.83	0.147
Surgical site infections	2	7	9	20.85	<0.001
Reoperation	4	7	11	15.88	<0.001
Unplanned readmission	1	5	6	12.56	0.002
Death	0	2	2	7.79	0.020
31-60 days					
Postoperative ventilation	0	1	1	3.831	0.147
Progressive renal insufficiency	2	1	3	1.233	0.540
Myocardial Infarction	0	1	1	3.831	0.147
Surgical site infections	0	1	1	3.831	0.147
Reoperation	0	1	1	3.831	0.147
Unplanned readmission	0	1	1	3.831	0.147
Any other	4	2	6	2.598	0.273
Death	1	1	2	1.399	0.497

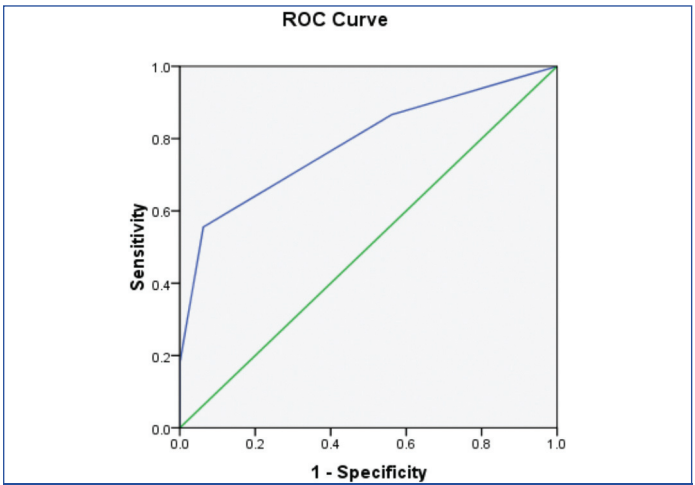
[Table/Fig-6]: Association between mFI <3 and mFI ≥3 with complications at different time points postoperative: within 48 hours, seven days, 30 days and 60 days.

Component of mFI5	No. of complications	No. of complications	Chi-square value	p-value	mFI-5 categories	mFI-5 categories	Chi-square value	p-value
	Nil	≥1			<3	≥3		
Congestive Heart Failure (CHF)								
No	17	40	11.58	0.003	36	21	6.86	0.006
Yes	0	5			0	5		
Total	17	45			36	26		
Diabetes Mellitus (DM)								
No	15	22	13.00	0.002	32	5	0.99	<0.001
Yes	2	23			4	21		
Total	17	45			36	26		
Chronic obstructive disease or pneumonia								
No	14	32	0.848	0.654	30	16	0.75	0.053
Yes	3	13			6	10		
Total	17	45			36	26		
Dependent functional status								
No	4	2	3.522	0.172	6	1	0.83	0.115
Yes	13	42			30	25		
Total	17	45			36	26		
Hypertension								
No	7	10	2.657	0.265	6	1	0.34	<0.001
Yes	10	35			30	25		
Total	17	45			36	26		

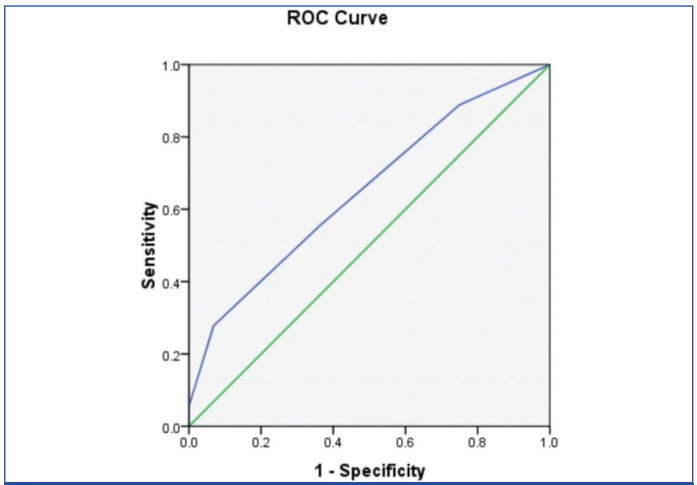
[Table/Fig-7]: Association of components of mFI5 and no. of complications.

mFI-5 score	No. of patients with zero complications	No. of patients with ≥1 complications	Test characteristic	Value	95% CI
<3 (N=36)	16	20	Sensitivity	96.15%	98.42-99.80
≥3 (N=26)	1	25	Specificity	44.44%	28.33-61.71
Total	17	45	Positive predictive value	55.60%	41.2-69.1
			Negative predictive value	94.10%	73.0-99.0
			AUC	0.787	
mFI-5 score	**No. of patients with zero dire complications**	**No. of patients with ≥1 dire complications**	**Test characteristic**	**Value**	**95% CI**
<3 (N=36)	28	8	Sensitivity	38.46%	20.91-59.27
≥3 (N=26)	16	10	Specificity	77.78%	60.41-89.27
Total	44	18	Positive predictive value	55.60%	31.34-77.60
			Negative predictive value	63.64%	47.74-77.17
			AUC	0.650	
mFI-5 score	**No. of overall complications per patient (Mean±SD)**		**No. of dire complications per patient (Mean±SD)**		
<3 (N=36)	1.37±1.91		0.22±0.42		
≥3 (N=26)	3.77±2.60	p-value <0.001	0.38±0.50	p-value=0.170	

[Table/Fig-8]: Association between mFI-5 scores and complications.
The no. of complications is higher as some patients had more than one dire complications



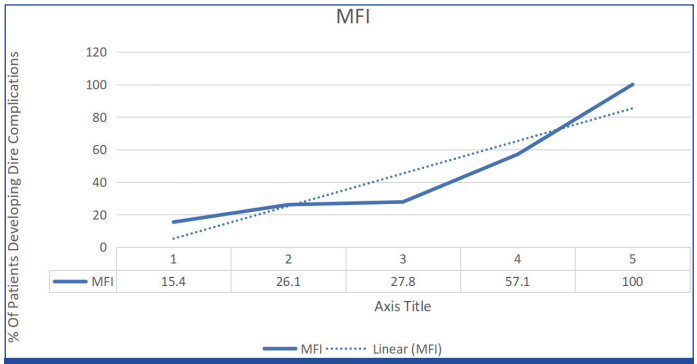
[Table/Fig-9]: ROC curve for mFI score for prediction of overall complications AUC 0.787.



[Table/Fig-10]: ROC curve for mFI score for prediction of dire complications AUC=0.650.

Derived parameters	Model	Factors
Overall complications	y=(-0.433)×1+(-0.236)×2+(-0.192)×3+(-0.075)×4+(-0.074)×5 R2=0.32=Robust predictive value	y=number of overall complications x1: Congestive Heart Failure (CHF) x2: Diabetes Mellitus (DM) x3: Chronic Obstructive Pulmonary Disease (COPD) or pneumonia x4: Dependent functional status x5: Hypertension
Dire complications	z=(-0.313)×1+(-0.04)×2+(-0.137)×3+(-0.104)×4+(-0.025)×5 R2=0.061=Poor predictive value	z=number of dire complications x1: Congestive Heart Failure (CHF) x2: Diabetes Mellitus (DM) x3: Chronic Obstructive Pulmonary Disease (COPD) or pneumonia x4: Dependent functional status x5: Hypertension

[Table/Fig-11]: Model for prediction of complications using multiple linear regression analysis.



[Table/Fig-12]: Graph of MFI v/s Incidence of dire complications.

grades and duration of surgery up to 3 hours were associated with higher number of complications. Age, gender, scheduling, site, or the nature of surgery made no difference to the outcome [Table/Fig-13].

Factors	mFI-5 scores		Overall complications		Dire complications	
	mFI-5 <3	mFI-5 ≥3	Nil (N)	≥1 (N)	Nil (N)	≥1 (N)
Age group (years)						
65-69	21	10	10	21	25	6
70-74	5	7	3	9	7	5
75-79	5	3	2	6	5	3
80-84	4	3	2	5	6	3
85-89	1	3	0	4	1	1
Total	36	26	17	45	44	18
	p-value=0.357		p-value=0.315		p-value=0.0230	
Gender						
Female	18	12	9	21	22	8
Male	18	14	7	25	22	10
Total	36	26	16	46	44	18
	p-value=0.765		p-value=0.635		p-value <0.00001	
ASA grade						
I	4	0	2	2	4	0
II	31	12	15	28	34	9
III	1	12	0	13	6	7
IV	0	2	0	2	0	2
Total	36	26	17	45	44	18
	p-value=<0.001		p-value=0.016		p-value=0.000080	
Scheduling						
Elective	22	14	7	29	24	12
Emergency	6	7	5	8	10	3
Urgency	8	5	4	9	10	3
Total	36	26	16	46	44	18
	p-value=0.0267		p-value=0.530		p-value=0.680	
Site						
Lower limb	24	21	12	33	32	13
Upper limb	10	3	5	8	1	3
Spine	2	2	0	4	11	2
Total	36	26	17	45	44	18
	p-value=0.11		p-value=0.077		p-value=0.071	
Nature						
Primary	30	25	13	42	38	17
Repeat	6	1	4	3	6	1
Total	36	26	17	45	44	18
	p-value=0.072		p-value=0.172		p-value=0.361	
Duration (h)						
0-3	24	16	13	27	29	11
3-6	11	8	4	15	15	4
>6	1	2	0	3	0	3
Total	36	26	17	45	44	18
	p-value=0.079		p-value=0.012		p-value=0.01	

[Table/Fig-13]: Association between other factors and mFI-5 scores and complications.

DISCUSSION

Frailty, a measure of depletion of physiological reserves, is a proven predictor of adverse surgical complications in geriatric patients. Various indices like Rockwood Frailty Index, Edmonton Frail Scale, modified 11-item frailty index and mFI-5, have been used to predict mortality in the past [1-4]. Of the many frailty indices, the mFI-5 is gaining favour due to its ease of use and reliability [5-12]. The inclusion of only five factors-CHF, DM, HT, DFS and COPD/pneumonia-in mFI-5 makes it easily reproducible, internally consistent, verifiable and relevant, with no missing data, unlike the earlier indices. Although simplified, it retains the predictive value of indices like mFI-11 [23]. The main finding in this prospective study was that geriatric patients with high frailty, diagnosed as mFI-5 scores ≥3, undergoing orthopaedic surgery developed higher number of anaesthesia-related and surgical complications up to 60 days postoperatively. There was no statistically significant association between increasing mFI-5 scores and mortality.

In their 2017 pioneering study deriving mFI-5 as predictor of mortality and morbidity for various surgeries, Subramaniam S et al., had concluded that mFI-5 had the strongest predictive value for mortality, postoperative complication and unplanned 30-day readmission in elderly patients undergoing general, orthopaedic and otolaryngologic surgeries, but not cardiac surgery [4]. A retrospective study in geriatric inguinal hernia repairs found non independent functional status, especially in emergent cases, to be most at risk for complications and that mFI-5 was a strong predictor of mortality, pneumonia and discharge destination not being home [7]. Furthermore, mFI-5 was significantly associated with major adverse cardiac events and all-cause mortality in patients with extensive aortoiliac occlusive disease, as demonstrated in a study conducted by Nóbrega L et al., [15]. The lack of association between higher frailty and mortality in the authors' study, unlike in these studies, may be due to uneven distribution and varied complexity of the surgical procedures in all the mFI-5 categories.

The authors observed that functional dependence, hypertension and diabetes were major contributors to mFI-5 scores in the study. The functional dependence seen in the study can be explained by the inclusion of geriatric patients requiring lower limb, upper limb and spinal orthopaedic procedures, which require partial or whole dependence for activities of daily living. The higher contribution of Diabetes Mellitus (DM) [24] and Hypertension (HT) are attributed to the increasing incidence of DM in India and HT being a major co-morbidity of elderly age group studied in the cohort. Higher contributions of diabetes [16,25], HT [13,25], COPD [16] and CHF have also been noted in other studies [8]. The major contributors to mFI-5 depend on the ethnicity and the age of the surgical cohorts, as indicated in the studies mentioned above.

The presence of CHF and DM was associated with higher risk of developing postoperative complications up to 60 days. Zhang X et al., concluded in their meta-analysis that DM is a risk factor for postoperative complications, hospitalisation and death after non cardiac surgery [26]. A study conducted by Smilowitz NR et al., found that in patients hospitalised for non cardiac surgery, heart failure was associated with an increased risk of perioperative mortality [27]. Higher ASA grades and duration of surgery of up to three hours were implicated in the incidence of complications. However, frailty indices were found to outperform ASA in predicting major complications after surgery [16,28-30]. As regards operative time, unlike present study, Strigenz A et al., reported 18% increased odds of morbidity for every 30 additional minutes of operative time [8]. A meta-analysis of 66 observational studies of various surgical procedures conducted by Cheng H et al., concluded that the likelihood of complications increases significantly with prolonged operative duration; approximately doubling when operative time exceeds two hours and increasing by almost 14% for every additional 30 minutes of operating time [31]. The preponderence of operative time up to three hours, with major bleeding suggested by transfusions in immediate postoperative period, may have contributed to this finding.

The cut-off value for dire complications was found to be ≥4, unlike the authors' assumed cut-off of ≥3. High frailty scores, defined as 3+, were not found to be predictive of dire complications in elective anterior lumbar interbody fusion, by Patel NP et al., [9]. However, Strigenz A et al., reported that an mFI-5 score of 2+ independently predicted 41% increase in the odds of morbidity in patients undergoing instrumented fusion after extradural metastatic spinal tumour excision [8]. The severity of complications has been shown to increase for every one-point increase in mFI-5 [29]. Therefore, a higher cut-off of four was noted in present study.

The requirement for blood and blood products, SSIs, reoperation and respiratory complications were the most common adverse outcomes. Pre-existing anaemia, osteoporotic bones with an increased tendency to fragment and bleed, decreased immune response and poor respiratory reserve with weak cough reflex can explain the occurrence of these complications in the studied age group. The dependent functional status, DM, postoperative ventilation and acute lung injury associated with blood product administration may have led to the increase in respiratory complications in this age group [7,25,26,32]. No comparisons could be obtained with other studies, as none of them have categorised complications on a day-wise basis.

Age, gender, whether the surgery was elective, urgent, or emergent surgery, site of surgery and whether it was a primary or redo surgery did not influence the incidence of complications. However, dependent functional status was correlated with increased complications in both elective and emergent cohorts undergoing inguinal hernia repair. Elective surgeries on extradural tumours decreased the risk by 39% as compared to non elective surgeries [8]. The dominance of elective surgeries in present study cohort may have led to an inability to estimate the true association. There were several strengths: it was prospective, assessed an exhaustive list of postoperative complications and had a longer follow-up period of 60 days.

Limitation(s)

It was an observational cohort study with single blind follow-up protocol. A randomised controlled trial with two groups, using a cut-off of mFI ≥3, would yield better results. The study had a heterogenous nature of surgeries, which led to an inability to correlate a specific orthopaedic procedure to the incidence of complications for a single mFI-5 score. Additionally, the nature of complications varied at the different time periods, i.e., <48 hours, 48 hours to seven days, eight to 30 days, and 31-60. Hence, a statistical comparison of the impact of the mFI-5 or other risk factors on the timeline of complications could not be assessed.

CONCLUSION(S)

The mFI-5, with its advantages of easy, consistent, verifiable and universal applicability and no missing data, is a good measure of frailty with strong predictive value for perioperative complications other than death within 60 days. Patients >65 years of age with mFI-5 scores ≥3, have statistically significant chance of developing complications like blood and blood products transfusions, SSIs, reoperation and respiratory complications. Patients with CHF, DM, higher ASA grades and surgery durations of up to three hours have higher chances of perioperative morbidity up to 60 days. Hence, mFI-5 score, ASA and duration of surgery need to be assessed preoperatively, co-morbidities need to be optimised, blood and blood product availability confirmed and surgical time optimised to decrease morbidity and mortality, providing the best chance for a successful outcome.

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PARTICULARS OF CONTRIBUTORS:
1. Additional Professor, Department of Anaesthesiology, Lokmanya Tilak Municipal Medical College, Mumbai, Maharashtra, India.
2. DNB Registrar, Department of Critical Care Medicine, Indraprastha Apollo Hospital, New Delhi, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Aparna Ashay Nerurkar,
Department of Anaesthesiology, 4th Floor, College BLDG, LTMG Hospital,
Dr. B. Ambedkar Road, Sion, Mumbai-400022, Maharashtra, India.
E-mail: draparnanerurkar@gmail.com

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