Original Article

Complication rate during multilevel lumbar fusion in patients above 60 years

Bijjawara Mahesh, Bidre Upendra, S Vijay, GC Arun Kumar, Srinivas Reddy

Abstract

Background: Spine surgery in elderly with comorbidities is reported to have higher complication rates and increased cost. However, the surgical outcome is good irrespective of the complications. Hence, it is essential to identify the factors affecting the complication rates in such patients and the measures to reduce them. This retrospective observational study determines the perioperative complications, their incidence and the measures to reduce complications in the elderly with comorbidities, operated by instrumented multilevel lumbar fusion.

Materials and Methods: Patients aged 60 years and above with one or more comorbidities operated by multilevel instrumented lumbar fusion in our center between January 2012 and December 2013 were included in the study. Perioperative complications and their incidence were calculated. Age, number of levels fused, operative time, blood loss, and complication rates were correlated with the duration of stay and the incidence of perioperative complications using SPSS software. Measures to reduce complications are determined by these results and by review of literature.

Results: Fifty two patients were included in the study (28 females and 24 males) with an average age of 69 years (range 60-84 years). Hypertension was the most common comorbidity followed by diabetes. Spondylolisthesis was the most common indication. Eleven complications were noted with an incidence of 21%. Three were systemic complications which required transfer to Intensive Care Unit. Local complications were incidental durotomy (three), transient root deficits (two), wound infections (one), and persistent radicular pain (two). Operative time and blood loss were significantly higher in patients with complications.

Conclusion: Complication rates strongly correlate with the blood loss and operative time. Reducing the operative time and blood loss by intraoperative tranexamic acid, laminectomy using osteotome, simultaneous bilateral exposure and instrumentation and reducing the number of interbody fusions can help in reducing the complications.

Key words: Comorbidities, lumbar fusion, geriatrics, spine
MeSH terms: Geriatrics, spinal fusion, degenerative diseases, spondylolisthesis, lumbar vertebrae

Introduction

Geriatric population is on rise globally because of increasing life span. As per the US Census, people above 60 years constituted 6.4% of the total population in 1900, which increased to 18.4% in 2010 and predicted to go up to 25.5% by 2050.[1] Spinal problems and spine surgeries in geriatric population are also showing a similar trend. Lumbar fusion surgeries in people aged 60 years and above have increased by 230% in a decade from 1991 to 2001.[2] Desire to lead a more active life in advanced age, improved diagnostic techniques, and better operative results are some of the reasons for increasing spine surgeries in the elderly. In general, spine surgery in the elderly in the presence of comorbidities is feared among both patients and surgeon, as it is presumed to have higher perioperative complications and increased cost. However, surgical outcomes are good if complications are low. Many

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articles can be found in literature supporting this.[3-5] A study by Daubs *et al*. involving adult spinal deformity in people over 60 years of age has reported that age and complication rates do not affect the surgical outcome.[6] Similar studies have reported 91%–96% good to excellent results following surgical treatment of lumbar canal stenosis (LCS) by decompression and decompression with fusion on people aged above 65–70 years.[7-9] This indicates that in the absence of complications, spinal decompression and fusion surgeries would result in a satisfied patient even in the elderly with comorbidities. Therefore, measures to reduced complications in such patients should be looked at rather than denying surgical management in symptomatic patients due to their old age or comorbidities. This study evaluates the perioperative complications and the contributing factors in patients over 60 years of age undergoing lumbar fusion surgeries.

Materials and Methods

Patients aged 60 years and above with one or more comorbidities undergoing lumbar decompression and instrumented fusion at our institute between January 2012 and December 2013 (2-year period) were included in the study. In all these patients, perioperative complications (intraoperative and complications occurring within 3 weeks postoperative period) and their incidence were recorded. The technique was a standard open technique of pedicle screw instrumentation and fusion, either interbody by transforaminal approach or posterolateral using morcellized bone from the posterior elements or rarely with iliac crest. No minimally invasive, endoscopic, or paraspinal techniques were employed. Age, number of levels instrumented and fused, operative time, blood loss, comorbidities, and the duration of stay were correlated with the incidence of perioperative complications using SPSS software (IBM, SPSS Statistics V 23.0, New York, United States). Factors contributing to perioperative complications were noted and measures to reduce them were suggested by these results and compared with the available literature in discussion.

Results

Analysis of our medical records revealed a total of 52 patients operated by lumbar fusions in the 2-year study period, who were aged 60 years and above and had one or more comorbidities. There were 28 females and 24 males [Figure 1]. The average age was 69 years (range 60-84 years). Most common indication for surgery was spondylolisthesis in 17 (32.7%) followed by LCS in 15 (28.8%) patients. Hypertension (HTN) was the most common comorbidity found in 39 patients (75%), followed by diabetes mellitus (Type 2) in thirty patients (56.4%). Twenty patients had single comorbidity while 18 patients had two comorbidities and 13 patients were found to have three comorbidities [Table 1].

Forty six patients were operated under general anesthesia (GA) while the remaining six patients were operated in regional or spinal anesthesia. 3.8 levels were the average levels instrumented per patient while one patient underwent 9 levels instrumentation. Interbody fusions were performed at single level in 24, 2 levels in 22, and 3 levels in 6 patients. Posterolateral fusions were performed at the remaining instrumented levels [Table 2]. Average operative time and blood loss were 150 min (range 60–270 min) and

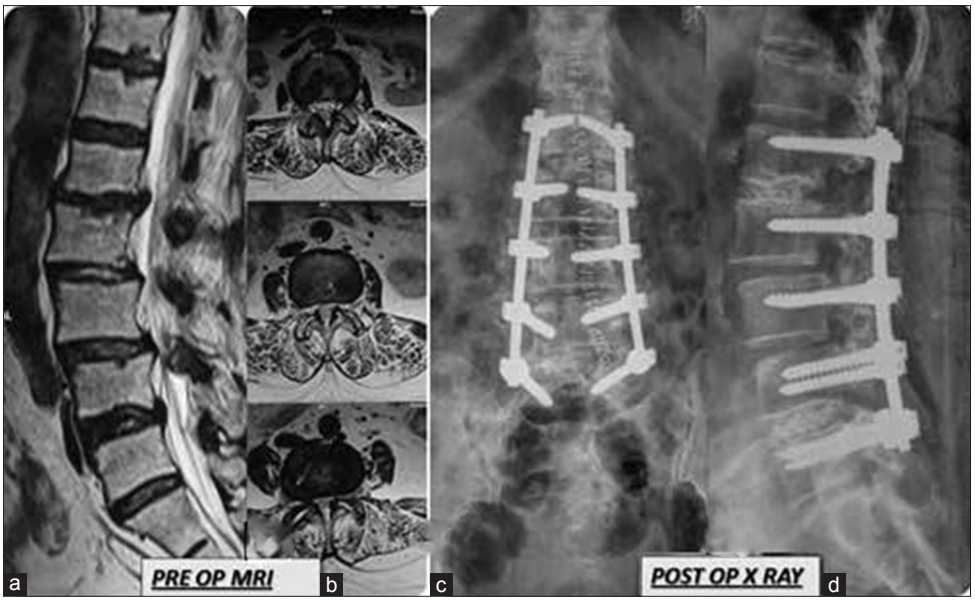

Figure 1: Preoperative MRI T2W, midsagittal (a) and axial (b) images showing multilevel listhesis and canal stenosis. Postoperative x-ray lumbosacral spine anteroposterior (c) and lateral (d) views showing implant (pedicle screws) *in situ* following instrumented fusion

Table 1: Diagnosis and comorbidites of patients

(a) Diagnosis	
Spondylolisthesis	17 (32.69)
Lumbar canal stenosis	15 (28.84)
Failed back	7 (13.46)
Infection	6 (11.3)
Tumor	3 (5.76)
Degenerative scoliosis	2 (3.84)
Trauma	2 (3.84)
Total	52 (100.0)
(b) Comorbidities	
Diabetes	30 (56.4)
Hypertension	39 (74.5)
Ischemic heart disease	7 (16.3)
Lung disorders	6 (10.9)
Chronic renal failure	2 (7.3)
Stroke	3 (7.3)
Cancer	3 (5.5)
Hypothyroidism	5 (9.1)
Obesity	1 (1.8)
Psychiatric ailments	1 (1.8)
Parkinsonism	2 (3.6)

369 ml (range 90–1050 ml), respectively. Both operative time and blood loss increased with additional levels of instrumentation and interbody fusions [Table 3]. The levels of instrumentation and fusions were decided on segmental instability observed on dynamic radiographs. The interbody fusions were based on degree of segmental stenosis, disc degeneration, and instability.

A total of 11 complications were noted, 3 systemic and 8 local. Among the systemic complications, 2 were hypostatic pneumonia with secondary infection and one was a psychiatric illness called Ganser's syndrome. All the three patients required transfer to ICU and one patient with pneumonia expired due to septicemia and shock. The average total duration of stay in the hospital was 6.2 days (range 4-14 days). On comparing the complication rates with other variables, we found that the patients with complications had higher blood loss, operative time, number of instrumented levels, and number of interbody fusion levels [Tables 4 and 5]. Similarly, the duration of stay was longer in these patients. On analyzing these

Table 2: Clinical details of patients

Age (years)	Sex	Diagnosis	Surgery	Comorbidities	Anesthesia	Number of instrumented levels	Number of IB fusions	Operative time (minutes)	Blood loss (ml)	Complications	Duration of stay
65	Male	LCS	PI	Asthma, thyroid, IHD	GA	4	2	270	650		5
77	Male	LCS	TLIF	DM, HTN, IHD	GA	3	2	105	250		9
62	Male	LCS	TLIF	HTN	GA	3	2	150	350		9
80	Female	LISTHESIS	PI	DM, HTN, IHD	GA	4	2	150	400		10
72	Female	TB spine	PI	HTN, IHD	RA	5	1	150	450	Chest infection	7
64	Female	Tumor	PI	CA, DM	GA	3	1	150	150		4
64	Female	Failed back	TLIF	HTN	GA	3	1	180	250		5
66	Female	LISTHESIS	TLIF	HTN	GA	4	2	150	250		4
84	Female	LCS	TLIF	DM, HTN, lymphoma	GA	3	2	180	350		5
62	Male	Failed back	TLIF	DM, HTN	GA	3	2	210	350	Postoperative infection	5
72	Female	LCS	TLIF	DM, HTN	GA	3	2	150	250		5
64	Male	Trauma	PI	DM, HTN, CVA	GA	5	1	120	250		5
65	Female	LCS	TLIF	DM, HTN, RAD, hyponatremia	RA	4	1	90	250		8
62	Male	TB spine	PI	HTN	GA	4	1	250	500		9
73	Male	TB spine	PI	DM, depression	GA	3	1	150	250	Postoperative radicular pain	6
68	Male	LCS	TLIF	DM	GA	2	1	120	250		5
77	Female	Trauma	TLIF	DM, HTN	GA	5	1	120	350		4
70	Female	LISTHESIS	TLIF	DM, RAD	GA	2	1	40	150		10
75	Male	LCS	PI	HTN	GA	5	1	150	600		10
64	Male	TB spine	TLIF	HTN	GA	4	1	150	350		5
63	Female	LISTHESIS	TLIF	DM, HTN	GA	2	1	150	250		3
60	Female	LISTHESIS	TLIF	HTN, hypothyroid	GA	3	2	180	350		4
77	Male	Failed back	TLIF	DM, HTN, IHD, CRF	GA	4	1	120	550	Ganser's syndrome	14

Contd...

Table 2: Contd...

Age (years)	Sex	Diagnosis	Surgery	Comorbidities	Anesthesia	Number of instrumented levels	Number of IB fusions	Operative time (minutes)	Blood loss (ml)	Complications	Duration of stay
62	Male	TB spine	TLIF	IHD, CA, COPD	RA	5	1	90	120		10
66	Male	LCS	TLIF	HTN	GA	3	2	120	250		7
72	Male	LISTHESIS	TLIF	DM	GA	2	1	120	250		5
75	Female	LCS	TLIF	HTN	GA	6	3	240	800	Dural tear	8
63	Female	LCS	TLIF	COPD	GA	5	2	210	400	Nerve root deficits	5
63	Female	LCS	TLIF	DM, HTN	GA	3	2	180	400		5
66	Female	LISTHESIS	TLIF	DM, HTN, CKD	GA	3	2	180	400		7
73	Male	LCS	TLIF	DM, HTN	GA	3	2	180	300		6
65	Female	LISTHESIS	TLIF	DM, HTN	GA	6	2	180	350		5
65	Female	Degen scoli	TLIF	HTN	GA	6	3	270	600		5
79	Female	LISTHESIS	TLIF	HTN	GA	6	3	240	800	Dural tear	6
65	Male	LCS	TLIF	DM, HTN	GA	4	2	150	400		4
65	Female	LISTHESIS	TLIF	DM	GA	2	1	150	90		4
61	Male	Degen scoli	TLIF	HTN, obesity	GA	5	3	180	1050	Nerve root deficits	12
72	Male	LISTHESIS	TLIF	CVA	RA	2	1	120	400		4
73	Male	TB spine	PI	DM, HTN, COPD	GA	5	1	180	600		8
73	Female	LISTHESIS	TLIF	Parkinson's disease	GA	3	2	120	350		5
75	Male	LCS	TLIF	HTN	GA	4	3	150	350		7
83	Male	Tumor	PI	HTN, CA, Parkinson's disease, epilepsy	RA	6	1	150	400		5
75	Female	Tumor	PI	DM, HTN, CVA	GA	5	1	60	400		4
67	Male	Failed back	TLIF	DM, HTN	GA	2	1	90	200		3
63	Female	LISTHESIS	TLIF	HTN	GA	3	2	150	200		4
64	Male	LISTHESIS	TLIF	DM, HTN	GA	2	1	90	200	Postoperation radicular pain	8
63	Female	Failed back	TLIF	HTN	GA	3	2	120	400		4
74	Male	LISTHESIS	TLIF	HTN	GA	5	3	150	400		5
71	Female	Failed back	TLIF	DM, IHD, CKD	GA	3	2	150	600		5
66	Female	Failed back	TLIF	DM.HTN, hypothyroid	RA	9	1	150	500	Chest infection	6
60	Female	Infection	PI	DM, HTN	GA	3	2	120	100	Dural tear	5
66	Female	LISTHESIS	TLIF	DM, HTN, hypothyroid	GA	2	1	60	100		10

LCS=Lumbar canal stenosis, LISTHESIS=Spondylolisthesis, TB=Tuberculosis, TLIF=Transforaminal lumbar interbody fusion, PI=Posterior instrumentation, DM=Diabetes mellitus, HTN=Hypertension, CKD=Chronic kidney disease, CA=Carcinoma, RAD=Restrictive airway disease, IHD=Ischemic heart disease, CVA=Cerebrovascular accident, GA=General anesthesia, RA=Regional anesthesia, IB=Interbody fusion

results statistically by ANOVA, the association of blood loss with complications was found to be statistically significant with $P = 0.002$. The duration of stay, operative time, and number of interbody fusion levels were close to significance with $P = 0.63$, 0.58, and 0.61, respectively, while number instrumented levels and the number of associated comorbidities showed no significance [Tables 4 and 5].

On analyzing the correlations between different variables, we found that there was a strong positive correlation of blood loss with operative time, number of instrumented levels, and number of interbody fusions which was statistically significant. Similarly, operative time showed a strong positive correlation with number of interbody fusions and a significant but a weaker positive correlation with number of instrumented levels [Table 6].

Discussion

The perioperative complication rates in the present study occurred in 11 of 52 patients with an incidence of 21%. Increased blood loss strongly correlated with the incidence

of complications. Age, operative time, number of levels of fusion, and the duration of stay were also more in patients with complications and were close to statistical significance while number of instrumented levels and number of associated comorbidities were unrelated to the complication rates. Perioperative complication rates in instrumented lumbar fusions in patients above 60 years of age described in literature range from 29% to 62% [Table 7]. The factors influencing the incidence of complications are controversial. Cho *et al*. and Carreon *et al*. reported increased complications in patients with advanced age and surgeries with increased blood loss and number of levels of fusions.[11,12] Carreon *et al*.[11] found increased complication rates with increased operative time while Cho *et al*.[12] found no such association. Guigui *et al*.[10] found comorbidities to influence the complication rates and a similar study by Acosta *et al*.[4] found ten times higher complication rates in patients with HTN while others found no association between comorbidities and the perioperative complications.[6,12]

Table 3: Operative time and blood loss with respect to the number of interbody fusion levels

Number of IB fusions	Number of patients	Percentage	Mean operative time (minute)	Mean blood loss (ml)
1	24	46.2	129.21	355.2
2	22	42.3	163.42	362.5
3	6	11.5	205	666.7
Total	52	100		

IB=Interbody fusion

Table 4: The complications and their incidence

Complications	Number of patients (%)
Dural leak	3
Transient root deficits	2
Persistent radicular pain	2
Psychiatric (Ganser's syndrome) ailment	1
Postoperative wound infection	1
Hypostatic pneumonia with secondary infection	2
Total	11 (21)
Patients shifted to ICU	3 (5.7)
Patients expired	1 (1.9)

ICU=Intensive Care Unit

Table 5: Comparisons of different variables in patients with and without complications

	Duration of stay (days)	Blood loss (ml)	Operative time (min)	Number of IB fusions	Number of instrumented levels
No complications (*n*=41)	6.00	336.09	144.11	1.53	3.54
Complications (*n*=11)	7.67	550.00	180.00	2.00	4.11
P value by ANOVA	0.063	0.002	0.058	0.061	0.318

Considering the group of population included, the complication rate in our series was within the acceptable limits compared to literature [Table 7].[4,6,11-14] Our patients were 60 years and above with the average age of 69 years, all of them had one or more comorbidities, and the average number of levels fused was 3.8, making this group more vulnerable for complications. Despite this, the complications in our series were about 21% with most of them being minor reversible complications such as dural tear, transient root deficits, and postoperative persistent radicular pain. Similarly, the operative time and blood loss, in our series, was lesser compared to that described in literature for multilevel fusions [Table 7].[4,6,11-14] The blood loss in literature ranged from 206 ml in single level to 2056 ml in 9-level fusions and the operative time ranged from 145 min in single level to 415 min in 10.5-level fusions [Table 7].[4,6,11-14] In comparison in our series with an average of 3.8 levels of fusion, the average operative time and blood loss were 150 min (range 60–270 min) and 367.45 ml (range 90–1050 ml), respectively. This could possibly explain the lesser complication rates in our study as the complications were strongly related to the operative time and blood loss.

On reviewing literature and analyzing our surgical technique, we found several strategies that helped in reducing the blood loss and operative time, and hence the complications. Injection tranexamic acid 1 g intravenous was given routinely preoperatively, immediately before skin incision in all cases. Literature describes that a single dose of tranexamic acid 15 mg/kg can effectively reduce blood loss without increasing the risk of deep vein thrombosis.[15] The other technique employed in our surgeries was simultaneous exposure and instrumentation on either side by two trained spine surgeons [Figure 2]. This reduced

Table 6: Correlations (±) between different variables and their statistical significance

Pearson's correlation (*r*)	Duration of stay (*P*)	Operative time (*P*)	Blood loss (*P*)	Number of IB fusions (*P*)	Number of instrumented levels (*P*)	Age (*P*)
Duration of stay	1.000*	−0.130 (0.359)	0.284 (0.041)**	−0.012 (0.935)	0.124 (0.379)	0.146 (0.301)
Operative time	−0.130 (0.359)	1.000*	0.595 (0.000)***	0.517 (0.000)***	0.364 (0.008)**	−0.068 (0.631)
Blood loss	0.284 (0.041)**	0.595 (0.000)***	1.000*	0.475 (0.000)***	0.553 (0.000)***	0.214 (0.127)
Number of IB fusions	−0.012 (0.935)	0.517 (0.000)***	0.475 (0.000)***	1.000*	0.217 (0.123)	0.049 (0.728)
Number of instrumented levels	0.124 (0.379)	0.364 (0.008)**	0.553 (0.000)***	0.217 (0.123)	1.000*	0.186 (0.187)
Age	0.146 (0.301)	−0.068 (0.631)	0.214 (0.127)	0.049 (0.728)	0.186 (0.187)	1.000*

***$P \leq 0.01$, **$P < 0.05$, *$P = 1$

Table 7: The incidence of complications and factors affecting it described in the literature

Author/year	Average age (range) (years)	Percentage of comorbidities	Average levels fused	Perioperative complication rate	Specific complications	Duration of stay (days)	Factors affecting complications	Factors not affecting complications	Operative time	Blood loss (ml)
Carreon *et al.*, 2003[11]	72	-	-	22% major 70% minor	10% infection, 34% urinary tract infection	-	Age, blood loss, operative time, levels of the arthrodesis	-	-	-
Cho *et al.*, 2007[12]	66.6 (48-83)	-	4.7±2.2	29	-	-	Blood loss, number of instrumented levels, age	Operative time, comorbidities	-	-
Acosta *et al.*, 2011[4]	77 (75-83)	72	10.5 (5-15)	62% overall	38% major, 43% minor	20 (12-43)	Age, hypertension	Approach, number of levels of fusion, other comorbidities, osteotomy	415±253 min (range 99-839 min)	-
Daubs *et al.*, 2007[6]	66.8±6.2	78	9.1±3.2 (5-16)	37% overall 24% intraoperative	20% major, dural tear (7%), iliac vein tear (11%), misplaced pedicle screw (3%), and nerve root injury (3%), death-4%, infection-(4%)	13.5±8.2 (6-43)	Age, osteotomy	Comorbidities	10 h (range 4-18 h)	2056 (range 300-5500)
Zimmerman *et al.*, 2010[13]	56.3±11.0	85	10±2.8	49% overall	26% major, 31% minor, infection (11%)	-	-	Approach	519±160	2735±1928
Sakaura *et al.*, 2013[14]	68.3	-	2	30%	Screw malposition-5%, postoperative radicular pain-10%, root deficits-10%, deep infection-5%	-	-		218±49 min (range 164-393 min)	612±424 (range 160-2000)
This study	69	100	3.8	21%	Dural tear (5.4%), infection (1.8%), persistent radicular pain (1.8%), systemic (5.4%), transient root deficits (3.6%)	6.3	Age, blood loss, operative time, levels of the fusion	Comorbidities	150 min (range 60-270 min)	367.45 (range 90-1050)

the surgery time and also the blood loss as compared to a single surgeon exposing and instrumenting one side after the other. We employed a laminectomy technique described by Okuda *et al*.[16] in which lamina was removed as a single fragment using osteotome and making cuts at pars on either side. This further reduced the operative time as compared to the classical technique of removing the lamina piecemeal by rongeurs.

Operative time and blood loss were strongly related to the number of levels of vertebra instrumented and fused. Even though operative time and blood loss could be reduced by reducing the number of instrumented and fused levels, not instrumenting or fusing the levels when indicated would compromise the principles of surgery and therefore affect the clinical outcome. Hence, the number of vertebrae fused or instrumented should be restricted to the minimum indicated levels, without compromising on indications. We also found that the blood loss increased steeply with number of interbody fusion levels. The average blood loss in single level interbody fusion was 307 ml which increased to 362 ml in 2 levels and almost doubled in 3-level interbody fusions [Table 3]. The reason for this exponential increase being continued bleeding from the bed of prepared interbody levels while performing the next level. Performing interbody fusions at selected levels such as the most stenotic or unstable levels or at the bottom of the construct and posterolateral fusions at other levels also could reduce the blood loss and hence the complications [Figures 3 and 4].

Apart from reduction in operative time and blood loss, a thorough preoperative workup with concerned specialist consultations such as pulmonologist, cardiologist, and optimization of the medical conditions helped in reducing the anesthetic risks during surgery. Six of our patients in the series underwent surgery under spinal or combined spinal epidural anesthesia, due to poor pulmonary or cardiac status. Studies have shown regional anesthesia (RA) in spine surgery to have many advantages over GA in high-risk patients, like lesser anesthetic intraoperative complications, lesser postoperative HTN, respiratory and cardiovascular complications, lesser postoperative vomiting, longer postoperative analgesia, and shorter hospital stay.[17,18] As surgeons we found spinal anesthesia to be satisfactory with reduced blood loss due to stable blood pressure one of these patients underwent surgery in sitting position which has shown in literature to be more convenient for the patient under RA, with the blood draining by gravity, resulting in clearer operative field and also reduce anesthesia complications by creating a hemodynamic status similar to that in othostasis.[19] Early mobilization postoperatively with optimal control of medical comorbidities also helped in reducing the early postoperative complications.

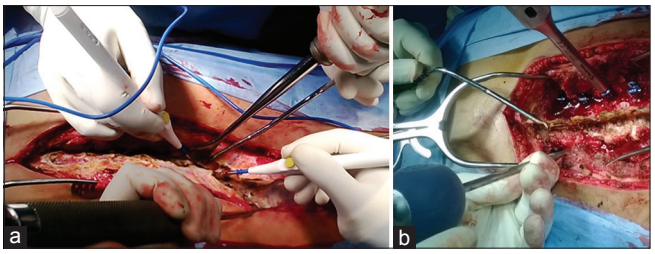

Figure 2: (a and b) Intraoperative images showing the technique of bilateral exposure and bilateral instrumentation

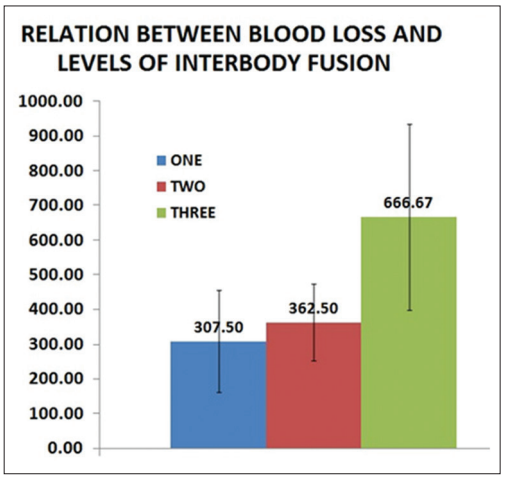

Figure 3: Bar diagram showing the relation between the intraoperative blood loss and number of interbody fusion levels

Figure 4: Postoperative x-rays anteroposterior and lateral views of lumbosacral spine showing interbody fusions at L2L3, L4L5, L5S1 with posterolateral fusion at L3L4 images

Conclusion

Lumbar fusion surgeries in the elderly with comorbidities have higher complications rates. Increased intraoperative blood loss significantly correlated with the complication rates. Spinal decompression and fusion surgery when indicated should not be denied merely considering the age

and comorbidities of the patients, fearing complications. Causes and measures to reduce complications should be considered as the outcome of surgeries in these patients in the absence of complications is good. The authors propose some of the measures to reduce the operative time, blood loss, and hence the complication rates in these patients.

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Conflicts of interest

There are no conflicts of interest.

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