Intraoperative Temperature in Hip Fractures: Effect on Complications and Outcome

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Purpose: Hip fractures are common orthopaedic injuries and are associated with high morbidity and mortality. Not unlike other orthopaedic procedures, intraoperative normothermia is a goal recommended by national guidelines to minimize additional morbidity / mortality, but limited evidence exists regarding the effect of intraoperative hypothermia on patients with hip fractures. The purpose of this study is to determine the incidence of intraoperative hypothermia in patients with hip fractures and evaluate the impact of hypothermia on complications and outcomes.

Methods: A retrospective chart review was performed of clinical records from 1541 consecutive patients who sustained an intertrochanteric (IT) or femoral neck (FN) fracture and underwent operative fixation at our institution from January 2005 to October 2013. Ultimately 1525 patients were included for analysis, excluding those with multiple injuries requiring additional surgical intervention. Chart review recorded patient demographic data, surgery-specific data, postoperative complications, length of stay, and 30-day readmission. Statistical analysis included univariate tests carried out using independent two-group t tests and X2 tests. A multivariable logistic regression model was built using clinically relevant variables to identify possible independent predictors of hypothermia. Statistical significance was set at $P < 0.05$. All analyses were performed using SAS 9.4.

Results: Overall incidence of mean intraoperative hypothermia (mean body temperature <36.0°C) in hip fracture was 17.0%. Increasing age and lower body mass index (BMI) were associated with mean intraoperative hypothermia (normothermic 77.2 years ± 14.6 vs hypothermic 79.6 years ± 11.9, $P = 0.005$; and normothermic BMI 24.3 ± 6.2 vs hypothermic BMI 23.2 ± 5.3, $P = 0.004$, respectively). In multivariate logistic regression analysis, hypothermia was associated with an increase in the rate of deep surgical site infection (DSSI) (adjusted odds ratio [OR] 3.30 [1.19, 9.14], $P = 0.022$). No other significant findings were observed in regard to complications, length of stay, or 30-day readmission.

Conclusion: The incidence of intraoperative hypothermia in hip fractures was 17.0%. In patients with hip fractures, low BMI and increasing age may be a risk factor for intraoperative hypothermia, and mean intraoperative hypothermia may be associated with increased risk of DSSI. This is the first study to our knowledge that specifically addresses intraoperative temperature monitoring in hip fracture patients.

Patient Characteristic		All (N = 1525)	Normothermic (N = 1265)	Hypothermic (N = 260)	p-value
Age (years ± SD)		77.6 ± 14.2 (1522)	77.2 ± 14.6 (1263)	79.6 ± 11.9 (259)	**0.005**
Gender					
	Male	36% (549)	37% (463)	33% (86)	0.296
	Female	64% (974)	63% (801)	67% (173)	
Side					
	Right	49% (746)	48% (604)	55% (142)	0.111
	Left	51% (777)	52% (659)	45% (118)	
	Bilateral	0% (2)	0% (2)	0% (0)	
Race					
	Caucasian	58% (884)	58% (733)	58% (151)	0.758
	Black	32% (488)	32% (402)	33% (86)	
	Other	10% (153)	10% (130)	9% (23)	
BMI		24.1 ± 6.1 (1370)	24.3 ± 6.2 (1135)	23.2 ± 5.3 (235)	**0.004**
Smoking Status					
	Nonsmoker	70% (1066)	70% (887)	69% (179)	0.068
	Smoker	27% (410)	27% (342)	26% (68)	
	Former Smoker	0% (1)	0% (0)	0% (1)	
	Unknown	3% (48)	3% (36)	5% (12)	

Table 1: Demographic Data for Hip Fracture Patients
Age and BMI are mean values with included standard deviation. BMI = body mass index. $P < 0.05$ is statistically significant.

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Characteristic		All (N=1525)	Normothermic (N=1265)	Hypothermic (N = 260)	p-value
Pre-op Hb		11.4 ± 1.9 (1505)	11.4 ± 1.9 (1251)	11.4 ± 2.0 (254)	0.621
ASA					
	1	1% (17)	1% (16)	0% (1)	0.299
	2	12% (176)	11% (142)	14% (34)	
	3	66% (984)	65% (814)	69% (170)	
	4	21% (309)	22% (269)	16% (40)	
	5	0% (4)	0% (3)	0% (1)	
Re-warmer					
	No	27% (405)	26% (330)	30% (75)	0.220
	Yes	73% (1109)	74% (933)	70% (176)	
OR time (min)		153.4 ± 46.3 (1520)	154.3 ± 46.6 (1263)	149.4 ± 44.5 (257)	0.122
Surgical Time (min)		86.2 ± 37.2 (1517)	87.1 ± 37.4 (1261)	81.8 ± 35.7 (256)	**0.039**
EBL (mL)		203.9 ± 175.7 (1511)	207.2 ± 176.8 (1262)	187.1 ± 169.2 (249)	0.099
IVF (mL)		1422.9 ± 801.9 (1498)	1425.7 ± 797.9 (1252)	1408.6 ± 823.3 (246)	0.761
Transfusion (units PRBC)		1.6 ± 1.7 (1525)	1.6 ± 1.8 (1265)	1.4 ± 1.6 (260)	0.101

Table 2: Perioperative Data and Association with Hypothermia
Pre-op Hb = preoperative hemoglobin, ASA = American Society of Anesthesiologists class, re-warmer = use of intraoperative active re-warming device, OR time = operating room time in minutes, EBL = estimated blood loss in milliliters, IVF = intraoperative intravenous fluid administration in milliliters, PRBC = packed red blood cells.

Complication		All (N=1525)	Normothermic (N=1265)	Hypothermic (N = 260)	p-value
DSSI					
	No	99% (1501)	99% (1251)	98% (250)	0.084
	Yes	1% (19)	1% (13)	2% (6)	
SSSI					
	No	98% (1497)	99% (1248)	97% (249)	0.079
	Yes	2% (23)	1% (16)	3% (7)	
NSSI					
	No	95% (1450)	95% (1203)	96% (247)	0.549
	Yes	5% (70)	5% (60)	4% (10)	
MI					
	No	94% (1427)	93% (1179)	96% (248)	0.099
	Yes	6% (93)	7% (83)	4% (10)	
Stroke					
	No	97% (1468)	97% (1221)	96% (247)	0.827
	Yes	3% (50)	3% (41)	4% (9)	
DVT					
	No	96% (1461)	96% (1212)	97% (249)	0.321
	Yes	4% (58)	4% (51)	3% (7)	
PE					
	No	97% (1475)	97% (1223)	98% (252)	0.148
	Yes	3% (45)	3% (41)	2% (4)	
LOS		7.5 ± 6.9 (1525)	7.6 ± 6.9 (1265)	7.1 ± 6.6 (260)	0.317
30day Readmission					
	No	82% (1248)	82% (1031)	83% (217)	0.455
	Yes	18% (277)	18% (234)	17% (43)	

Table 3: Complications Associated with Hypothermia
DSSI = deep surgical site infection, SSSI = superficial surgical site infection, NSSI = non-surgical site infection, MI = myocardial infarction, DVT = deep venous thrombosis, PE = pulmonary embolism, LOS = length of stay in days.

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Characteristic	Description	Adjusted OR (95% CI)	p-value
DSSI	**Yes vs. No**	3.30 (1.19, 9.14)	**0.022**
Smoking	**Smoker vs. Nonsmoker**	0.96 (0.70, 1.32)	0.881
	Unknown vs. Nonsmoker	0.80 (0.30, 2.09)	
HTN	**Yes vs. No**	1.15 (0.82, 1.62)	0.416
DM	**Yes vs. No**	0.87 (0.61, 1.22)	0.411
CKD	**Yes vs. No**	1.23 (0.87, 1.74)	0.235
Arrhythmia	**Yes vs. No**	0.60 (0.41, 0.87)	**0.007**
ASA	**1v2**	3.46 (0.44, 27.28)	0.481
	1v3	3.10 (0.40, 24.01)	
	1v4	2.30 (0.29, 18.32)	
	1v5	6.35 (0.30, 136.46)	
	1v6	<0.01 (<0.01, >999.9)	
OR time (min)		1.00 (0.99, 1.00)	0.077
Transfusion	**Yes vs. No**	0.90 (0.67, 1.19)	0.455

Table 4: Multivariable Logistic Regression Analysis
DSSI = deep surgical site infection, HTN =hypertension, DM = diabetes mellitus, CKD = chronic kidney disease, ASA = American Society of Anesthesiologists class, OR time = operating room time in minutes