



Inadvertent hypothermia in hip and knee total joint arthroplasty[☆]

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ABSTRACT

Background: This clinical study aims to establish rates of inadvertent hypothermia (IH) in both primary and revision total hip/knee arthroplasty (THA/TKA and rTHA/rTKA). We postulate differences exist between demographic, surgical and anesthetic variables and outcomes for IH and normothermic patients.

Methods: We conducted a single centre, retrospective study of 2431 total joint arthroplasty (TJA) patients having undergone THA (n = 1096), TKA (n = 1083), rTHA (n = 165) and rTKA (n = 87) from March 2013 to December 2016. Outcomes include length of stay (LOS), 31-day complication rates for thrombotic events and infection and 31-day readmission rates (RR).

Results: Overall rates of IH were 11.7%; with cohort analysis demonstrating rates of 13.2%, 11.2%, 8.3% and 3.9% in THA, TKA, rTHA and rTKA respectively. Patients with body mass index (BMI) < 29 kg/m² and undergoing THA were at risk of IH. For all TJA, no difference was observed in 31-day complications (1.6% vs. 2.8%, p = 0.19), 31-day RR (3.3% vs. 4.5%, p = 0.50) or LOS (4.6 ± 2.9 vs. 5.1 ± 4.5, p = 0.11). IH was associated with higher RR for haematoma in TKA (2.9% vs. 0.4%, p = 0.021) and higher deep infection rates in rTHA (20% vs 0%, p = 0.006).

Conclusion: Our study demonstrates a 3.9% to 13.2% rate of IH in TJA, with lower BMI, THA and primary cases as risk factors. We recommend protective steps are taken to maintain patient normothermia in these groups.

1. Introduction

Total joint arthroplasty (TJA) patients are at risk of inadvertent hypothermia (IH) during surgery due to uncovered and exposed tissues skin, anaesthesia eliminating normal protective thermo-regulatory reflexes and using fluid intravenously and for wound irrigation. IH results in unpleasant post-operative shivering on return of the patient's homeostatic control.¹ Further deleterious sequelae of peri-operative IH include an increased blood transfusion requirement, infection, myocardial infarction, ventilation and mortality.² Furthermore, IH results in longer ITU stay and longer length of stay (LOS) with is associated cost implications.²

Studies in multiple surgical specialty cohorts have found pre-operative warming, active warming, high baseline core temperature, and high ambient temperature is protective against IH.³ Finding from non-orthopaedics cohorts postulate that the resultant vasoconstriction from intra-operative IH slows healing and increases surgical wound infection rates. Indeed, pre-operative warming is associated with lower wound infection rates in general surgical patients.⁴ Extrapolating these findings for orthopaedic surgery engenders a desire to maintain patient

normothermia. Indeed, the National Institute for Health and Care Excellence (NICE) Guidelines (CG65) offer recommendations for maintaining intra-operative normothermia, including the use of warming devices. The beneficial effects of warming are mediated through increased blood flow and oxygen tension at tissue level.⁵ Despite this, studies report IH rates of 26.3–43.9% for THA and 28.0–32.6% for TKA.^{6,7} There remains a paucity of data delineating risk factors associated with IH in elective TJA. We investigate the IH rates in our institute, hypothesizing lower IH rates for both primary total hip/knee arthroplasty (THA/TKA) compared with revision total hip/knee arthroplasty (rTHA/rTKA). We postulate differences exist between demographic, surgical and anesthetic variables and outcomes for IH and normothermic patients.

2. Methods

We conducted a retrospective study a TJA patients (n = 2431) with differentiation into operation type (THA n = 670, TKA n = 607, rTHA n = 99 and rTKA n = 54) from March 2013 to December 2016. We compare patients who were hypothermic on leaving theatre with those

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Table 1

(a) Demographics, characteristics and anesthetic variables of patients undergoing **total joint arthroplasty** in the inadvertent hypothermic and normothermic groups. (b) Outcomes of patients undergoing **total joint arthroplasty** with two cohorts: inadvertent hypothermic and normothermic groups.

	All	Hypothermic	Normothermic	P value
Number of joints	2431	240 (11.7)	1815 (88.3)	
Mean Age ± SD (range)	72.3 yrs ± 10.4 (17.8–96.6)	72.0 ± 10.0 (37.2–94.9)	71.3 ± 10.3 (17.8–93.5)	0.32
Gender (%)				
Male	1001 (41.7)	144 (61.3)	751 (42.0)	0.35
Female	1397 (58.3)	91 (38.7)	1039 (58.0)	
Laterality (%)				
Left	1138 (46.9)	126 (52.5)	964 (53.3)	0.96
Right	1280 (52.8)	113 (47.1)	840 (46.4)	
Bilateral	8 (0.3)	1 (0.4)	6 (0.3)	
Operation (%)				
TKA	1083 (44.5)	104 (43.4)	821 (45.2)	0.045
THA	1096 (45.1)	123 (51.3)	810 (44.6)	
Revision TKA	87 (3.6)	3 (1.3)	74 (4.1)	
Revision THA	165 (6.8)	10 (4.2)	110 (6.1)	
Indication (%)				
Elective	2356 (97.0)	236 (98.3)	1756 (96.8)	0.19
Trauma	73 (3.0)	4 (1.7)	58 (3.2)	
Mean ASA grade ± SD	2.29 ± 0.58	2.20 ± 0.56	2.23 ± 0.55	0.50
Mean BMI ± SD	30.4 ± 5.7	29.5 ± 5.3	30.5 ± 5.7	0.019
BMI (%)				
≥ 30 kg/m ²	847 (51.7)	88 (44.7)	759 (52.6)	0.036
< 29 kg/m ²	792 (48.3)	109 (55.3)	683 (47.4)	
Ethnicity (%)				
White (British/Irish)	2355 (98.8)	233 (97.9)	1750 (98.8)	0.33
White & Black Caribbean	1 [0]	0	1 (0.1)	
Other White Background	19 (0.8)	3 (1.3)	14 (0.8)	
White & Asian	2 (0.1)	0	2 (0.2)	
Other Asian Background	4 (0.2)	2 (0.8)	2 (0.1)	
Indian	2(0.1)	0	2 (0.1)	
Black	1 [0]	0	1 (0.1)	
Anaesthesia type (%)				
Regional	1365 (56.1)	139 (57.9)	995 (54.8)	0.41
General	903 (37.1)	90 (37.5)	691 (38.1)	
LA + Sedation	163 (6.7)	11 (4.7)	129 (7.1)	
Operative time ± SD	106.2 ± 43.4	99.9 ± 28.5	104.9 ± 41.6	0.068
Time in theatre ± SD	139.0 ± 49.1	130.8 ± 33.0	137.4 ± 47.1	0.036
Warming Device (%) Blanket				
Yes	60 (8.7)	6 (12.2)	44 (8.8)	0.42
No	629 (91.3)	43 (87.8)	455 (91.2)	
Fluid Warmer				
Yes	397 (57.6)	30 (61.2)	284 (56.9)	0.56
No	292 (42.4)	19 (38.8)	215 (43.1)	
Forced Air Blanket				
Yes	669 (97.1)	49 [100]	488 (97.8)	0.61
No	20 (2.9)	0	11 (2.2)	
Heated Mattress				
Yes	6 (0.9)	0	6 (1.2)	1.0
No	683 (99.1)	49 [100]	493 (98.8)	

Variable	All	Hypothermic (n = 240)	Normothermic (n = 1815)	P value
Length of Stay (SD)	5.4 ± (4.9)	4.6 ± 2.9	5.1 ± 4.5	0.11
31-day Complications (%)				
PE	12 (0.5)	0	12 (0.7)	0.38
DVT	4 (0.2)	0	4 (0.2)	1.0
SSSI	9 (0.4)	1 (0.4)	8 (0.4)	1.0
DSSI	13 (0.5)	1 (0.4)	12 (0.7)	1.0
CVE	14 (0.6)	1 (0.4)	13 (0.7)	1.0
MI	3 (0.1)	0	3 (0.2)	1.0
31-day Re-admissions (%)				
All	90 (3.7)	8 (3.3)	82 (4.5)	0.50
PE	10 (0.4)	0	10 (0.6)	0.62
DVT	3 (0.1)	0	3 (0.2)	1.0
SSSI	8 (0.3)	0	8 (0.4)	0.61
DSSI	13 (0.5)	1 (0.4)	12 (0.7)	1.0
Wound problem	6 (0.2)	2 (0.8)	4 (0.2)	0.15
Pain	15 (0.6)	0	15 (0.8)	0.24

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