

Increased Patient Body Mass Index is Associated with Increased Surgeon Physiologic Stress during Total Hip Arthroplasty

Itay Ashkenazi, Kyle William Lawrence, Ittai Shichman, Alana Marie Prinos, Jonathan L Katzman, Claudette Malvina Lajam¹, Ran Schwarzkopf², Joshua Craig Rozell

¹NYU Langone Orthopedics, ²NYU Langone Orthopedic Hospital, Hospital For Joints

INTRODUCTION:

While increased body mass index (BMI) in patients undergoing total hip arthroplasty (THA) increases surgical complexity, there is a paucity of objective studies assessing the impact of patient BMI on the cardiovascular stress experienced by surgeons during THA. Furthermore, the majority of the 22-modifiers appended to the operative Current Procedural Terminology code, which indicate increased operative work, are due to patient obesity. The aim of this study was to assess the impact of patient BMI on surgeon cardiovascular strain during THA.

METHODS:

We prospectively evaluated three fellowship-trained arthroplasty surgeons performing a total of 115 THAs. A smart-vest worn by the surgeons recorded mean heart rate, stress index (correlate of sympathetic activation), respiratory rate, minute ventilation, and energy expenditure throughout the procedures. Patient demographics as well as perioperative data including surgical approach, surgery duration, number of assistants, and the timing of the surgery during the day were collected. Linear regression was utilized to assess the impact of patient characteristics and perioperative data on cardiorespiratory metrics.

RESULTS:

Average surgeon heart rate, energy expenditure, and stress index during surgery were 98.50 beats/minute, 309.49 calories/hour, and 14.10, respectively. Higher patient BMI was significantly associated with increased hourly energy expenditure (slope: 4.71; standard error: 2.10, P=0.027), mean heart rate (slope: 0.24; standard error: 0.11, P=0.037), and stress index (slope: 0.08; standard error: 0.04 P=0.027) independent of surgical approach. Respiratory rate and minute ventilation were not associated with patient BMI. The number of assistants and time of surgery during the day did not impact cardiorespiratory strain on the surgeon.

DISCUSSION AND CONCLUSION:

The physiologic burden on surgeons during primary THA significantly increases as patient BMI increases. Current and future reimbursement models should account for higher physical strain on surgeons as an indicator for case complexity and difficulty.

Table 1. Patients' demographics and perioperative data

Variable	Overall (n=115)
Mean BMI (Kg/m ²) [range]	30.05 [17.4-52.3]
Women, n (%)	66 (57.39)
Mean Age (years) [range]	63.05 [28-89]
Indication for surgery, n (%)	
Primary osteoarthritis	99 (86.09)
Avascular necrosis	6 (5.22)
Developmental dysplasia of the hip	5 (4.35)
Other	5 (4.35)
Approach	
Posterior	73 (63.48)
Direct anterior	42 (36.52)
Number of assistants, n (%)	
1	10 (8.70)
2	96 (83.48)
3	9 (7.83)
Number of surgery of the surgical plan, n (%)	
Cases 1 to 3	75 (65.22)
Case 4 or after	40 (34.78)
Mean surgery duration (minutes) [range]	81.08 [47.9-205.0]

BMI, Body mass index

Table 2. Cardiorespiratory metrics

Variable	Overall (n=115)
Mean energy expenditure (Calorie/hour) (SD)	309.49 (73.41)
Mean respiratory rate (Breath/minute) (SD)	23.13 (3.49)
Mean minute ventilation (Liter/minute) (SD)	20.04 (3.54)
Mean heart rate (Beats/minute) (SD)	98.50 (7.96)
Mean RMMSD (millisecond) (SD)	12.85 (12.41)
Mean stress index (SD)	14.10 (3.80)

SD, Standard deviation; RMMSD, The root mean square of successive differences between normal heartbeats

Table 3. Regression analyses for cardiorespiratory data

Variable	Slope	Std error	Statistic	P value
Energy expenditure (Calorie/hour)				
(Intercept)	305.096	90.172	3.383	0.001
BMI	4.713	2.101	2.243	0.027
Case 4 or after of the surgical plan	-24.172	30.009	-0.806	0.422
Number of assistants	-0.636	32.564	-0.296	0.768
Respiratory rate (Breath/minute)				
(Intercept)	22.520	1.969	11.437	0.000
BMI	0.059	0.047	1.268	0.208
Case 4 or after of the surgical plan	2.257	0.658	3.429	0.001
Number of assistants	-0.996	0.706	-1.411	0.161
Minute ventilation (Liter/minute)				
(Intercept)	18.866	2.065	9.135	0.000
BMI	0.089	0.049	1.809	0.073
Case 4 or after of the surgical plan	-1.924	0.690	-2.787	0.006
Number of assistants	-0.396	0.740	-0.535	0.593
Heart rate (Beat/minute)				
(Intercept)	91.573	4.711	19.440	0.000
BMI	0.235	0.112	2.107	0.037
Case 4 or after of the surgical plan	-2.693	1.575	-1.711	0.090
Number of assistants	0.431	1.689	0.255	0.799
RMMSD (millisecond)				
(Intercept)	11.186	7.535	1.485	0.141
BMI	0.100	0.179	0.561	0.576
Case 4 or after of the surgical plan	-2.221	2.519	-0.882	0.380
Number of assistants	-0.273	2.701	-0.101	0.920
Stress index				
(Intercept)	5.085	1.503	3.383	0.001
BMI	0.079	0.035	2.243	0.027
Case 4 or after of the surgical plan	-0.403	0.500	-0.806	0.422
Number of assistants	-0.161	0.543	-0.296	0.768

BMI, Body mass index; SD, Standard deviation; RMMSD, The root mean square of successive differences between normal heartbeats