Factors Associated with Pain Reduction after Cryoneurolysis in Patients Undergoing TKA

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INTRODUCTION:

Preoperative cryoanalgesia is a non-opioid pain management technique for total knee arthroplasty (TKA). This study aimed to evaluate the efficacy of cryoanalgesia in reducing preoperative pain in patients with end stage knee OA prior to undergoing TKA.

METHODS:

A retrospective review of all patients undergoing cryoanalgesia prior to TKA at a single institution was performed. Only cases of primary TKA were included. Numeric rating scale (NRS) pain questionnaires were completed while at rest, during active range of motion (ROM), passive ROM, and while weight bearing both before and immediately after the administration of cryoanalgesia. Pre and post treatment pain scores were compared using paired ttests. Multiple linear regression was used to assess the relationship between patient factors and change in NRS pain scores while controlling for pretreatment pain levels. The percentage of patients achieving the minimal clinically important difference (MCID), substantial clinical benefit (SCB), and patient acceptable symptom state (PASS) were determined using previously published values of 1, 2, and 3 or less, respectively.

RESULTS: 111 patients with a mean age of 68.7 ± 8.2 years and BMI of 32.3 ± 6.1 were included. Seventy-eight were female (70.3 percent) (Table 1). Females had greater pretreatment pain scores while at rest (5.2 ± 1.1 vs. 3.9 ± 2.5, p=.016), with passive ROM (6.5 ± 2.3 vs. 5.3 ± 2.2, p=.008), and with active ROM (7.7 ± 2.1 vs. 6.2 ± 2.6, p=.002) (Table 2). There was a significant reduction in NRS pain scores after treatment with cryoanalgesia (at rest: 4.8 ± 2.5 vs. 1.0 ± 0.97; passive ROM: 6.2 ± 2.3 vs. 1.2 ± 1.2; active ROM: 7.2 ± 2.3 vs. 1.3 ± 1.2; weight bearing: 7.8 ± 2.4 vs. 1.2 ± 1.3; p<.0001 for all). On multiple regression analysis adjusted for pretreatment pain scores, no demographic factor was significantly associated with improvement in NRS pain (Table 3). MCID, SCB, and PASS were achieved by over 92%, 81%, and 95% of patients, respectively (Table 4). No complications occurred.

DISCUSSION AND CONCLUSION:

Cryoanalgesia is effective at reducing pain prior to TKA. The efficacy of cryoanalgesia was not influenced by patient demographics making it a suitable opioid sparing pain management strategy for a wide range of patients.

Table 1: Demographics of included patients

	Total cohort (n=111)	Males (n=33)	Females (n=78)	p value
Age	68.7 (8.2)	66.5 (6.0)	69.8 (8.8)	0.057
BMI	32.3 (6.1)	32.2 (6.0)	32.3 (6.2)	0.93
ASA, (%)				0.1
1	2 (1.8)	0 (0.0)	2 (2.6)	
2	54 (48.6)	21 (63.6)	33 (42.3)	
3	55 (49.6)	33 (36.4)	43 (55.1)	
Insurance, (%)				0.39
Commercial	35 (31.5)	13 (39.4)	22 (28.2)	
Medicare	69 (62.2)	19 (57.6)	50 (64.1)	
Medicaid	7 (6.3)	1 (3.0)	6 (7.70)	

Data reported as mean and standard deviation unless otherwise specified.

Table 2: Improvement in NRS Pain Scores after Cryoanalgesia by Gender

	Pre			Post			Change		
	Males	Females		Males	Females		Males*	Females*	Males vs females**
Motion	Mean (SD)	Mean (SD)	p value	Mean (SD)	Mean (SD)	p value	p value	p value	p value
At rest	3.9 (2.5)	5.2 (1.1)	**0.016**	.81 (.8)	1.08 (1.03)	0.19	**<.0001**	**<.0001**	**0.042**
Passive	5.3 (2.2)	6.5 (2.3)	**0.008**	1.1 (.9)	1.31 (1.2)	0.37	**<.0001**	**<.0001**	**0.036**
Active	6.2 (2.6)	7.7 (2.1)	**0.002**	1.1 (.9)	1.44 (1.3)	0.22	**<.0001**	**<.0001**	**0.014**
Weight Bearing	7.1 (2.6)	8.1 (2.2)	0.07	1.2 (1.1)	1.26 (1.42)	0.81	**<.0001**	**<.0001**	**0.038**

* p value for comparison of post treatment NRS pain score to pretreatment score in males and females. ** comparison of the change in scores between males and females.

Table 3: Factors associated with decrease in NRS pain score

Univariable Linear Regression			Multiple Linear Regression
At rest			
	Coefficient (95 % CI)	p value	p value
Age	-0.05 (-.10, .01)	0.08	
Female Sex	1.02 (.04, 2.01)	**0.042**	0.33
BMI	-0.04(-.12, .03)	0.23	
ASA	-0.71 (-1.64, .21)	0.13	
Insurance	-0.87 (-1.85, .12)	0.08	
Passive			
Age	-0.05 (-.10, .01)	0.09	
Female Sex	1.01 (.07, 1.96)	**0.036**	0.81
BMI	-0.02 (-.09, .05)	0.62	
ASA	-0.52 (-1.42, .37)	0.25	
Insurance	-0.47 (-1.41, .47)	0.33	
Active			
Age	-0.05 (-.11, .001)	0.06	
Female Sex	1.22 (.24, 2.19)	**0.015**	0.66
BMI	-0.04 (-.12, .03)	0.26	
ASA	-0.73 (-1.65, .18)	0.12	
Insurance	-0.81 (-1.79, .17)	0.11	
Weight bearing			
Age	-0.06 (-.13, .02)	0.12	
Female Sex	1.32(.08, 2.56)	**0.038**	0.61
BMI	0.02 (-.08, .12)	0.66	
ASA	-0.63 (-1.86, .61)	0.32	
Insurance	-0.05 (-1.35, 1.26)	0.94	

Results of univariable and multiple regression analyses. In regression analysis, ASA class 3 was compared to ASA class 2 and patients with Medicare were compared to those with commercial insurance. Multiple regression analyses adjusted for pre-treatment NRS pain score for each motion.

Table 4: Percentage of patients achieving MCID, SCB, and PASS

	MCID			SCB			PASS		
Motion	Overall	Females	Males	Overall	Female	Male	Overall	Female	Male
At rest, (%)	91.8	93.5	87.5	80.9	83.3	75.0	98.1	98.6	96.9
Passive, (%)	98.2	98.7	96.9	90.9	93.6	84.4	96.1	95.8	96.9
Active, (%)	99.1	100.0	96.8	94.0	92.8	96.8	95.1	93.0	100.0
Weight Bearing, (%)	98.5	97.8	100.0	95.1	95.0	95.2	95.2	92.9	100.0