ORIGINAL ARTICLE

A Randomized Clinical Trial Assessing the Efficacy of Periarticular Injection (LIA) during Total Knee Joint Replacement in the Asian Population

Venkatappa Somashekar[1], Anandsrinivas Sowlee[2], Prahalad K Singhi[3], Sivakumar Raju[4], Venkatasamy Pandiarajan Raghava Kumar[5]

Abstract

Introduction: Osteoarthritis patients usually come very late in the natural course often having bilateral involvement of degenerative changes. Patients are counseled and advised for staged procedures, however, after the first knee surgery, due to postoperative pain, the majority of them are reluctant to undergo total knee arthroplasty (TKA) in the other knee. We did a prospective randomized double-blind control study comparing the amount of analgesic required in the immediate postoperative period in those patients who received a periarticular cocktail injection and those who did not, following TKA.

Materials and methods: This was a single-center prospective randomized controlled, double-blind, clinical analysis comparing 126 patients receiving intraoperative analgesia cocktail and control group during TKA. Group I (*n* 72) received local infiltration of analgesic (LIA), group II (*n* 54) did not receive any injection. Patients were assessed for pain in terms of visual analog scale (VAS) score, postoperative analgesia requirement, and knee range of motion.

Results: The mean postoperative Oxford knee score at 2 months of group I was 30.47 (SD 4.45) compared with group II was 30.30 (SD 5.44). There was a significantly lower mean VAS score (3.16) in group I than group II (7.45) and was statistically significant with a *p* value of 0.0005. At the end of 2 months, both the groups had similar degrees of range of motion.

Conclusion: Local infiltration of analgesia during TKA with our combination of drugs effectively reduces postoperative pain and decreased analgesic consumption, without adding much to the cost of the surgery and also significantly improves patient compliance and rehabilitation.

Keywords: Asian population, Pain management, Periarticular injection, Total knee arthroplasty.

Journal of Orthopedics and Joint Surgery (2021): 10.5005/jp-journals-10079-1030

Introduction

Total knee arthroplasty (TKA) is the most successful procedure for treating knee osteoarthritis. Though the patient seeks surgery for pain relief, it is often associated with considerable postoperative pain.[1] The association of pain is the cause of postoperative dissatisfaction, delayed rehabilitation, and resultant poor functional outcome.[2] Often in clinical settings where the patient comes very late in the natural course of osteoarthritis have bilateral involvement of degenerative changes in our scenario. Patients are counseled and advised for staged procedures; however, after the first knee due to postoperative pain, most of them will be reluctant to undergo TKA in the opposite knee.

There are many modes of postoperative analgesia epidural pumps, patient-controlled analgesia, femoral nerve blocks, adductor canal blocks, and continuous infusion into the knee. Patient-controlled analgesia with opioids is accompanied by nausea and vomiting. Epidural analgesia is associated with neurogenic bladder, spinal headache, and risk of infection.[3] Femoral nerve blocks in some patients have poor quadriceps function and hence cause a problem in the physiotherapy in the immediate postoperative period. Intra-articular injection of analgesics appears to provide pain relief at the site of requirement and decreases the dosage of postoperative opioid consumption.[4] We did a prospective randomized double-blind control study comparing the postoperative analgesia used and pain relief in those patients receiving a periarticular injection and those who did not, following TKA.

[1–5]Department of Orthopaedics, Preethi Hospitals (P) Ltd, Madurai, Tamil Nadu, India

Corresponding Author: Anandsrinivas Sowlee, Department of Orthopaedics, Preethi Hospitals (P) Ltd, Madurai, Tamil Nadu, India, Phone: +91 9994100690, e-mail: a.sowlee@gmail.com

How to cite this article: Somashekar V, Sowlee A, Singhi PK, *et al.* A Randomized Clinical Trial Assessing the Efficacy of Periarticular Injection (LIA) during Total Knee Joint Replacement in the Asian Population. J Orth Joint Surg 2021;3(1):41–50.

Source of support: Nil

Conflict of interest: None

Materials and Methods

This was a single-center prospective randomized controlled, double-blind, clinical analysis done at PIMS, Madurai, comparing 126 patients receiving intraoperative analgesia cocktail with the control group undergoing TKA. The purpose was to evaluate the efficacy of the cocktail injection without the use of steroids in the Indian population to rule out any chances of infection that may be attributable to steroids. Scientific Research Committee (SRC) approval of the hospital was obtained and patients were randomly allocated with simple randomization, using the computer-generated randomization tables into two groups. Inclusion criteria consisted of patients of both sexes with grade III or IV osteoarthritis knees (Kellgren and Lawrence system), ability to give informed

consent, and cooperation were included in the study. Exclusion criteria consisted of major psychological problems, hypersensitivity to local anesthetic agents, abnormal liver or renal function tests, and multiple comorbidities that may impair the excretion of drugs. All eligible patients were screened with detailed demographic medical and clinical history. After informed consent was obtained, patients received detailed instructions from the team concerning the treatment. Patient involvement was entirely voluntary and each patient had the opportunity to refuse the treatment protocol.

The sample size was determined after consulting with the statistical team. The collected data were analyzed with IBM.SPSS statistics software 23.0 Version. To describe the data, descriptive statistics frequency analysis and percentage analysis were used for categorical variables and the mean and SD were used for continuous variables. To find the significant difference between the bivariate samples in paired groups the paired sample *t*-test was used and for independent groups, the unpaired sample *t*-test was used. To find the significance in categorical data, Chi-square test was used. In the above statistical tools, the probability value 0.05 was considered as a significant level.

Technique

Randomized patients were taken up for surgery under regional anesthesia with epidural catheter *in situ* for both groups. Preoperative antibiotics were given and all patients underwent TKA through a midline incision and medial parapatellar arthrotomy under tourniquet. Standard release with cuts are taken, ligaments balanced, the flexion-extension gap balance achieved with trial implants. Wash was given, cleared of all debris, and the bone bed is prepared for cementing. Before implantation group I received periarticular local infiltration of analgesic (LIA) which is 150 mg of ropivacaine, 2 drops of adrenaline, 10 mg of morphine constituted with normal saline to make total volume to 100 mL. Local infiltration of analgesic is injected into medial meniscus capsular attachment, lateral meniscus capsular attachment, posteromedial capsule, posterolateral capsule, suprapatellar pouch/synovium, and around quadriceps tendon with only 5–6 mL of cocktail to diffuse per pass (Figs 1 to 6). Next cementing of the definitive implants done. Group II did not receive any cocktails. A three-layered watertight closure was done with a drain. Tourniquet was released. Postoperatively standard rehabilitation protocol was followed. Drains were kept in suction mode, clamped for the first 4 hours, and later opened with periodic assessment of drain collection which was removed at 24 hours. Patients were assessed for pain in terms of visual analog scale (VAS) score and also when the patient did complain of pain and analgesia was given.

Analgesia during the postoperative days (1–5) was standardized for all patients. The epidural pump was used with 0.2% ropivacaine (240 mL) + 500 µ fentanyl @ 5 mL/hour. it was connected only after the patient started complaining of pain. The epidural catheter was removed after 48 hours. Patients who reported moderate to severe pain (i.e., VAS >3) were given intravenous 1 g paracetamol as rescue medication by the nursing staff who was blinded to the study. No narcotics/sedatives were used for pain relief apart from that used in an epidural pump. Postoperative ankle pumps and standing were started the same evening. Static quadriceps and high sitting were allowed from the next morning. Straight-leg raise (SLR) started as soon as the patient became comfortable. The range of movement of the operated knee was documented daily by a physiotherapist who was also blinded. Following discharge, all patients were given a standard discharge analgesic medication and the rehabilitation protocol. All the data were collected, assessed preoperatively, on the first postoperative day, day 6, at 4 weeks and 8 weeks.

Results

One hundred and forty patients were assessed out of which 126 patients were included in the study, their basic demographic profile is given in Table 1. Out of which 14 patients were excluded. Eight patients refused to give consent to participate in the study. Six patients were excluded as the anesthetist deemed them not fit for TKA. Of 126 patients, 72 patients (57%) were in group I who received LIA, and the rest were in group II (*n* 54, 43%). No patients were lost to follow-up. The mean age of group I was 63 years compared with 59.69 years of those who did not receive LIA, which was not statistically significant (Table 2).

The mean preoperative Oxford knee score was 13.44 (SD 3.865) in group I. The mean Oxford knee score of group II was 11.70 (SD 2.072). The mean postoperative Oxford knee score at 2 months of group I receiving LIA was 30.47 (SD 4.450) compared with group II was 30.30 (SD 5.44). This was statistically not significant (Table 2).

During the early postoperative days, (1–5) pain was significantly less in group I compared with group II which was assessed by VAS.

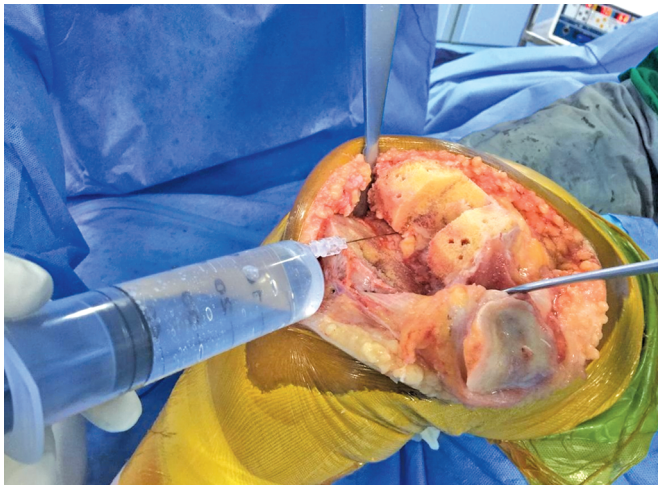

Fig. 1: Infiltration into medial gastrocnemius and capsule

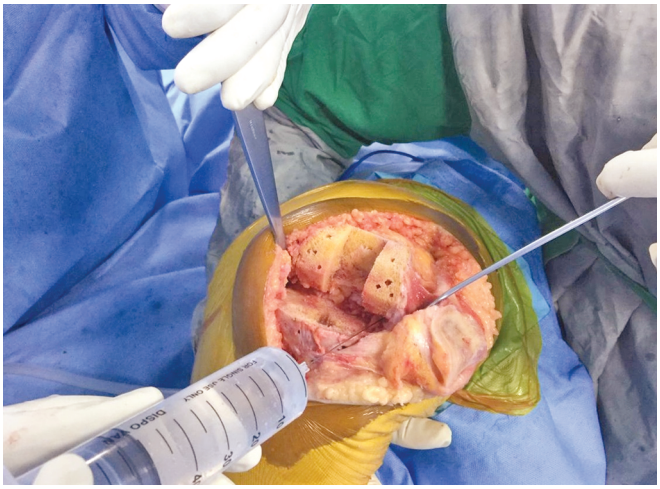

Fig. 2: Infiltration into lateral gastrocnemius and capsule

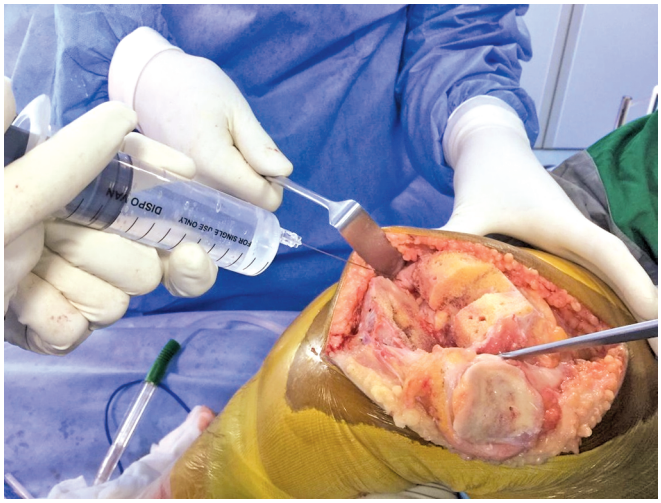

Fig. 3: Infiltration into medial meniscus and capsule

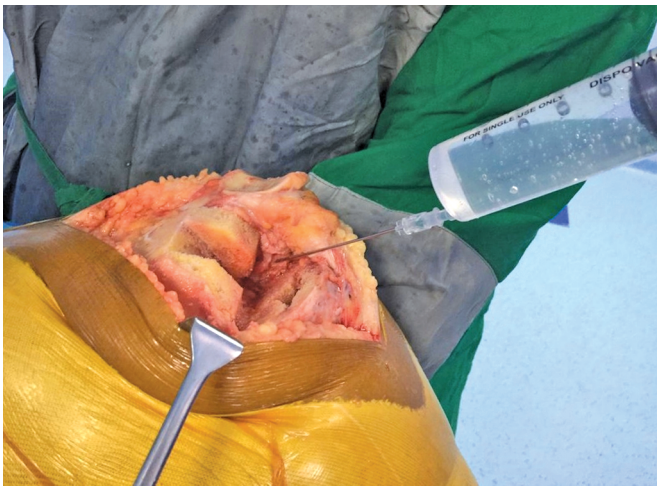

Fig. 4: Infiltration into lateral meniscus and capsule

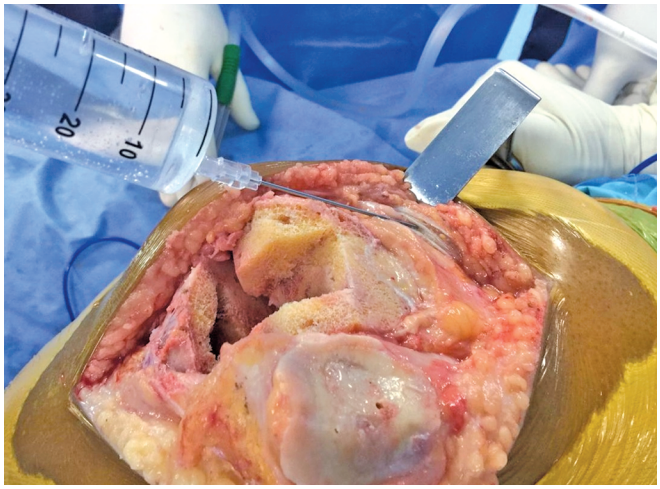

Fig. 5: Infiltration into quadriceps tendon, vastus medialis and suprapatellar pouch

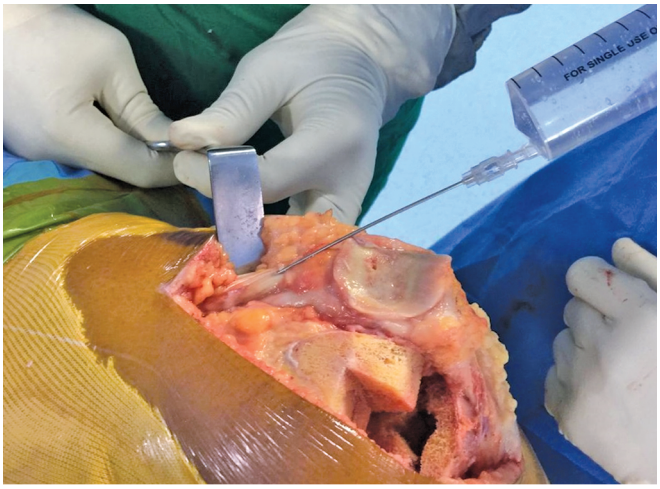

Fig. 6: Infiltration into rectus and quadriceps tendon and suprapatellar area

There was a significantly lower mean VAS score (3.16) (Table 2) in group I than group II (7.45) (Table 2) and was statistically significant with a *p* value of 0.0005 (Table 3). There was an increased analgesia requirement in group II up to postoperative day 3. The mean total analgesic consumption at day 3 postoperative day was significantly less in group I (1.22) (Table 2) compared with group II (5.67) (Table 2), positive correlation with a *p* value of 0.0005 (Table 3).

The results from both the groups are shown separately in Tables 4 and 5. On the 3rd postoperative day, patients who received the intra-articular injection were able to do more degrees of flexion than those who did not receive it. Significantly patients in group I were able to do active straight leg raise (ASLR) on a postoperative day 1 than in group II. Duration to start ASLR and time to discharge was significantly reduced in group I than in group II.

The mean amount of drain collected was significantly less in those receiving LIA, group I had a mean of 162.50 mL (SD 62.536 mL) (Table 2) compared with 403.70 mL of group II (SD 114.29 mL) (Table 2), which was statistically highly significant with a *p* value of <0.0005 (Table 3).

At the end of 2 months, patients in both groups had similar degrees of range of motion. Both the groups had four cases of nausea which was treated symptomatically. No patient in either group experienced serious adverse events such as respiratory distress, or local anesthetic intoxication. None of the patients in either group reported any surgical site infection or reported disruption of the extensor mechanism. In our study, no cases with single-stage bilateral total knee replacement were done.

Table 1: Demographic profile

	Group I	*Group II*
n	72	54
Male/female	16/56	16/38
Age	63.69	59.67
Left/right	40/32	24/30
Diabetes/hypertensive	44/52	36/40

Discussion

Total knee arthroplasty is an effective treatment for osteoarthritis and is performed with several goals, but the primary being pain relief and improved function. Due to the poorly controlled pain postoperatively, the patient's ability to do physical activities is reduced with disturbance of sleep.[5,6] Pain is the third most

Table 2: Measured outcome of the two groups

	Cocktail injection	*N*	*Mean*	*Std. deviation*	*Std. error mean*
Age	Yes	72	63.69	8.451	1.408
	No	54	59.67	7.211	1.388
Oxford knee score (preoperative)	Yes	72	13.44	3.865	0.644
	No	54	11.70	2.072	0.399
Oxford knee score (postoperative)	Yes	72	30.47	4.450	0.742
	No	54	30.30	5.441	1.047
Amount of drain collected	Yes	72	162.50	62.536	10.423
	No	54	403.70	114.292	21.996
VAS score	Yes	72	3.17	1.949	0.325
	No	54	7.44	1.013	0.195
Analgesic top-up requirement	Yes	72	1.22	0.989	0.165
	No	54	5.67	0.961	0.185

common medical cause of delayed discharge after surgery. Unrelieved pain prolongs the stress response, adversely affecting patients' recovery rate.[7] Studies have reported a significantly lower satisfaction rate after TKA than after total hip arthroplasty due to postoperative pain.[8,9] Postoperative pain is of concern for patients, and adequate analgesia countermeasures are necessary which facilitates early and effective rehabilitation after TKA. The optimal form of pain relief should be instituted preoperatively, perioperative and postoperative period to avoid the establishment of pain hypersensitivity.[10] The pain may be a result of direct trauma to the bone and soft tissue, or hyperperfusion following tourniquet release.[11] The surgical trauma results in peripheral sensitization by decreasing the threshold of the afferent nociceptive neurons and also increases the excitability of spinal neurons by sensitization. Intraoperative cocktail injection of analgesia facilitates direct visualization and precise placement of the needle into the traumatized tissues and nerve endings. Also, the local concentration of the drugs within the traumatized tissue increases the analgesic duration and reduces the loss from the wound.[12]

The active ingredients of the infiltration mixture we used were morphine, ropivacaine, and adrenaline. Morphine acts on the opioid receptors that are present in the peripheral inflamed tissues.[13] These receptors are expressed within hours after surgical trauma and mediate the afferent sensory input to the central nervous system.[14] Certain trials have shown reduced pain scores and lower need for opiate analgesia with intra-articular infiltration of local anesthetic agents,[12,15] whereas some studies do not show the same.[16,17] The use of 0.5% ropivacaine enhances pain relief both directly and indirectly by inhibiting the neuroendocrine stress response to the operative procedure.[18] Ropivacaine is similar to bupivacaine, but it is longer acting, less lipophilic hence less likely to penetrate large myelinated motor fibers, thereby causing relatively less motor blockage but similar sensory blockade by its selective motor sensory differentiation. Its improved safety profile, less cardiac, and CNS toxicity allow the patient to tolerate larger doses.[19] The maximum circulating level is reached twenty to thirty minutes after injection. In addition to its nociceptive activity, it also shows anti-inflammatory properties in human cells.[20] Injection adrenaline was added to prolong the local effect of the drug by keeping its action localized to the area of injection.

The results of the present study demonstrated that the use of intraoperative multimodal cocktail injection significantly reduces postsurgical pain, postoperative in-hospital analgesic requirements, and hospital stay. The significantly decreased pain with cocktail injection results in a decreased duration of hospital stay and enhances early rehabilitation. We found the cocktail injection to be effective and safe in postoperative pain control and early rehabilitation in TKA. In the present study, the addition of cocktail injection significantly reduces the consumption of the analgesic drug, as also reported by Crowley et al.[21] The shorter duration of hospital stay and a better percentage of ASLR on day 1 observed in our study was reported in a study done by Maheshwari et al.[22] Mullaji showed the pain score (VAS) on day 1 was about 3.3 in infiltrated knees compared with 6.3 in the noninfiltrated knees which despite not using steroids in our study yielded similar results.[23] We maintained strict aseptic precautions and exclusion criteria, we had no infection during both the early postoperative days and during follow-up. At the end of 2 months, the cocktail group and the control group had a similar degree of range of motion. Indicating that the benefits of the cocktail injection were limited to the early postoperative period. In a study by Busch et al., those patients who received the injection showed less analgesic requirement in the immediate postoperative period, greater VAS scores for patient satisfaction, lower mean VAS scores for postoperative pain, and but at 8 weeks the range of motion was the same in both groups. These observations were similar to our study.[24]

In the Indian population, since the infrapatellar area is very thin the cocktail injection was not injected to avoid any wound complications. The original Ranawat's suspension contained steroid which was not used in our study due to the risk of postoperative wound infection and tendon rupture, but still, our study showed that there is good pain relief, low VAS score, lower need for analgesics, improved range of motion in the immediate postoperative period and shorter hospital stay.

Conclusion

The cocktail combination of our study proves to be safe and effective in pain control during the postoperative period of TKA. Also, cocktail injected patients had a significant positive correlation with lower pain scores, better cooperation during rehabilitation, improved range of motion, and thus the lower need for analgesics, especially in the immediate postoperative period. Side effects of steroid and parenteral narcotics were mitigated, thus improving patient compliance. There was no significant difference in the operative time, hospital stay, overall cost, wound complications,

Table 3: Independent samples test with correlation

		Levene's test for equality of variances		*t-test for equality of means*						
									95% confidence interval of the difference	
		F	*Sig.*	*t*	*df*	*Sig. (two-tailed)*	*Mean difference*	*Std. error difference*	*Lower*	*Upper*
Age	Equal variances assumed	0.577	0.450	1.991	61	0.051	4.028	2.023	−0.017	8.073
Oxford knee score (preoperative)	Equal variances not assumed	8.171	0.006	2.298	55.911	0.025	1.741	0.758	0.223	3.259
Oxford knee score (postoperative)	Equal variances assumed	0.099	0.755	0.141	61	0.888	0.176	1.247	−2.317	2.669
Amount of drain collected	Equal variances not assumed	11.812	0.001	−9.910	37.579	0.0005	−241.204	24.340	−290.496	−191.912
VAS score	Equal variances not assumed	15.845	0.000	−11.291	55.115	0.0005	−4.278	0.379	−5.037	−3.519
Analgesic top-up requirement	Equal variances assumed	0.507	0.479	−17.869	61	0.0005	−4.444	0.249	−4.942	−3.947

Table 4: Result of patients from group I (case group)

Magnetic resonance neurography	*Age*	*Sex*	*Side*	*Oxford knee score (Pre-Op)*	*Oxford knee score (Post-Op)*	*Amount of drain*	*VAS score*	*Analgesic top-up requirement*	*Type of prosthesis*	*Cocktail injection*
100,079	67	F	L	15	38	200	4	2	PS	Yes
105,279	60	F	L	9	26	250	5	2	TC3	Yes
105,684	56	F	L	3	24	175	3	1	TC3	Yes
105,961	69	F	L	6	26	300	6	3	PS	Yes
106,790	63	F	L	13	28	250	2	1	PS	Yes
106,340	71	F	R	9	27	200	0	0	PS	Yes
105,563	42	M	L	18	25	150	2	1	PS	Yes
107,016	69	F	L	18	20	300	5	2	PS	Yes
106,216	67	F	R	16	23	250	2	1	PS	Yes
101,732	50	F	L	15	24	200	5	2	PS	Yes
107,149	55	F	R	14	29	225	4	1	PS	Yes
109,188	60	F	R	13	33	150	6	2	PS	Yes
110,479	59	F	L	19	30	50	4	2	PS	Yes
110,468	59	F	R	15	30	75	5	2	PS	Yes
110,633	62	F	L	12	29	100	5	2	PS	Yes
110,680	70	F	R	18	30	150	5	2	CR	Yes
80,466	65	F	L	14	28	125	6	3	TC3	Yes
110,945	70	F	R	18	28	150	3	1	PS	Yes
111,187	78	M	R	15	35	100	3	1	PS	Yes
110,726	69	M	L	14	35	175	0	0	CR	Yes
111,580	42	F	R	14	32	175	0	0	PS	Yes
112,132	54	M	L	12	32	150	2	0	CR	Yes
109,279	68	F	L	12	35	200	4	1	PS	Yes
112,301	70	M	R	13	30	100	5	2	PS	Yes
110,079	67	F	L	15	35	150	4	2	PS	Yes
107,460	55	F	R	12	35	175	6	3	PS	Yes
105,541	65	F	L	17	32	200	4	2	CR	Yes
108,944	78	M	L	18	35	100	2	0	PS	Yes
109,390	68	F	R	17	35	125	0	0	PS	Yes
110,404	63	F	R	15	35	75	2	0	PS	Yes
85,416	65	F	L	7	30	50	0	0	PS	Yes
120,932	70	F	R	8	36	125	4	2	PS	Yes
90,466	65	F	R	10	25	150	2	1	PS	Yes
115,439	62	F	R	8	32	175	0	0	PS	Yes
111,322	62	M	L	17	35	125	2	0	PS	Yes
96,340	71	F	R	9	27	200	0	0	PS	Yes
95,563	42	M	L	18	25	150	2	1	PS	Yes

Contd...

Contd...

Magnetic resonance neurography	*Age*	*Sex*	*Side*	*Oxford knee score (Pre-Op)*	*Oxford knee score (Post-Op)*	*Amount of drain*	*VAS score*	*Analgesic top-up requirement*	*Type of prosthesis*	*Cocktail injection*
97,016	70	F	L	18	20	300	5	2	PS	Yes
107,032	66	F	R	16	23	250	2	1	PS	Yes
91,732	50	F	L	15	24	200	5	2	PS	Yes
97,149	55	F	R	14	29	225	4	1	PS	Yes
99,188	60	F	R	13	33	150	6	2	PS	Yes
90,479	59	F	L	19	30	50	4	2	PS	Yes
90,468	59	F	R	15	30	75	5	2	PS	Yes
90,633	62	F	L	12	29	100	5	2	PS	Yes
90,680	70	F	R	18	30	150	5	2	CR	Yes
110,430	65	F	L	14	28	125	6	3	CR	Yes
70,945	70	F	R	18	28	150	3	1	PS	Yes
111,140	78	M	R	15	35	100	3	1	PS	Yes
110,716	69	M	L	14	35	175	0	0	CR	Yes
111,112	42	F	R	14	32	175	0	0	PS	Yes
112,130	54	M	L	12	32	150	2	0	CR	Yes
111,000	78	M	L	15	35	200	2	0	PS	Yes
79,390	68	F	R	17	35	125	0	0	PS	Yes
120,404	63	F	R	15	35	75	2	0	PS	Yes
70,434	65	F	L	7	30	50	0	0	PS	Yes
100,945	70	F	R	8	36	125	4	2	PS	Yes
82,366	65	F	R	10	25	150	2	1	PS	Yes
110,638	62	F	R	8	32	175	0	0	PS	Yes
101,320	62	M	L	17	35	125	2	0	PS	Yes
101,279	67	F	L	15	38	200	4	2	PS	Yes
102,079	60	F	L	9	26	250	5	2	PS	Yes
95,671	56	F	L	3	24	175	3	1	PS	Yes
85,960	69	F	L	6	26	300	6	3	PS	Yes
107,797	63	F	L	13	28	250	2	1	PS	Yes
99,276	68	F	L	12	35	200	4	1	PS	Yes
110,309	70	M	R	13	30	100	5	2	PS	Yes
120,070	67	F	L	15	35	150	4	2	PS	Yes
117,468	55	F	R	12	35	175	6	3	PS	Yes
115,571	65	F	L	17	32	200	4	2	CR	Yes
128,643	78	M	L	18	35	100	2	0	PS	Yes

Table 5: Result of patients from group II (control group)

Magnetic resonance neurography	*Age*	*Sex*	*Side*	*Oxford knee score (Pre-Op)*	*Oxford knee score (Post-Op)*	*Amount of drain*	*VAS score*	*Analgesic top-up requirement*	*Type of prosthesis*	*Cocktail injection*
102,806	67	M	L	12	34	300	8	6	PS	No
59,173	58	M	R	14	48	350	6	5	PS	No
103,722	72	M	R	10	30	375	8	6	PS	No
6,966	65	F	R	10	31	300	7	5	PS	No
105,435	72	F	R	11	27	275	9	8	PS	No
103,734	60	F	L	17	35	250	5	5	PS	No
60,001	62	F	L	10	20	350	7	5	PS	No
103,760	71	F	R	12	34	375	7	5	PS	No
105,897	62	M	R	8	31	425	8	6	PS	No
96,689	65	M	L	11	31′	500	8	6	PS	No
102,405	55	F	L	14	29	650	6	4	PS	No
107,290	58	F	L	13	32	600	8	6	PS	No
107,399	55	F	R	12	26	550	9	7	PS	No
48,990	65	F	R	15	26	250	7	6	PS	No
107,249	60	F	R	11	27	350	8	6	PS	No
107,759	55	F	L	14	29	375	8	6	PS	No
70,637	49	F	L	12	25	450	8	6	PS	No
110,320	55	F	R	11	29	450	7	6	PS	No
108,603	55	F	R	11	35	400	8	4	PS	No
103,793	60	M	R	12	37	375	8	6	PS	No
96,595	65	M	L	10	30	425	6	4	PS	No
103,796	45	M	L	12	25	600	7	5	PS	No
103,797	62	F	R	10	32	550	8	5	PS	No
2,926	43	F	R	10	25	500	9	7	PS	No
109,182	56	F	R	9	25	300	7	6	PS	No
109,534	60	F	L	10	28	275	6	5	PS	No
70,367	59	F	L	15	37	300	8	7	PS	No
113,758	71	F	R	12	34	375	7	5	PS	No
115,857	62	M	R	8	31	425	8	6	PS	No
86,687	65	M	L	11	31′	500	8	6	PS	No
112,457	55	F	L	14	29	650	6	4	PS	No
117,277	58	F	L	13	32	600	8	6	PS	No
87,398	55	F	R	12	26	550	9	7	PS	No
118,990	65	F	R	15	26	250	7	6	PS	No
127,278	60	F	R	11	27	350	8	6	PS	No
122,876	67	M	L	12	34	300	8	6	PS	No
79,165	58	M	R	14	48	350	6	5	PS	No

Contd...

Contd...

Magnetic resonance neurography	*Age*	*Sex*	*Side*	*Oxford knee score (Pre-Op)*	*Oxford knee score (Post-Op)*	*Amount of drain*	*VAS score*	*Analgesic top-up requirement*	*Type of prosthesis*	*Cocktail injection*
83,728	72	M	R	10	30	375	8	6	PS	No
96,986	65	F	R	10	31	300	7	5	PS	No
95,414	72	F	R	11	27	275	9	8	PS	No
83,778	60	F	L	17	35	250	5	5	PS	No
110,201	62	F	L	10	20	350	7	5	PS	No
125,926	43	F	R	10	25	500	9	7	PS	No
129,181	56	F	R	9	25	300	7	6	PS	No
119,534	60	F	L	10	28	275	6	5	PS	No
90,367	59	F	L	15	37	300	8	7	PS	No
117,857	55	F	L	14	29	375	8	6	PS	No
120,637	49	F	L	12	25	450	8	6	PS	No
120,347	55	F	R	11	29	450	7	6	PS	No
118,614	55	F	R	11	35	400	8	4	PS	No
113,787	60	M	R	12	37	375	8	6	PS	No
106,578	65	M	L	10	30	425	6	4	PS	No
123,797	45	M	L	12	25	600	7	5	PS	No
83,797	62	F	R	10	32	550	8	5	PS	No

and deep vein thrombosis between the two groups. Recovery is more comfortable for patients undergoing staged bilateral TKA and the rehabilitation less tedious. Multimodal analgesia will help in utilizing the effectiveness of individual drugs of different classes in optimal doses and the use of different sites of administration to obtain maximum pain relief and reduce the side effects, thereby improving the postoperative outcome.

Limitation

Even though the staff who recorded the outcome and patients involved in the study were blinded to whether they received the LIA or not, the surgeons injecting the suspension were aware. We have not recorded the baseline pain threshold of patients as it may vary individually and so do the analgesics requirement. Moreover, we have not eliminated the use of opioids nor have we eliminated the pain.

References

1. Giuffre M, Asci J, Arnstein P, et al. Postoperative joint arthroplasty pain: description and opioid requirement. J Post Anesth Nurs 1991;6:239–245.
2. Kahlenberg CA, Nwachukwu BU, Mclawhorn AS, et al. Patient satisfaction after total knee arthroplasty: a systematic review n.d. HSS J 2018;14(2):192–201. DOI: 10.1007/s11420-018-9614-8.
3. Pettine KA, Wedel DJ, Cabanela ME, et al. The use of epidural bupivacaine following total knee arthroplasty. Orthop Rev 1989;18:894–901.
4. Kalso E, Tramer MR, Carroll D, et al. Pain relief from intraarticular morphine after knee surgery: a qualitative systematic review. Pain 1997;71(2):127–134. DOI: 10.1016/S0304-3959(97)03344-7.
5. Forst J, Wolff S, Thamm P, et al. Pain therapy following joint arthroplasty. a randomized study of patient-controlled analgesia versus conventional pain therapy. Arch Orthop Trauma Surg 1999;119(5-6):267–270. DOI: 10.1007/s004020050407.
6. Strassels SA, Chen C, Carr DB. Postoperative analgesia: economics, resource use, and patient satisfaction in an urban teaching hospital. Anesth Analg 2002;94(1):130–137. DOI: 10.1213/00000539-200201000-00025.
7. Pasero C, Paice JA, McCaffery M. Basic mechanisms underlying the causes and effects of pain. In: McCaffery M, Pasero C, ed. Pain: clinical manual. 2nd ed., St. Louis, MO: Mosby; 1999. pp. 15–34.
8. Bourne RB, Chesworth B, Davis A, et al. Comparing patient outcomes after THA and TKA: is there a difference? Clin Orthop Relat Res 2010;468(2):542–546. DOI: 10.1007/s11999-009-1046-9.
9. Kim SJ, Bamne A, Song YD, et al. Patients still wish for key improvements after total knee arthroplasty. Knee Surg Relat Res 2015;27(1):24–33. DOI: 10.5792/ksrr.2015.27.1.24.
10. Badner NH, Bourne RB, Rorabeck CH, et al. Intra-articular injection of bupivacaine in knee-arthroplasty operations. Results of use for analgesia and for pre-emptive blockade. J Bone Joint Surg Am 1996;78(5):734–738. DOI: 10.2106/00004623-199605000-00013.
11. Estebe JP, Kerebel C, Brice C, et al. Pain and tourniquet in orthopaedic surgery. Cah Anesthesiol 1995;43:573–578.
12. Vendittoli PA, Makinen P, Drolet P, et al. A multimodal analgesia protocol for total knee arthroplasty: a randomized, controlled study. J Bone Joint Surg Am 2006;88(2):282–289. DOI: 10.2106/00004623-200602000-00005.
13. Stein C. The control of pain in peripheral tissue by opioids. N Engl J Med 1995;332(25):1685–1690. DOI: 10.1056/NEJM199506223322506.
14. Stein C. Peripheral mechanisms of opioid analgesia. Anesth Analg 1993;76(1):182–191. DOI: 10.1213/00000539-199301000-00031.
15. Lombardi JrAV, Berend KR, Mallory TH, et al. Soft-tissue and intra-articular injection of bupivacaine, epinephrine, and morphine has a

beneficial effect after total knee arthroplasty. Clin Orthop Relat Res 2004;428:125–130. DOI: 10.1097/01.blo.0000147701.24029.cc.
16. Ritter MA, Koehler M, Keating EM, et al. Intra-articular morphine and/or bupivacaine after total knee arthroplasty. J Bone Joint Surg Br 1999;81(2):301–303. DOI: 10.1302/0301-620X.81B2.0810301.
17. Browne C, Copp S, Reden L, et al. Bupivacaine bolus injection versus placebo for pain management following total knee arthroplasty. J Arthroplasty 2004;19(3):377–380. DOI: 10.1016/j.arth.2003.10.012.
18. Rasmussen S, Kramhøft MU, Sperling KP, et al. Increased flexion and reduced hospital stay with continuous intraarticular morphine and ropivacaine after primary total knee arthroplasty: open intervention study of efficacy and safety in 154 patients. Acta Orthop Scand 2004;75(5):606–609. DOI: 10.1080/00016470410001501.
19. Feldman HS. Toxicity of local anaesthetic agents. In: Rice SA, Fish KJ, ed. Anesthetic Toxicity. New York: Raven Press; 1994. pp 107–133.
20. Martinsson T, Haegerstrand A, Dalsgaard CJ. Effects of ropivacaine on eicosanoid release from human granulocytes and endothelial cells in vitro. Inflamm Res 1997;46(10):398–403. DOI: 10.1007/s000110050210.
21. Crowley C, Dowsey MM, Quinn C, et al. Impact of regional and local anaesthetics on length of stay in knee arthroplasty. ANZ J Surg 2012;82(4):207–214. DOI: 10.1111/j.1445-2197.2011.05991.x.
22. Maheshwari AV, Ranawat AS, Ranawat CS. Multimodal pain management after total hip and knee arthroplasty at the ranawat orthopaedic center. Clin Orthop Relat Res 2009;467(6):1418–1423. DOI: 10.1007/s11999-009-0728-7.
23. Mullaji Arun. Efficacy of periarticular injection of bupivacaine, fentanyl, and methylprednisolone in total knee arthroplasty - a prospective, randomized trial. J Arthroplasty 2010;25(6):851–857. DOI: 10.1016/j.arth.2009.09.007.
24. Busch CA, Shore BJ, Bhandari R. Efficacy of periarticular multimodal drug injection in total knee arthroplasty - a randomized trial. J Bone Joint Surg Am 2006;88(5):959–963. DOI: 10.2106/00004623-200605000-00005.