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Novel lumbar plexus block versus femoral nerve block for analgesia and motor recovery after total knee arthroplasty

--Manuscript Draft--

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Short Title:	Novel lumbar plexus block for knee arthroplasty
Article Type:	Research Article
Keywords:	Total knee arthroplasty; Lumber plexus block; Femoral nerve block; ultrasound
Abstract:	Objective: The purpose of this study was to compare the postoperative analgesic efficacy of novel lumbar plexus block (LPB) with the femoral nerve block (FNB) after total knee arthroplasty (TKA). Methods: A total of 40 patients undergoing TKA were randomized equally into the LS group (receiving novel LPB) or the FS group (receiving FNB). The assessed variables were the onset time of pain, time to the first analgesic request, pain scores and motor block at 6, 12, and 24 h after TKA, and number of patients receiving successful blockade for each branch of the lumbar plexus. Results: In the LS group, the femoral, lateral femoral cutaneous, genitofemoral, iliohypogastric, ilioinguinal, and obturator nerves were blocked in 18, 20, 16, 18, 15, and 19 patients, respectively. Compared with FS group, LS group had a significantly shorter onset time of pain and time to the first analgesic request, significantly larger total postoperative dose of sufentanil, significantly higher numeric rating scale scores for both rest pain and dynamic pain at 6, 12, and 24 h, and faster motor recovery. Conclusion: Ultrasound-guided novel LPB has a high blocking success rate, and provides inferior postoperative analgesia but faster motor recovery after TKA compared with FNB.

Cover letter

Dear Editor,

We would like to submit the enclosed manuscript entitled "Novel lumbar plexus block versus femoral nerve block for analgesia and motor recovery after total knee arthroplasty", which we wish to be considered for publication in "Open Medicine" as an "Research Article". No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication. I would like to declare on behalf of my co-authors that the work described was original research that has not been published previously, and not under consideration for publication elsewhere, in whole or in part. All the authors listed have approved the manuscript that is enclosed.

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Sciatic nerve block combined with lumbar plexus block (LPB) or femoral nerve block (FNB) is the most prevalent postoperative analgesic technique for total knee arthroplasty (TKA). The analgesic efficacy of single-injection FNB versus single-injection LPB after TKA remains unknown. In addition, traditional ultrasound-guided techniques for LPB require a postural change of the patient to the lateral decubitus position, adding to the inconvenience and pain of the patient. We developed a novel LPB technique in the supine position. Our study was a prospective randomized controlled trial, demonstrating that: firstly, the novel technique for LPB was safe to perform and showed a high success rate; secondly, in TKA, LPB provided shorter postoperative analgesic duration with minor impact on movement, while FNB offered prolonged postoperative analgesia with a greater impact on mobility. The results of this study address the controversial issue regarding the analgesic effects of LPB versus FNB in TKA, thereby advancing the analgesic technique to post-TKA pain management. Additionally, the

novel nerve block technique for LPB proposed in this study enhances patient comfort during manipulation, providing a significant clinical value.

Thank you and best regards.
Yours sincerely,
Kun Fan

Novel lumbar plexus block versus femoral nerve block for analgesia and motor recovery after total knee arthroplasty

Running title: Novel lumbar plexus block for knee arthroplasty

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Abstract

Objective: The purpose of this study was to compare the postoperative analgesic efficacy of novel lumbar plexus block (LPB) with the femoral nerve block (FNB) after total knee arthroplasty (TKA).

Methods: A total of 40 patients undergoing TKA were randomized equally into the LS group (receiving novel LPB) or the FS group (receiving FNB). The assessed variables were the onset time of pain, time to the first analgesic request, pain scores and motor block at 6, 12, and 24 h after TKA, and number of patients receiving successful blockade for each branch of the lumbar plexus.

Results: In the LS group, the femoral, lateral femoral cutaneous, genitofemoral, iliohypogastric, ilioinguinal, and obturator nerves were blocked in 18, 20, 16, 18, 15, and 19 patients, respectively. Compared with FS group, LS group had a significantly shorter onset time of pain and time to the first analgesic request, significantly larger total postoperative dose of sufentanil, significantly higher numeric rating scale scores for both rest pain and dynamic pain at 6, 12, and 24 h, and faster motor recovery.

Conclusion: Ultrasound-guided novel LPB has a high blocking success rate, and provides inferior postoperative analgesia but faster motor recovery after TKA compared with FNB.

Keywords Total knee arthroplasty; Lumber plexus block; Femoral nerve block; Ultrasound

1 Introduction

Total knee arthroplasty (TKA) is a common orthopedic procedure known to cause moderate to severe postoperative pain [1,2], which can significantly affect patient outcomes. Inadequate pain management may result in acute adverse effects such as immunosuppression, reduced mobility leading to deep vein thrombosis (DVT), pulmonary embolism, myocardial infarction, and pneumonia [3]. Long-term consequences include chronic pain and opioid dependence due to prolonged narcotic consumption [3,4]. Despite numerous analgesic options available for knee surgery, approximately 50% of TKA patients still experience postoperative pain [5], and 20% remain dissatisfied due to suboptimal pain relief [6].

Peripheral nerve block, especially the femoral nerve block (FNB), plays a crucial role in minimizing postoperative pain after TKA [7]. A combination of FNB and sciatic nerve block (SNB) has been shown to decrease pain intensity and additional analgesic requirements [8-10]. Sensory innervation around the knee joint is mainly from the femoral nerve (FN), obturator nerve (ON), lateral femoral cutaneous nerve, and sciatic nerve (SN) [11], which suggests the potential advantage of lumbar plexus block (LPB) over FNB. However, its efficacy in comparison to FNB for TKA remains controversial. Some studies have proposed a combined psoas-sciatic block to be more effective than FNB-sciatic block [12], whereas others have shown no significant difference between LPB and FNB in pain relief after TKA [13].

Most ultrasound-guided techniques for LPB require a lateral decubitus position, which can be inconvenient and painful for the patient [14]. Recently, a new short axis ultrasound-guided LPB approach in the supine position has been developed, which is considered safe, effective, and comfortable for TKA patients. The aim of this study is to investigate the efficacy and safety of this novel technique compared to FNB and to evaluate its potential utility in perioperative pain management.

2 Materials and methods

2.1 Study design

This prospective, single-center, randomized, clinical trial was conducted in accordance with the ethical principles of the Helsinki Declaration, and was approved by the Medical Ethics Committee of Zhongshan Wusong Hospital Affiliated to Fudan University, Shanghai, China (approval no. 2020-Y-19, approval date 15 June 2020). This study was registered in the Chinese Clinical Trial Register (registration no. ChiCTR2100048454).

2.2 Patients

The trial was performed in the operating room of Zhongshan Wusong Hospital Affiliated to Fudan University over the period of July 2020 to March 2021. The study enrolled a total of 40 patients, aged 18 years or older, who underwent total knee arthroplasty for osteoarthritis and had an American Society of Anesthesiologists physical status classification of I-III. Informed written consent was obtained from all participants and their relatives. The exclusion criteria consisted of psychiatric disorders, inability to

cooperate or communicate in Chinese, chronic pain, ingestion of any pain medication, lower limb neuropathy, allergy to nonsteroidal anti-inflammatory drugs, renal failure, myocardial ischemia, cerebral infarction, liver injury, active gastric ulcer, and contra-indications to regional anesthesia (coagulopathy, local infection at the block site, and/or allergy to local anesthetic).

2.3 Randomization and blinding

Patients were randomized into two groups, using a computer-generated randomization table (http://www.random.org) by a researcher who was not involved in the study, in a 1:1 allocation ratio. Group LS received a lumbar plexus (LP)-SN block, while Group FS received a FN-SN block. Before the arrival of the patient in the operation room, an anesthetist opened a sequentially numbered, sealed, opaque envelope containing the patient's group assignment. The patients, research coordinator, statistician, surgeons, and intraoperative anesthesiologists were blinded to the group assignments.

2.4 Preparation for nerve blocks

All patients received standard monitoring, including heart rate, noninvasive blood pressure, oxygen saturation, skin temperature, and bispectral index, upon arrival in the operation room. Intravenous access was established in the forearm of each patient. Before the nerve block procedure, patients were given 40 mg of intravenous parecoxib and 1 μg/kg of intravenous dexmedetomidine administered over a period of 10 min.

2.5 Nerve blocks

2.5.1 Group LS

The patient was positioned in a supine posture with legs in a naturally straight alignment. Ultrasound imaging was performed using a 2 to 5 MHz convex array probe (SonoSite SII, Washington, USA) placed in the transverse plane at the posterior axillary line near the iliac crest (Fig. 1a). The quadratus lumborum muscle, erector spinae muscle, psoas major muscle, L4 vertebral body, and L4 transverse process were identified through ultrasound imaging (Fig. 1b-1d). The LP was detected as short axis hyperechoic structures located in frontal proximity to the L4 transverse process and within the posterior one-third of the psoas major muscle (Fig. 1b-1d). A 22-gauge puncture needle was inserted in-plane from the ventral side of the probe (Fig. 1b-1d). Following the puncture needle's penetration through the quadratus lumborum muscle into the psoas major muscle, aspiration was done to ensure there were no vascular punctures. Finally, 30 ml of 0.33% ropivacaine was deposited adjacent to the LP.

Ultrasound-guided SNB was performed in the upper medial thigh with the patient in the supine position, following the standard procedure outlined in existing literature [15]. A total of 20 ml of 0.33% ropivacaine was then injected.

2.5.2 Group FS

In accordance with previous studies [16,17], the ultrasound-guided FNB was performed in the inguinal region by injecting 30 ml of 0.33% ropivacaine with the patient in the

supine position. Ultrasound-guided SNB was performed as described above using 20 ml of 0.33% ropivacaine.

2.6 Intraoperative management

The anesthetic procedure utilized a laryngeal mask for general anesthesia and was performed by an anesthetist not involved in nerve block manipulation. Propofol at a dose of 3 mg/kg and sufentanil at 0.2 μg/kg were administered for induction of anesthesia. Sevoflurane was used for maintenance of anesthesia with titration of inhaled concentration to maintain a bispectral index of 40-60. Intraoperatively, a 5 μg bolus of sufentanil was given if the baseline systolic blood pressure or heart rate increased by 20%. Ondansetron (4 mg) was given intravenously for prophylaxis of postoperative nausea and vomiting (PONV) 30 min prior to surgery. Postoperatively, patients received patient-controlled intravenous analgesia (PCIA) for rescue analgesia. The PCIA device dispensed 2 μg bolus doses of sufentanil with a 10 min lock-out interval, without a basal infusion.

2.7 Postoperative management

The patients were transferred to the post-anesthesia care unit after surgery and were shifted to the surgical ward only when the Steward score was ≥4 after removal of the laryngeal mask. Intravenous parecoxib was given at a dose of 40 mg at 12 and 24 h after surgery. Pain was evaluated using a numerical rating scale (NRS) score that ranges from 0 (no pain) to 10 (worst pain imaginable). PCIA was initiated if the NRS score was ≥4 or the pain was intolerable. Patients with PONV were treated with 10 mg of intravenous

metoclopramide.

2.8 Outcome measures

The primary outcome of the study was the onset time of postoperative pain, which was recorded by a research coordinator.

Demographic details, including sex, age, height, weight, affected side, and American Society of Anesthesiologists grade, were recorded by a research coordinator for each patient. Other recorded parameters included occurrence of PONV, dose of metoclopramide, duration of surgery, complications related to nerve block (vascular injury, hematoma, and local anesthetic toxicity), and epidural extension (defined as either bilateral sensory block achieved to the L1-L2 levels, or complete motor block in both lower limbs detected 30 min after the nerve block [18]).

Nerve visibility was assessed by the anesthetist performing the nerve block using a 4-point scale, in which 0 indicated that the nerve was not visible, 1 indicated that the nerve was barely visible, 2 indicated that the nerve was clearly visible, and 3 indicated that the nerve was very clearly visible [19]. Patients with a visibility score of 0 for the nerve requiring blockade were withdrawn from the trial. The onset time of sensorial blockade was recorded by the research coordinator. At 30 min after the nerve block, the research coordinator performed sensory examination in the regions innervated by the LP branches (the iliohypogastric, ilioinguinal, genitofemoral, obturator, lateral femoral cutaneous, and femoral nerves) [20], using pinprick sensation scores where 0 indicated no sensation loss, 1 indicated partial sensation loss, and 2 indicated complete sensation

loss. Additionally, the total intraoperative sufentanil dose was recorded by a research coordinator.

The time to first analgesic request, sufentanil consumption within 24 h postoperatively, numeric rating scale (NRS) scores for rest pain and dynamic pain (pain in the operated knee on active or passive flexion to 45° [21]) at 6, 12, and 24 h postoperatively, Bromage score (0 = free movement of the legs and feet; 1 = just able to flex the knees with free movement of the feet; 2 = unable to flex the knees, free movement of the feet; 3 = unable to move the legs or feet [22]) of the affected lower limb at 6, 12, and 24 h postoperatively, and adverse effects of opioids (respiratory depression and pruritus) were also recorded by a research coordinator. Patients were followed up by telephone 2 weeks postoperatively to assess the presence of hematuria, hematochezia, and peripheral nerve injury (sensory or motor dysfunction in the affected extremity).

2.9 Statistical analysis

The power calculation was based on the onset time of pain. According to our pilot study results, we assumed that the onset times of pain for patients in Group LS and Group FS would be 331.78 ± 309.683 min and 1225.91 ± 335.215 min, respectively. Detection of this intergroup difference with α=0.05 and a power of 80% would require a sample size of 17 patients in each group. To allow for dropouts, 20 patients were allocated to Group LS, and 20 patients were allocated to Group FS.

All statistical analyses were performed with IBM SPSS Statistics 22 (IBM Corp., Armonk, NY, USA). Data were evaluated for normality using the Shapiro-Wilk test.

Normally distributed data, including age, weight, height, duration of surgery, and time to first analgesic request, were expressed as mean (standard error of the mean). Intergroup differences were assessed for significance using Student's t-test. Non-normally distributed data, including total dose of metoclopramide, onset time of sensorial blockade, total intraoperative dose of sufentanil, onset time of pain, sufentanil consumption within 24 h postoperatively, NRS scores for rest pain and dynamic pain at 6, 12, and 24 h postoperatively, and Bromage score at 6, 12, and 24 h postoperatively, were expressed as median (range). Intergroup differences were assessed for significance using the Mann-Whitney U-test. Categorical variables, including sex, side, ASA, PONV, visibility, pinprick sensation score 30 min after injection, rest pain score < 4 within 24 h, and dynamic pain score < 4 within 24 h, were expressed as numbers. Intergroup differences were assessed using Pearson's χ^2 test or Fisher's exact test as appropriate. A two-sided p-value of less than 0.05 was considered statistically significant.

3 Results

The investigation flowchart is shown in Figure 2. A total of forty patients were enrolled and divided into two groups (Group LS or Group FS) through randomized grouping. No patients were withdrawn from the study, and the demographic data are presented in Table 1. None of the patients in either group experienced vascular injury, hematoma, local anesthetic intoxication, epidural extension, hematuria, hematochezia, nerve injury, respiratory depression or pruritus.

In Group LS, the LP was visualized in all patients, while in Group FS, the FN was visible in all patients (Table 2). In Group LS, the innervation areas of the femoral, lateral femoral cutaneous, genitofemoral, iliohypogastric, ilioinguinal, and obturator nerves had a pinprick sensation score of 1 or 2 in 18, 20, 16, 18, 15, and 19 patients, respectively, 30 min post-injection (Table 2). There were significantly fewer patients with a pinprick sensation score of 0 in the innervation areas of the lateral femoral cutaneous, genitofemoral, iliohypogastric, and ilioinguinal nerves in Group LS compared to Group FS, 30 min post-injection (Table 2).

The onset time of pain and time to the first analgesic request in Group LS were both significantly shorter when compared to Group FS (Table 3). Total dose of sufentanil at 0−6 h, 6−12 h, and 12−24 h post-surgery was significantly greater in Group LS than in Group FS (Table 3). NRS scores for both rest and dynamic pain were significantly higher in Group LS than in Group FS at 6, 12, and 24 h post-surgery (Table 3). Group LS had fewer patients with rest and dynamic pain scores less than four within 24 h post-surgery compared to Group FS (Table 3). Bromage scores at 12 and 24 h were both significantly lower in Group LS than in Group FS (Table 3).

4 Discussion

In this investigation, successful ultrasound identification of the LP was achieved in all subjects, and LP branches were blocked with a success rate ranging from 75-100%. Various ultrasound-guided LPB techniques have been described, including the paramedian transverse, median transverse, shamrock, and trident approaches. Previous

studies have demonstrated that the LP is often identifiable under ultrasound using the trident approach [23], the median transverse approach achieves an identifying success rate of 100% [24], the paramedian transverse approach obtains an identification rate of 57% and 67% [19,25], respectively, and the shamrock approach reveals the LP in 89.1% and almost 100% of cases [23,26]. The blocking success rate of LP branches is reported to be 80%-100% using the paramedian transverse approach, 70%-90% by using the shamrock approach, and 80-100% for the median transverse approach [14]. Thus, our novel technique that offers comparable LP visibility and LPB success rates to traditional LPB methods.

Our study findings reveal that, within the first 24 h after TKA, the postoperative analgesic efficacy of the LPB was suboptimal compared with that of the FNB. Anatomically, the knee's sensory nerves primarily originate from the femoral, obturator, and tibial nerves [27]. A network meta-analysis indicated that the FNB and adductor canal block are crucial for postoperative analgesia following TKA [24], while the use of the ON block as postoperative analgesia after TKA is still debatable [13,28]. Our results indicated that the analgesia duration of femoral-sciatic nerve block was up to 22 h, which further supports the importance of blocking both the FN and the sciatic nerve for optimal pain management after TKA. Although some studies suggest that LPB simultaneously blocks the FN and ON, thereby achieving superior postoperative analgesia after TKA to FNB, it is only effective in continuous blocks [12]. Our findings illustrate that a single-injection LPB was able to effectively block the ON and FN; however, its duration of

blocking may potentially be shorter, resulting in poorer analgesic effects after TKA than single-injection FNB. In conclusion, femoral–sciatic nerve block offers superior analgesia compared to LP–SN block when a single-injection nerve block is performed to manage postoperative pain after TKA.

In our study, it was found that despite the majority of patients in Group FS having an NRS score less than 4 for rest pain, and receiving minimal amounts of opioids, the group demonstrated higher Bromage scores at both 12 and 24 h postoperatively as compared to Group LS. This indicates that FNB had a greater impact on lower extremity mobilization. It is important to note that peripheral nerve blocks can result in decreased muscle strength, leading to an increased risk of falls and difficulty with ambulation after a TKA. This may impede early functional exercise and potentially increase postoperative nociceptive adverse events [29]. Additionally, without traditional anticoagulation therapy following TKA, anywhere from 40% to 62% of patients are likely to develop postoperative DVT [30]. The addition of combined FNB and SNB can further delay lower extremity mobilization, elevating the risk of postoperative DVT even further. Considering these risks, the LPB approach constitutes a superior alternative to FNB for TKA patients at high risk of falls or DVT.

Our findings suggest that the supine-positioned LPB is a safe, effective, and straightforward peripheral nerve block technique. This approach obviates the need for positional change, thereby augmenting patient comfort. Thus, the supine-positioned LPB may emerge as the preferred method of performing ultrasound-guided LPB in the future.

However, we acknowledge the possible limitations present in our study. Despite observing no renal, ureteral, or gut injuries in this study, the close proximity between the needle trajectory and abdominal organs may lead to organ injury. Therefore, real-time ultrasound monitoring of needle tip location during puncture is necessary to avoid organ damage. Additionally, our investigation failed to compare the efficacy and possible complications of the supine-positioned LPB with traditional ultrasound-guided LPB techniques. We cannot assert the superiority of this novel technique over the conventional approach. A prospective, randomized, controlled study will be conducted to compare the effect and complications of this novel technique versus traditional ultrasound-guided LPB techniques. Furthermore, the application of supine LPB in other lower extremity surgeries, such as total hip arthroplasty, will be investigated in the future.

In conclusion, ultrasound-guided novel LPB presents a viable technique for peripheral nerve block, offering a high rate of successful blocking outcomes and overall safety. Notably, this novel single-injection LPB combined with the SNB affords inferior analgesia after TKA compared to single-injection FNB combined with the SNB. However, the novel LPB, in conjunction with the SNB, facilitates quicker motor recovery following TKA.

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Conflict of interest: The authors declare that they have no known conflict of interest or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Table 1 Demographic characteristics, PONV, total dose of metoclopramide, and duration of surgery

Parameter	LS (n=20)	FS (n=20)	P value
Age, y	63.9±1.6	65.8±1.4	0.386[a]
Sex (male/female), n	5/15	4/16	1.000[d]
Weight, kg	66.6±2.2	67.4±2.4	0.871[a]
Height, cm	159.1±1.7	157.4±1.3	0.413[a]
Side (left/right), n	12/8	11/9	0.749[c]
ASA (I/II), n	3/17	0/20	0.231[d]
PONV (yes/no), n	5/15	7/13	0.490[c]
Total dose of metoclopramide, mg	0.0 (0.0-20.0)	0.0 (0.0-20.0)	0.545[b]
Duration of surgery, min	80.5±4.3	72.0±3.2	0.122[a]

Data were presented as mean ± SEM, median (range), or number of patients. a, Student's t test; b, Mann-Whitney U test; c, Pearson's χ^2 test; d, Fisher's exact test. LS, lumbar plexus block combined with sciatic nerve block group; FS, femoral nerve block combined with sciatic nerve block group; ASA, American Society of Anesthesiologists physical status; PONV, postoperative nausea and vomiting.

Table 2 Nerve visibility, sensory block characteristics 30 min after injection, and total intraoperative dose of sufentanil

Parameter	LS (n=20)	FS (n=20)	P value
Visibility (0/1/2/3), n	0/5/13/2	0/0/9/11	
Onset time of sensorial blockade, s	60.0 (30.0-110.0)	50.0 (30.0-90.0)	0.354[b]
Pinprick sensation score 30min after injection, n			
Femoral nerve			
0	2	0	0.487[d]
1	5	2	0.407[d]
2	13	18	0.127[d]
Lateral femoral cutaneous nerve			
0	0	13	0.000[c]
1	6	6	1.000[c]
2	14	1	0.000[c]
Genitalfemoral nerve			
0	4	20	0.000[c]
1	5	0	0.047[d]
2	11	0	0.000[c]
Iliohypogastric nerve			

0	2	20	0.000[c]
1	9	0	0.001[d]
2	9	0	0.001[d]
Ilioinguinal nerve			
0	5	20	0.000[c]
1	5	0	0.047[d]
2	10	0	0.000[c]
Obturator nerve			
0	1	2	1.000[d]
1	12	13	0.744[c]
2	7	5	0.490[c]
Total intraoperative dose of sufentanil, ug	10.0 (5.0-25.0)	10.0 (10.0-30.0)	0.052[b]

Data were presented as median (range), or number of patients. b, Mann-Whitney U test; c, Pearson's χ^2 test; d, Fisher's exact test. LS, lumbar plexus block combined with sciatic nerve block group; FS, femoral nerve block combined with sciatic nerve block group.

Table 3 Postoperative sensory and motor block characteristics

Parameter	LS (n=20)	FS (n=20)	P value
Onset time of pain, min	437.5(70.0-1150.0)	1270.0(700.0-1605.0)	0.000[b]
Time to first analgesic request, min	609.0±87.4	1347.5±62.8	0.000[a]
Total postoperative dose of sufentanil, ug			
0-6 h	0.0 (0.0-26.0)	0.0 (0.0-0.0)	0.004[b]
6-12 h	12.0 (0.0-26.0)	0.0 (0.0-2.0)	0.000[b]
12-24 h	9.0 (2.0-20.0)	3.0 (0.0-14.0)	0.001[b]
NRS score of rest pain			
6 h	0.0 (0.0-5.0)	0.0 (0.0-0.0)	0.002[b]
12 h	3.0 (0.0-5.0)	0.0 (0.0-2.0)	0.000[b]
24 h	3.0 (1.0-4.0)	1.0 (0.0-3.0)	0.001[b]
Rest pain score<4 within 24 h, n	12	20	0.003[d]
NRS score of dynamic pain			
6 h	1.0 (0.0-7.0)	0.0 (0.0-0.0)	0.000[b]
12 h	4.0 (0.0-7.0)	0.0 (0.0-4.0)	0.000[b]
24 h	4.0 (2.0-7.0)	2.5 (0.0-6.0)	0.000[b]
Dynamic pain score <4 within 24 h,	2	15	0.000[c]

n			
Bromage score			
6 h	1.0 (0.0-3.0)	2.0 (1.0-2.0)	0.184[b]
12 h	0.0 (0.0-1.0)	1.0 (0.0-2.0)	0.000[b]
24 h	0.0 (0.0-0.0)	0.0 (0.0-2.0)	0.001[b]

Data were presented as mean ± SEM, median (range), or number of patients. a, Student's t test; b, Mann-Whitney U test; c, Pearson's χ^2 test; d, Fisher's exact test. LS, lumbar plexus block combined with sciatic nerve block group; FS, femoral nerve block combined with sciatic nerve block group.

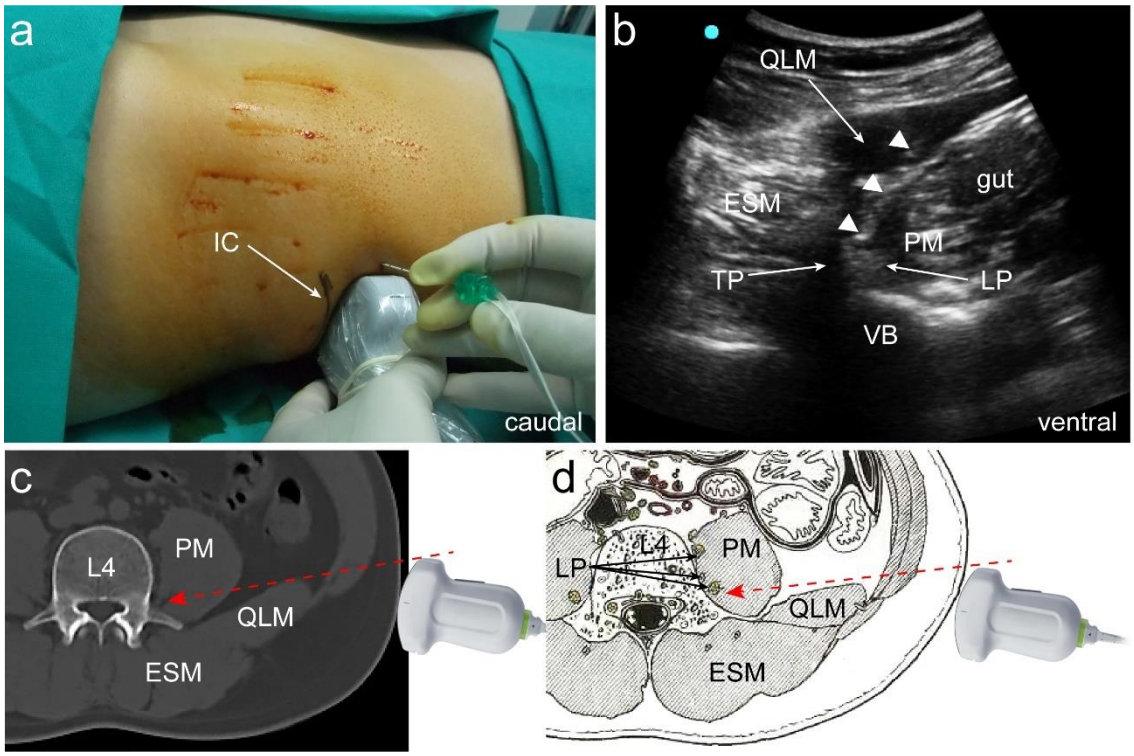

Figure 1 Ultrasound-guided lumber plexus block with short axis in supine position. a, Probe position; b, Ultrasound-guided lumber plexus block in supine position at L4 level; c, A schematic computed tomography diagram of ultrasound-guided lumber plexus block in supine position; d, A schematic anatomical illustration of ultrasound-guided lumber plexus block in supine position. IC, iliac crest; PM, psoas major muscle; QLM, quadratus lumborum muscle; ESM, erector spinae muscle; VB, vertebral body; TP transverse process; LP, lumber plexus. Three white triangles point at the trajectory of a needle. Red dotted arrows denote the trajectory of a needle.

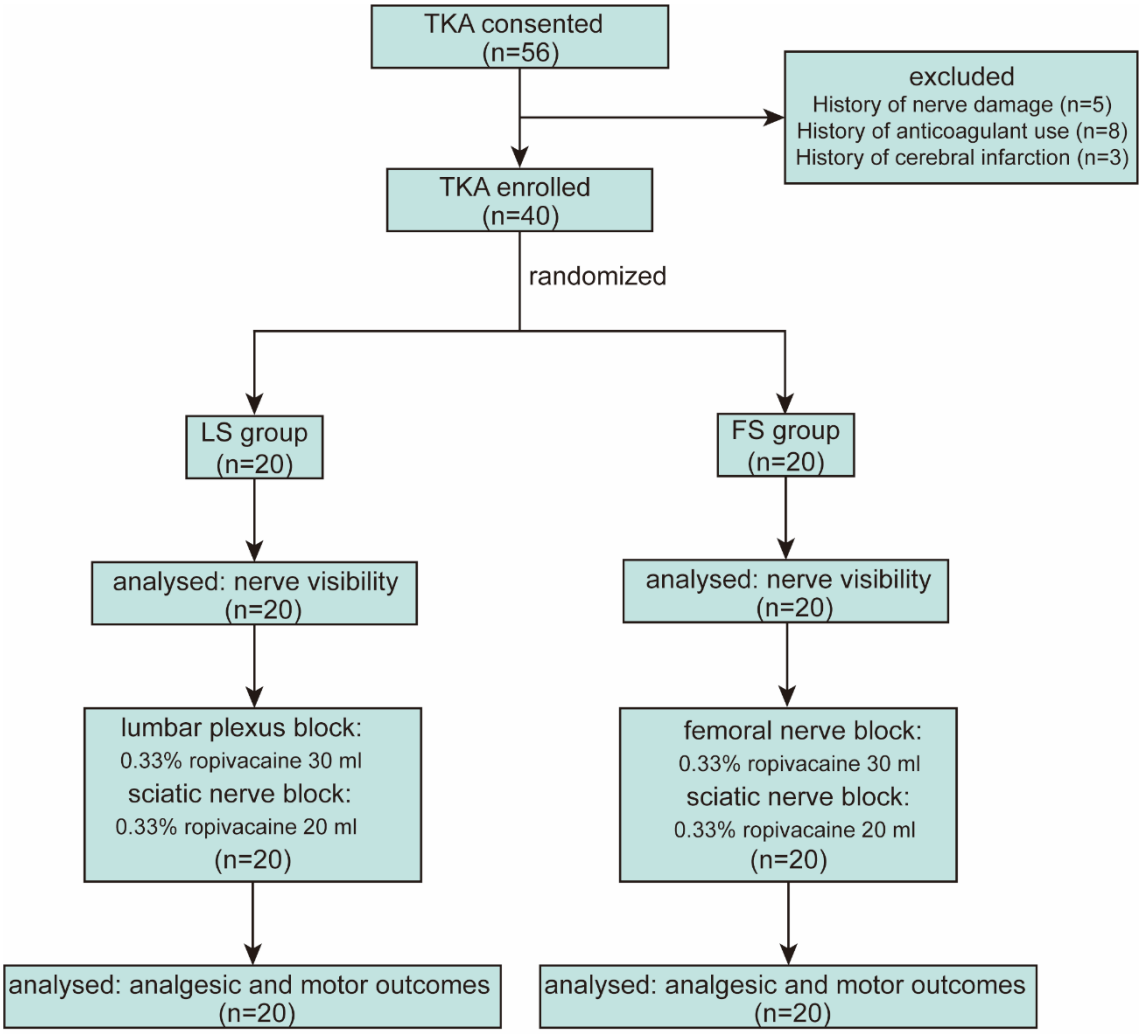

Figure 2 Consolidated standards of reporting trials flow diagram. LS, lumbar plexus block combined with sciatic nerve block group; FS, femoral nerve block combined with sciatic nerve block group; TKA, total knee arthroplasty.