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REVIEW

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Ultrasound-guided iliopsoas plane block, the effects on postoperative pain, opioid consumption, and quadriceps strength in adults undergoing hip surgery: A Systematic Review

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ABSTRACT

The iliopsoas plane block (IPB) is a novel motor-sparing analgesic technique for hip surgery. While promising, its clinical benefits over conventional nerve blocks remain uncertain due to limited evidence. This systematic literature review evaluates postoperative pain, quadriceps strength, and quality of recovery after ultrasound-guided iliopsoas plane block (IPB) compared with conventional analgesic nerve blocks in hip surgery. It is hypothesized that IPB reduces postoperative pain and opioid consumption, without a decline in quadriceps strength.
Following PRISMA guidelines, we systematically reviewed studies on IPB in patients undergoing hip surgery under general anesthesia. Databases were searched up to May 2025. Seven RCTs and two case series were included, assessing postoperative pain, opioid use, and quadriceps strength. One RCT reported significantly lower pain scores with IPB compared with sham, while other studies found no significant differences compared with sham or other blocks. Two RCTs showed reduced opioid consumption with IPB, while others showed no difference. Postoperative opioid consumption after IPB was significantly less in two out of four studies after surgery ($p < 0.001$). Regarding postoperative quadriceps strength, one study showed superior strength in the IPB group compared with the femoral nerve block (FNB) group at various time points ($p < 0.05$), whereas other studies found no significant differences or reductions in strength compared with sham ($p > 0.05$). Seven RCTs showed mixed results in postoperative outcomes. Our findings show that multiple studies reveal that IPB may influence postoperative pain and opioid use while highlighting its potential to preserve quadriceps strength.

INTRODUCTION

Hip arthroplasty is one of the most frequently performed and successful surgical interventions[1]. Indications for hip arthroplasty include mild to severe hip osteoarthritis, osteonecrosis, femoral neck fractures, dysplasia of the hip, and inflammatory arthritis[2]. The number of total hip arthroplasties (THAs) is estimated to increase by approximately 71% from 2014 to 2030, reaching an estimated 635,000 procedures annually in the US[3]. This increase is due to several factors, such as an aging population, rising rates of osteoarthritis diagnosis and treatment, growing demand for quality of life, and the global rise in obesity[4,5]. Furthermore, existing evidence varies regarding the association between metabolic syndrome and hip osteoarthritis[6,7].

Patients undergoing hip fracture surgery often experience (semi-acute) pre- and postoperative pain. This pain can impede their ability to move, prolonging their hospital stay, and negatively impacting their postoperative functionality[8]. In addition, uncontrolled postoperative pain could increase the risk of complications, such as delirium or cardiovascular events[9,10]. Hence, postoperative pain management is essential in improving patient satisfaction after hip surgery.

At present, oral analgesics and other opioids are often used for managing postoperative pain. However, the use of opioids comes with significant side effects such as dizziness, sedation, nausea, vomiting, and the risk of addiction. Consequently, clinicians have recognized the benefits of utilizing peripheral nerve blocks, including psoas compartment block, quadratus lumborum block, fascia iliaca compartment block, and femoral nerve block (FNB). Peripheral nerve blocks have been shown to alleviate postoperative pain in individuals undergoing hip surgery, decreasing hospital cost and length of stay[11]. In addition, these anesthesia techniques have demonstrated the potential to reduce the need for opioids after hip arthroplasty[12]. However, these techniques may lead to reduced quadriceps muscle strength, which results in reduced mobility[13,14].

The innervation of the hip joint is complex. The anterior capsule is the most richly innervated section of the hip joint and contains predominantly nociceptive fibers[15]. It receives innervation predominantly from the articular branches of the femoral nerve, the obturator nerve, and accessory obturator nerves[16]. As a result, these nerves contribute to the sensory supply of the anterior hip capsule and serve as the primary target for regional analgesic techniques, such as the FNB and fascia iliaca block, although these strategies do not cover the obturator nerve[17]. The posterior capsule primarily consists of mechanoreceptors involved in proprioception rather than nociception[18]. Achieving complete sensory coverage of the capsule for pain management is challenging.

The pericapsular nerve group (PENG) block targets the articular branches of the femoral nerve, obturator nerve, and accessory obturator nerves by injecting local anesthetic in the fascial plane between the psoas tendon and pubic ramus, near the iliopectineal eminence. It was designed to preserve motor function and is now widely used, although some studies have indicated that PENG blocks can cause up to 25% loss of quadriceps strength[19,20]. Unintentional motor blockade of the quadriceps can occur due to the proximity of the femoral nerve when anesthetic spreads too laterally or deeply[21]. Furthermore, articular branches distal to the inguinal ligament may be missed, resulting in incomplete sensory coverage[22].

Hence, the ultrasound-guided iliopsoas plane block (IPB) has recently emerged as a potential alternative to traditional peripheral nerve blocks. This technique involves an anesthetic injection into the iliopsoas plane, which is an anatomical plane between the iliopsoas muscle and the hip joint capsule, lateral to the iliopsoas tendon and the iliopectineal bursa[23,24]. Anatomically, at the level of the anterior superior iliac spine, the psoas major muscle travels superior to the iliac muscle. In the inferior portion of the psoas major muscle, the femoral nerve then appears and lies between those two muscles, while the obturator nerve lies more medially to the psoas muscle. The sensory branches of the femoral nerve course toward the anterior hip capsule within the iliopsoas plane[23].

While sensory branches of the femoral nerve and accessory obturator nerves diverge medially from the motor branches towards the anterior hip capsule within the iliopsoas plane, the femoral cutaneous nerve situated anteriorly to the iliac muscle, is secured in a fibrous layer known as the fascia iliaca[25,26]. By targeting the sensory branches of the hip joint derived from the femoral nerve, lateral femoral cutaneous nerve, obturator nerve, and accessory obturator nerve, IPB can be used as local anesthesia in THA and potentially mitigate postoperative pain while minimizing the risk of quadriceps strength loss in patients undergoing hip surgery[24]. Nonetheless, knowledge regarding the efficacy of ultrasound-guided IPB following hip surgery and the extent of its impact remains limited.

Therefore, the objective of this study is to perform a systematic review of the literature to evaluate postoperative pain (1), opioid use (2), and quadriceps strength (3) following an ultrasound-guided IPB in comparison to conventional placebo treatment and peripheral nerve blocks for adults undergoing hip surgery. It is postulated that IPB reduces postoperative pain and opioid consumption, coupled with no induction of a decline in quadriceps strength, as it has been proposed to be motor-sparing. Consequently, this study will provide a reliable foundation for informed decision-making in using ultrasound-guided IPB after hip surgery.

METHODS

Data source and search strategy

A systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, using a MEDLINE (PubMed) search until May 2025, with a primary search string developed for MEDLINE. No date limitation was used in the search. A search strategy was used to search through the electronic database. Additionally, records were identified through other sources, including Web of Science, Embase, Cochrane, and the European Union Clinical Trials Register, using free terms, such as iliopsoas plane block.

Study selection

Two independent reviewers conducted the literature search using PubMed, hereafter, the search string was inserted in Rayyan (http://rayyan.qcri.org). Title and abstracts were reviewed, and potentially eligible studies received a full-text review with Rayyan. Records identified through Research Gate and the European Union Clinical Trials Register were also reviewed on title and abstract, and potentially eligible studies received a full-text review. Studies that met the following inclusion criteria were included: randomized controlled trials (RCTs), case reports, and case series that included adult patients who underwent hip surgery, focusing on the iliopsoas compartment block, and reporting clinical outcomes such as postoperative pain, opioid use, and quadriceps strength. The exclusion criteria comprised: study design other than an RCT, case report, or case series (e.g., nonclinical research, reviews, letters to editors), studies with fewer than ten participants, subjects under 18 years, studies focusing on other nerve blocks (e.g., FNB, fascia iliaca compartment block, and 3-in-1 block), and studies published in another language than English or Dutch. The reference lists of all included studies were manually screened for eligible studies. Uncertainties during the study selection were resolved by consensus. However, if no consensus was reached, a third person was consulted. A Cohen's kappa was calculated to measure interobserver agreement (https://www.graphpad.com/quickcalcs/kappa1/?K=3).

Data extraction and quality assessment

Two individuals independently performed the data extraction, using a standardized data sheet covering the study authors, year, country, study type, orthopedic intervention, nerve block technique, control group, medication regimen, population demographics (accounting for female and male, mean, median age, or age range), and outcome measures. The methodological quality of randomized trials was assessed using the Jadad Scale[27,28]. The Jadad Scale assesses RCTs on randomization, blinding, and withdrawals (scoring 0-5, with quality ranked as low, moderate, or high). The ROBINS-I tool evaluates bias in non-randomized studies across seven domains, yielding judgments from low to critical risk of bias.

Data synthesis and analysis

Descriptive analyses were performed. The primary outcome measure was postoperative pain, measured by Visual Analog Rating Scale (VAS), Numerical (Pain) Rating Scale (N(P)RS), or Verbal Numerical Scale (VNS), which are widely used, validated, and subjective analog scales to measure acute and chronic pain[29-32]. Secondary outcomes encompassed opioid analgesic usage after surgery and quadriceps muscle strength.

RESULTS

Search and Literature Selection

A total of 33 records were identified through MEDLINE database searching using predefined MeSH terms and text words. Additionally, 41 records in Web of Science, 6 in Embase, and 31 in Cochrane were identified and assessed for eligibility. After removing duplicates, 33 records were included in this study; of these, 24 did not meet the predefined inclusion criteria and were excluded from the search. After resolving uncertainties and inconsistencies, a total of 7 RCTs and 2 Case Studies were included in the qualitative synthesis (Fig. 1). Two independent researchers conducted the predefined search. Cohen's kappa as a measure for interobserver agreement was 0.847 (95% CI., 0.643 – 1.000).

Study Characteristics

While the IPB was the primary nerve block technique of interest, studies examining combinations of the IPB with other peripheral nerve blocks were also included. The included RTCs were conducted between 2021 and 2025[26,33-38]. The remaining two case reports were published in 2022[39,40]. The majority of the RCTs were conducted in Asia. Patients included in all RCTs were scheduled for hip surgery. The included studies conducted their research mostly on elderly patients aged 50 to 70; however, one included patients aged 19, and three other studies included patients aged 18. Other inclusion and exclusion criteria are mentioned in the supplementary material. Outcome measures included postoperative pain, cumulative postoperative opioid use, and postoperative quadriceps strength. The methodological quality of seven RCTs was assessed using the Jadad Scale (Table II). Four studies were arbitrarily defined as high quality in our study (Jadad score >4). Three other studies were defined as moderate quality. Both case series were assessed using the ROBINS-I tool and were found to have methodological limitations and a moderate-to-serious risk of bias.

All patients received general anesthetics. Ropivacaine was the local anesthetic used in most of the studies, whereas bupivacaine was used in one RCT. Comparative groups were subjected to either a sham or other nerve block techniques. These techniques included a posterior lumbar plexus block, a combination of a posterior lumbar plexus block with a sacral plexus block, and an FNB paired with a lateral femoral cutaneous nerve (LFCN) block. No conflicts of interest were declared in any of the studies included in our review. A comprehensive overview of key outcomes, including quadriceps strength, pain scores, and opioid consumption, is presented in Table III.

Postoperative pain outcomes

All RCTs evaluated postoperative pain levels, either as a primary or secondary outcome (Table IV). Only

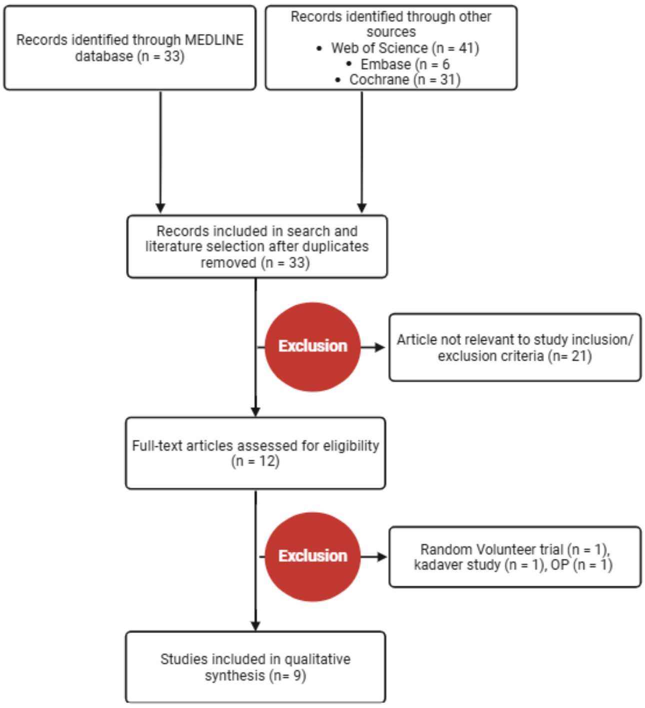

Fig. 1 —Flowchart describin.g the systematic screening process following PRISMA guidelines for included studies

the study by Hu et al. demonstrated significantly lower VAS scores in the comparative group than in patients receiving a sham at 3, 6, 12, and 24 hours after surgery ($p < 0.05$)[33]. Meanwhile, two studies demonstrated no differences in pain between IPB and sham groups, as measured by the NRS ($p > 0.05$)[34,35]. Furthermore, no differences were observed between groups receiving a posterior lumbar plexus block or an IPB in pain, as measured by the VNS score ($p > 0.05$)[26]. No significant differences were seen when a combination of an IPB with LFCN block was compared to a combination of a posterior lumbar plexus block with a sacral plexus block ($p > 0.05$)[36]. When compared to an FNB paired with an LFCN block, the combination of IPB and LFCN block showed no significant difference in pain scores at various time points in the hours following surgery, as reported in two studies ($p > 0.05$)[37]. In the case reports, the median VAS score decreased after IPB at different resting and flexion intervals. However, these reports lacked a control group, limiting interpretability[39,40].

Postoperative opioid consumption

Postoperative opioid consumption was evaluated in four out of seven RCTs (Table V). Two studies demonstrated a significant reduction in opioid use between the comparative group and patients receiving sham[33,35]. Hu et al. showed that within the first 24 hours after surgery, patients of the IPB group consumed significantly fewer opioids than sham patients ($p < 0.001$). In accordance, Jessen et al. reported that the mean 3-hour intravenous opioid equivalent consumption in the iliopsoas plane block group was 10.4 mg vs 23.8 mg in the placebo group[35]. In contrast, Kim et al. demonstrated that the cumulative opioid consumption of the comparative group was not significantly different from the sham-receiving group ($p > 0.05$)[34]. Similarly, Jiang et al. found no significant differences in cumulative opioid consumption between the IPB and controls ($p> 0.05$)[38]. Other studies did not evaluate postoperative opioid consumption and remain, therefore, inconclusive.

Postoperative quadriceps strength

Postoperative quadriceps strength was assessed in four out of seven RCTs (Table VI). Three studies used the manual muscle testing (MMT) grade (0–5; 0: no muscle contraction, 5: able to withstand full resistance). Wang et al. demonstrated that patients receiving IPB had superior quadriceps strength than those receiving FNB upon arrival at the postoperative anesthesia care unit (PACU) and 2, 4, 6, and 24 hours after surgery ($p < 0.05$)[37]. Likewise, Jiang et al. reported significantly greater quadriceps strength in the IPB group at 12 and 24 hours after surgery ($p< 0.001$)[38]. Consistently, Hu et al. found no significant difference in quadriceps strength between the comparative group and patients receiving a sham (p

Table I. — Study characteristics.

Author	Title	Year	Country	Type of Study	Orthopedic intervention	Nerve block technique	Control	Medication regime	Age (median [IQR])	Total number of patients (F/M)	Outcome measures	Jadad scale
Dong et al.	Ultrasound-guided anterior iliopsoas muscle space block versus posterior lumbar plexus block in hip surgery in the elderly	2021	China	RCT	Unilateral hip surgery under general anaesthesia	IPB	Posterior lumbar plexus block	IPB: 30 mL of 0.33% ropivacaine injection Control: 30 mL of 0.33% ropivacaine injection	IPB: 69.23 (SD: 11.11) Control: 75.22 (SD: 10.80) **	22/18	Primary: Pain score in PACU (VNS) Secondary: Intraoperative fentanyl use Onset time after nerve block and the VNS after nerve block	3
Hu et al.	Analgesic efficacy of anterior iliopsoas muscle space block combined with local infiltration analgesia after total hip arthroplasty: A prospective, double-blind, placebo-controlled study.	2023	China	RCT	Unilateral THA under general anaesthesia	IPB*	Sham	IPB: 30 mL of 0.33% ropivacaine injection & epinephrine (1:200,000) Control: 30 mL 0.9% saline	IPB: 55.13 (SD: 14.79) Control: 57.28 (SD: 11.93) **	39/41	Primary: Cumulative 24 h postop morphine consumption. Secondary: postop. Pain scores (VAS), time to first rescue analgesia, cumulative morphine consumption during hospitalization, intraoperative consumption of opioids, postop. Quadriceps strength (5-point scale), time to hospital discharge, frequency of sleep in-terruption, quality of recovery, postop. Adverse events.	5
Jessen et al.	Efficacy of iliopsoas plane block for patients undergoing hip arthroscopy: a prospective, triple-blind, randomized, placebo-controlled trial	2025	Denmark	RCT	Ambulatory THA indicated by femor acetabular impingement disease	IPB	Sham	IPB: 10 mL of bupivacaine 5 mg/mL & epinephrine 5 µg/mL Control: 10 mL 0.9% saline	IPB: 32 [24 – 42] Control: 33 [23 – 40]	27/22	Primary: IV morphine consumption for the first 3h in PACU Secondary: pain score at rest (NRS), pain score during 45° flexion of the hip measured at arrival to PACU and every 30 min during the first 3h postop (NRS), quadriceps muscle strength difference	4

Table I. — Study characteristics - Continued.

Author	Title	Year	Country	Type of Study	Orthopedic intervention	Nerve block technique	Control	Medication regime	Age (median [IQR])	Total number of patients (F/M)	Outcome measures	Jadad scale
Jiang et al.	Iliopsoas plane block versus femoral nerve block for postoperative quality of recovery following hip arthroplasty: a randomized controlled trial	2025	China	RCT	THA under general anesthesia	IPB + LFCN block	FNB + LFCN block	IPB: 10 mL of 0.5% ropivacain injection Control: 10 mL 0.5% ropicvacain	IPB: 61.4 (SD: 11) Control: 62.8 (SD: 11.5)	50/50	Primary: quality of recovery 24 h after surgery using the QoR-15 questionnaire., including pain score at 12, 24, and 48h after surgery using VAS Secondary: quality of recovery at 48 and 72 h after surgery; maximum pain score at 12, 24, and 48 h after surgery; quadriceps strength at 12, 24, and 48 h after surgery; the first time out of bed, total opioid consumption; patient satisfaction (0–10; 0: worst, 10: great satisfaction); and the incidence of complications	
Kim et al.	Iliopsoas plane block does not improve pain after primary total hip arthroplasty in the presence of multimodal analgesia: a single institution randomized controlled trial	2023	Korea (the Republic of)	RCT	Unilateral hip surgery under general anaesthesia	IPB	Sham	IPB: 10 mL of 0.75% ropivacaine and epinephrine (1:200,000)	IPB: 59.5 [53.3 - 66.8] Control: 63.0 [52.0 - 66.8]	36/20	Primary: Pain intensity during 45-degree passive flexion of the hip with the ipsilateral knee flexed naturally, evaluated by numeric pain score (NRS) 1, 6, 24 and 48 hours after the surgery. Secondary: Opioid consumption 24 and 48 postop	5
Teng et al.	Ultrasound-guided anterior iliopsoas muscle space block effectively reduces intraoperative hypotension in elderly adults undergoing hip surgery: A randomized controlled trial	2023	China	RCT	Unilateral hip surgery under general anaesthesia	IPB (& LFCN block)	Posterior lumbar plexus block (& sacral plexus block)	IPB: 50 mL of 0.33% ropivacaine & LFCN block: 10 mL of 0.33% ropivacaine Control: 30 mL of 0.33% ropivacaine (both)	IPB: 73.33 (SD: 13.10) Control: 76.76 (SD: 9.13) **	19/19	Primary: interop, hypotension. Secondary: pain score 1h after surgery and perioperative. Sufentanil dose	3

Table I. — Study characteristics - Continued.

Author	Title	Year	Country	Type of Study	Orthopedic intervention	Nerve block technique	Control	Medication regime	Age (median [IQR])	Total number of patients (F/M)	Outcome measures	Jadad scale
Wang et al.	A randomized controlled trial of iliopsoas plane block vs. femoral nerve block for hip arthroplasty	2023	China	RCT	Unilateral THA under general anaesthesia	IPB (& LFCN block)	FNB (& LFCN block)	IPB: 10 mL of 0.5% ropivacaine & LFCN block: 5 mL of 0.5% ropivacaine FNB: 10 mL of 0,5% ropivacaine & LFCN block: 5 mL of 0.5% ropivacaine	IPB: 64 [56.5 – 70] Control: 65 [57.5 – 70.5]	40/50	Primary: pain score during hip flexion at 4h post-surgery (VAS). Secondary: quadriceps strength (MMT) and pain scores upon arrival at the PACU and at 2, 4, 6, 24, 48h post-surgery, the first time out of bed, total opioids consumption, patient satisfaction and complications	3

Table II. — Jadad Scale - Randomized Control Trials.

Author	Randomization		Blinding		Account of all patients	Points
	Randomization is mentioned (yes/no)	Method of randomization is appropriate (yes/no)	Blinding is mentioned (yes/no)	Method of blinding is appropriate (yes/no)		
Dong et al.	Yes	Yes	Yes	No	Yes	3
Hu et al.	Yes	Yes	Yes	Yes	Yes	5
Jessen et al.	Yes	Yes	Yes	Yes	No	4
Jiang et al.	Yes	Yes	Yes	Yes	Yes	5
Kim et al.	Yes	Yes	Yes	Yes	Yes	5
Teng et al.	Yes	Yes	Yes	No	Yes	3
Wang et al.	Yes	Yes	No	No	Yes	2

Table III. — Tubular comparison of postoperative pain, opioid consumption, and quadriceps strength outcomes.

Author	Design	Comparison	Pain Score Outcome	Opioid Consumption Outcome	Quadriceps Strength Outcome
Dong et al.(16)	RCT	IPB vs Posterior lumbar plexus block	No difference observed (VNS)	Not evaluated	Not evaluated
Hu et al.(24)	RCT	IPB vs Sham	Significantly lower VAS at 3-24h post-op ($p < 0.05$)	Significantly reduced opioid use in IPB group ($p< 0.001$)	No difference observed
Jessen et al. (26)	RCT	IPB vs Sham	No difference observed (NRS)	Significantly reduced opioid use in IPB group ($p< 0.001$) *	No difference observed
Jiang et al.	RCT	IPB (& LFCN block) vs FNB (& LFCN block)	No difference observed (NRS)	No difference observed	Strength preservation in IPB group observed ($p< 0.001$)**
Kim et al. (25)	RCT	IPB vs Sham	No difference observed (NRS)	No difference observed	No difference observed
Teng et al. (27)	RCT	IPB (& LFCN block) vs Posterior lumbar plexus block (& sacral plexus block)	No difference observed (VAS)	Not evaluated	Not evaluated
Wang et al.(28)	RCT	IPB (& LFCN block) vs FNB (& LFCN block)	No difference observed (VAS)	Not evaluated	Strength preservation in IPB group observed ($p< 0.05$)
Wang et al. 29 - 30	Case reports	IPB	Lower VAS observed	Not evaluated	Strength preservation in IPB observed

IPB: Iliopsoas plane block, LFCN: Lateral femoral cutaneous nerve, FNB: Femoral nerve block, NRS: Numeric Rating Scale, VAS: Visual analog scale, VNS: Verbal numerical scale.
* Significantly lower consumption at 3h (IV morphine equivalent)
** Strength preservation in IPB group at 12 & 24h post-op.

Table IV. — Postoperative pain levels.

Author	Nerve block technique	Control	Scoring technique	Results	Conclusion postop. pain outcomes comparison
Dong et al.	IPB	Posterior lumbar plexus block	VNS	There was no significant difference in pain score between the lumbar plexus block and IPB	IPB = Posterior lumbar plexus block
Hu et al.	IPB	Sham	VAS	IPB group showed significantly lower VAS scores at 3, 6, 12, and 24 h when compared to Sham ($p < 0.05$)	IPB < Sham
Jessen et al.	IPB	Sham	NRS	No significant differences in IPB and sham were seen	IPB = Sham
Jiang et al.	IPB (& LFCN block)	FNB (& LFCN block)	VAS	No significant difference in maximum pain score at 12, 24, and 48h post-op between groups	IPB (& LFCN block) = FNB (& LFCN block)
Kim et al.	IPB	Sham	NRS	No significant differences in IPB and sham were seen	IPB = Sham
Teng et al.	IPB (& LFCN block)	Posterior lumbar plexus block (& sacral plexus block)	VAS	There was no significant difference in pain scores between the lumbar plexus block and IPB	IPB (& LFCN block) = Posterior lumbar plexus block (& sacral plexus block)
Wang et al.	IPB (& LFCN block)	FNB (& LFCN block)	VAS	IPB showed no significant difference in terms of pain score during hip flexion at 4h post-surgery between IPB and FNB groups.	IPB (& LFCN block) = FNB (& LFCN block)

IPB: Iliopsoas plane block, LFCN: Lateral femoral cutaneous nerve, FNB: Femoral nerve block, NRS: Numeric Rating Scale, VAS: Visual analog scale, VNS: Verbal numerical scale.

Table V. — Postoperative opioid consumption.

Author	Nerve block technique	Control	Results	Conclusion post op. opioid consumption
Dong et al.	IPB	Posterior lumbar plexus block	Not measured	Inconclusive
Hu et al.	IPB	Sham	Within the first 24 h after surgery, patients in the IPB group consumed ($p < 0.001$) significantly less morphine than Sham patients	IPB < Sham
Jessen et al.	IPB	Sham	The mean 3-hour intravenous morphine equivalent consumption in the iliopsoas plane block group was 10.4mg vs 23.8mg in the placebo group ($p < 0.001$)	IPB < Sham
Jiang et al.	IPB	FNB (& LFCN block)	No significant difference in total opioid consumption between groups	IPB (& LFCN block) = FNB (& LFCN block)
Kim et al.	IPB	Sham	Cumulative opioid consumption was not significantly different from sham ($p > 0.05$)	IPB = Sham
Teng et al.	IPB (& LFCN block)	Posterior lumbar plexus block (& sacral plexus block)	Not measured	Inconclusive
Wang et al.	IPB (& LFCN block)	FNB (& LFCN block)	Not measured.	Inconclusive

IPB: Iliopsoas plane block, LFCN: Lateral femoral cutaneous nerve, FNB: Femoral nerve block.

Table VI. — Postoperative quadriceps strength.

Author	Nerve block technique	Control	Method of measurement	Results	Conclusion post op. strength
Dong et al.	IPB	Posterior lumbar plexus block	None	Not measured	Inconclusive
Hu et al.	IPB	Sham	Manual muscle testing (MMT) grade (0-5)	No significant differences were observed in quadriceps strength or postoperative complications between the two groups ($p>0.05$).	IPB = Sham
Jessen et al.	IPB	Sham	Dynamometer	The reduction in quadriceps strength was similar regardless of active or placebo iliopsoas plane block ($p>0.05$).	IPB = Sham
Jiang et al.	IPB	IPB (& LFCN block)	Manual muscle testing (MMT) grade (0-5)	Quadriceps strength was higher in IPB group at 12 and 24h post-op compared to FNB group ($p< 0.001$)	IPB (& LFCN block) > FNB (& LFCN block)
Kim et al.	IPB	Sham	Oxford muscle strength grading (5 - point Likert scale)	No strength differences in quadriceps strength levels in either operated or non-operated sides.	IPB = Sham
Teng et al.	IPB (& LFCN block)	Posterior lumbar plexus block (& sacral plexus block)	None	Not measured	Inconclusive
Wang et al.	IPB (& LFCN block)	FNB (& LFCN block)	Manual muscle testing (MMT) grade (0-5)	The quadriceps strength of patients receiving IPB was superior to those receiving FNB upon arrival at PACU and at 2, 4, 6 and 24 h after surgery ($p<0.05$).	IPB > FNB

IPB: Iliopsoas plane block, LFCN: Lateral femoral cutaneous nerve, FNB: Femoral nerve block.

> 0.05)[33]. Kim et al. showed no strength differences in quadriceps strength levels on either the operated or non-operated side using the Oxford muscle strength grading scale (5-point Likert)[34]. Jessen et al. observed a reduction in quadriceps strength in the IPB group similar to the placebo groups ($p > 0.05$) (35). Case series utilizing MMT grades reported preserved muscle strength, grading no less than 4 after IPB[39,41].

DISCUSSION

This systematic review aims to examine the effectiveness of ultrasound-guided IPB for postoperative pain, opioid consumption, and quadriceps muscle strength following hip arthroplasty. The qualitative synthesis included seven RCTs and two case series.

Experiencing pain in the early postoperative period could increase the risk of developing chronic pain following a surgical procedure[42]. Hence, effective pain management in the immediate postoperative phase is crucial. The iliopsoas plane contains proximal articular branches of the femoral nerve that diverge towards the anterior hip capsule, and some branches may emerge more distally, after the nerve has passed under the inguinal ligament. Nonetheless, the obturator nerve stands out as the primary reported source of innervation to the anterior portion of the hip capsule[43]. Compared to other peripheral nerve blocks, such as the posterior lumbar plexus block and FNB, no significant differences in postoperative pain scores were found[26,36,37]. However, reduced postoperative pain was observed in patients who received IPB compared to patients who received a sham[33,35]. In their study, Nielsen et al. described that IPB inadequately encompasses the articular branches of the obturator nerve[24]. Other nerve blocks, including PENG, do not achieve complete coverage of this region either[44].

In a pilot study, Jessen et al. found that patients receiving IPB had a significant effect on opioid consumption compared to patients who received a placebo[45]. This is in line with the findings of two studies that demonstrated a significant difference in opioid consumption between the IPB groups and the sham group[33,35]. Despite these outcomes, using opioid consumption as an outcome has limitations as well, as it does not describe how well a treatment works. While the reduction in opioid consumption could suggest a positive result, it does not necessarily capture the entire picture of the well-being or pain relief of patients[46]. Furthermore, there may be differences between clinical practice and the methodologies employed in these studies. For instance, Jessen et al. used remifentanil to mitigate any residual analgesic effects from intraoperative medications during the immediate postoperative phase[35]. Yet, according to PROSPECT guidelines, it is recommended to administer paracetamol, NSAIDs, or COX-2 inhibitors in addition to dexamethasone to manage postoperative pain[47]. Alternatively, patients undergoing THA are often likely to receive oral non-opioid analgesics, supplemented with short-acting intravenous opioids[47]. Regardless, this study shows that IPB could make the pain more bearable for patients, particularly for those whose pain cannot be sufficiently controlled with medication alone.

Preserving postoperative quadriceps strength is particularly relevant as it facilitates faster recovery, enabling patients to mobilize earlier, leading to shorter hospital stays and possibly reducing the risk of complications[24]. Wang et al. demonstrated that quadriceps strength in patients receiving IPB was superior to that of patients receiving other nerve blocks within the first 24 hours after surgery[37]. In accordance, Jessen et al. and Hu et al. found no significant differences between quadriceps strength and postoperative complications between the comparative group and patients receiving a sham or placebo[33,35]. The motor-sparing effect occurs because IPB selectively blocks the sensory branches of the hip joint originating from the accessory obturator nerve and the femoral nerve[23]. Compared to the PENG block, IPB is performed in a lateral-to-medial orientation within the iliopsoas plane, targeting structures superior and lateral to the obturator foramen, rather than the deep, medial trajectory of the PENG block near the psoas tendon and iliopectineal eminence. The obturator nerve provides articular branches to the anteromedial portion of the hip capsule, which typically course along the inferior border of the superior pubic ramus, medial and deeper than the reach of the IPB. Consequently, the obturator nerve is generally not adequately covered unless there is significant local anesthetic spread beyond the intended plane, which could compromise the block's selectivity and potentially affect motor function[15,16]. Increased volume could lead to a broader distribution of anesthetics along the articular branches, extending to the femoral nerve trunk. While most studies used 10 mL of ropivacaine, a volunteer RCT used a lower volume[24]. Here, minor injectate spread into the fascia iliaca compartment was observed. Yeoh et al. proposed that a difference in needle tip position between the PENG block and IPB may also play an important role in the likelihood of incidental rupture of the iliopectineal bursa, potentially spreading to the fascia iliaca compartment[21]. As with the PENG block, achieving comprehensive sensory blockade, particularly of the obturator nerve and distal branches of the femoral nerve, remains very difficult.

All in all, IPB could be a useful analgesic technique when postoperative quadriceps strength needs to be preserved. That is, greater quadriceps strength facilitates early functional rehabilitation, leading to fewer complications and quicker recovery. However, compared to other analgesic techniques, better efficacy needs to be weighed against the fact that deep blocks require a higher level of anaesthesiologist expertise and are considered more difficult to perform.

Limitations regarding this systematic review include the heterogeneity in the reported outcomes. The lack of standardized data collection and outcome measures across the included studies complicates the ability to draw definitive conclusions. One of the difficulties in determining which pain score is most reliable is the lack of a reliable method for objectively measuring postoperative pain[48]. Pain is frequently assessed through patient reporting and based on subjective feelings, the need for analgesia, or the impact on functioning[49]. Four of seven RCTs used the VAS, the most commonly used method to assess postoperative pain. Four RCTs reported on postoperative opioid consumption. Two RCTs did not measure the quadriceps strength. Furthermore, the method of quantification differs vividly between the analyzed RCTs. Three studies used the MMT grade; Jessen et al.[35] used a dynamometer; and Kim et al. used a 5-point Likert scale. Furthermore, the absence of a comparison between IPB and PENG blocks remains a limitation. Moreover, this block was designed to preserve motor function and is now widely used. Unfortunately, no RCT comparing PENG and IPB has been conducted yet. We identified an ongoing randomized study (NCT05397145). This prospective study compares the efficacy of PENG block and IPB for postoperative analgesia management in patients undergoing hip arthroplasty. Another limitation is the relatively small number of included studies, which limits the power to detect potential adverse events, and none had a long follow-up period to evaluate long-term effectiveness and/or side effects. Moreover, the follow-up duration differs greatly between the included studies. Jessen et al., for example, had the briefest follow-up period of 3 hours, while Wang et al. had a follow-up period of 48 hours[35]. Altered follow-up durations might contribute to differences in study results, as longer follow-up periods may decrease postoperative pain scores due to a longer interval between operation and recovery. Besides, a prolonged follow-up can influence quadriceps strength either positively, due to reduced pain[50], or negatively, as prolonged rest can reduce muscle strength[50].

CONCLUSION

In conclusion, this systematic review showed that IPB has a similar effect on postoperative pain following hip surgery compared to other peripheral nerve blocks. In contrast to sham interventions, IPB might diminish opioid consumption compared to sham. Yet, our findings show that IPB may preserve postoperative quadriceps strength, as no differences were seen when compared to sham interventions, and may potentially lead to superior postoperative quadriceps strength compared to FNB postoperatively. Due to heterogeneity in outcome measures, the definitive beneficial effects of IPB on postoperative pain remain unclear, which highlights the complexity of postoperative pain management after hip surgery. Therefore, qualitative research must be conducted to prove the acclaimed possible benefits of IPB over other nerve blocks. In addition, we endorse using a standardized pain measurement tool in future research to improve consistently to improve comparability between studies.

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