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Comparison of Supra-inguinal Fascia Iliaca Block (S-FIB) with Infra-ingunal Fascia Iliaca Block (I-FIB) in Total Hip Arthroplasty (THA) Surgery based on Interleukin-6 (IL-6) Level, Numeric Rating Scale (NRS), Rescue Opioid, and Motor-Sparring

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Abstract

Background: Pain is an unpleasant sensory and emotional experience that typically involves actual or potential tissue damage. Hip fractures are fractures of the upper part of the femur, usually resulting in groin and thigh pain. Pain management is essential to reduce postoperative morbidity and mortality and accelerate recovery, so multimodal techniques including peripheral nerve blocks are highly favoured for postoperative analgesia. Aim to determine which is superior, supra-inguinal or infra-inguinal iliaca fascia nerve block.

Methods: A total of 30 patient samples, with ASA physical status I-II, age group 20-85 years, who will undergo *THA* procedure with Spinal Anaesthesia and agree to participate in this study. The study design was a double-blind randomised trial assessing IL-6, NRS, Rescue Opioid, and Motor-Sparring.

Results: Divided into two groups, S-FIB and I-FIB with 15 patients per group. In the calculation of IL-6 levels, S-FIB is far superior to I-FIB in the SP0 (preoperative), SP1 and SP2 (postoperative) tests ($P < 0.05$), meaning that S-FIB IL-6 levels are much lower. There is a significant difference in NRS values, in S-FIB compared to I-FIB at hours 6, 12, and 24 ($P<0.05$), it was found that S-FIB had no complaints of pain for 24 hours. In I-FIB there were 4 patients with NRS values of more than 4 so that rescue opioids were carried out. Whereas in the Motor-Sparring examination after the administration of peripheral nerve blocks, S-FIB had no muscle weakness compared to I-FIB there was muscle weakness at hours 6 and 12 ($P<0.05$). Thus, S-FIB is far superior in managing pain and minimal complications after THA surgery compared to I-FIB.

Conclusion: S-FIB peripheral nerve block is far superior in postoperative pain management and no side effects of muscle weakness compared to I-FIB, post THA surgery.

Keywords: *Fascia Iliaca Block, Hip Fracture, Pain, Interleukin-6*

Introduction

According to the *International Association for the Study of Pain* (IASP), pain is defined as an unpleasant sensory and emotional experience that is typically caused by actual or potential tissue damage. Pain can also be divided into two main components, namely emotional (psychogenic) and sensory (physical) components.[1,2,3]

Hip fracture is an injury to the upper part of the femur, usually resulting in pain in the groin and thigh, which manifests as the affected limb becoming shorter if the fracture is displaced with the hip positioned in external rotation and abduction, and impossible to bear weight. The incidence of hip fractures is high in adults >65 years.[3,4]

Total Hip Arthroplasty (THA) is a common surgical procedure that aims to improve mobility and quality of life for patients suffering from hip pain. Adequate analgesia with minimal side effects allows early postoperative mobility, optimal functional recovery and decreased postoperative morbidity. Despite being a frequently performed surgical procedure, there is high variability in perioperative anaesthetic and analgesic management for THA. Recent guidelines focusing on *ERAS (Enhanced Recovery After Surgery)* aim to develop a perioperative multidisciplinary programme to shorten hospital stays and reduce complications, readmissions and costs for patients undergoing major surgery. [5,6,7]

The *PROSPECT (previous procedure-specific postoperative pain management)* working group is a global collaboration of surgeons and anaesthesiologists that formulates and recommends specific procedures for pain management after surgery that are common but not potentially painful. One of the analgesia recommendations for THA patients is the use of peripheral nerve blocks, in the form of femoral nerve blocks, lumbar plexus blocks, psoas compartment blocks, quadratus lumborum blocks and iliac fascia blocks to reduce postoperative pain scores and morphine consumption.[8,9]

Bullock *et al* (2021), described the *iliac fascia* compartment block better known as *Supra inguinal fascia iliaca block (S-FIB)*. This new method may block the lateral femoral cutaneous nerve more effectively than the inferior inguinal ligament fascia iliaca compartment block or *Infra inguinal fascia iliaca block (I-FIB)*, thus providing good analgesia during and after THA surgery.[4]

Based on the above review, pain management in hip fracture patients is essential to reduce postoperative morbidity and mortality. Thus, we concluded to examine the effectiveness of the recently popularised *S-FIB* with the conventional *I-FIB,* on *Interleukin-6 (IL-6), Numeric Rating Scale (NRS)*, *Rescue Opioid and Motor Sparring* scores in patients undergoing THA surgery with Spinal Anaesthesia.

Methods

This study used a double-blind randomised trial research design, conducted at Wahidin Sudirohusodo Hospital Makassar, RSPTN Hasanuddin University, Bhayangkara Hospital Makassar, Pelamonia TK 1 Hospital Makassar, and Biomedical Research Laboratory RSPTN Unhas 6th Floor building A, starting on 3 April 2024 until 31 July 2024. After obtaining approval from the Hasanuddin University Research Ethics Committee on 2 April 2024 Protocol Number UH.24030184.

A total of 30 samples of patients with physical status I-II *of* the *American Society of Anesthesiologists (ASA)*, between the age group of 20-85 years, who would undergo elective surgical procedures of unilateral *Total Hip Arthoplasty* under Spinal Anaesthesia were involved in this study. Patients who refused to give informed consent for the study, patients with local anaesthetic agent allergy, or patients who had contraindications for SAB anaesthesia were excluded.

All patients who fulfil the inclusion criteria will be given an explanation of the study procedures and asked for written informed consent if it is for Research and Education purposes. This study followed the guidelines provided by the university and hospital ethics committees as per the Declaration of Helsinki in 2013. Patients were randomly allocated by giving an envelope containing the block action to be given and opened when the patient performed a peripheral nerve block. Patients were divided into two groups: group S which performed *S-FIB* and group I which performed *I-FIB*. Patients were fasted 6 hours before surgery, but patients were still allowed to drink sweet tea as much as 50 ml, 2 hours before surgery were

given prophylactic antibiotics and postoperative nausea and vomiting prophylaxis. Initial NRS measurements and muscle strength measurements were taken using a microfet 2 hendel dynamometer and 3 ml blood samples were taken to measure initial IL-6 levels (SP0) before surgery.

Spinal anaesthesia using hyperbaric bupivacaine 0.5% local anaesthetic agent 10 mg + fentanyl 25 mcg at the L3-L4 interspace in the *left lateral decubitus* (LLD) position with a 25 G spinocan needle. Maintenance of anaesthesia with nasal cannula 3 litres/minute. The patient was given a blanket, a warm mattress, and intravenous fluids that had been warmed intraoperatively. *Total hip arthoplasty* was performed by an orthopedic expert with *Implant* insertion making an incision in the hip skin after the patient was anaesthetised.

After the surgery was completed, both groups underwent *Fascia Iliaka Block (FIB)* with supra inguinal or infra inguinal technique according to the envelope given earlier, and will be performed by an anaesthetist. The ultrasound transducer is placed transversely in the inguinal crease, or according to the location of the peripheral nerve block to be performed. Under sterile conditions, a 22 Tuohy 80 mm needle (Pajunk, Germany) is inserted in-plane until the needle tip is placed supra inguinal or infra inguinal of the femoral artery at the apex of the femoral triangle. A 5 ml normal saline solution was injected to confirm proper positioning and assess catheter patency. Bupivacaine Isobaric 0.25% was injected by intermittent negative aspiration with a total dose of Bupivacaine Isobaric 0.25% of 40 ml per sample.

After the administration of peripheral nerve block, the NRS score was checked at 4, 6, 12, 24 hours, if the NRS score was greater than or equal to 4, fentanyl 0.5-1 mcg / kg / IV would be given as a rescue drug. The administration of rescue drugs was recorded as opioid administration. 3 ml peripheral blood samples were also taken for IL-6 examination at 6 hours (SP1) and 12 hours (SP2) after treatment in both groups of patients. Measurement of muscle strength (Muscle Streght Test) using Hendel Dynamomaeter Microfet 2 in postoperative after peripheral nerve block at 6 and 12 hours, to assess muscle strength after peripheral nerve block. For samples of IL-6 levels will be examined at the Biomedical Laboratory RSPTN Unhas 6th Floor building A by ELISA method.

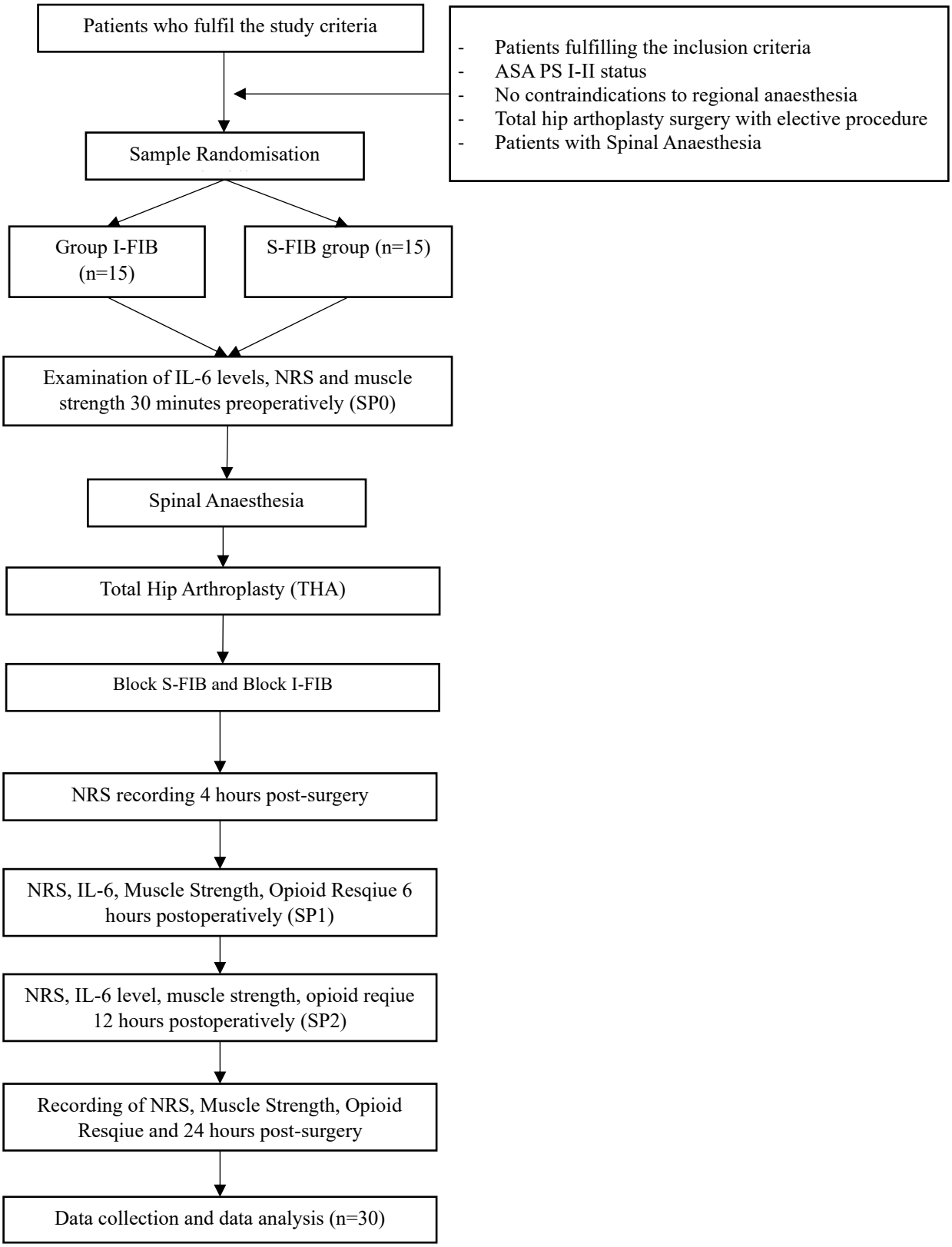


Figure 1. Research flow diagram

Statistical Analysis

The data obtained were displayed in the form of narratives, tables, graphs, frequencies, and percentages, using SPSS 25.0 for Windows. Data are shown with the mean and frequency of age, BW, TB, BMI, IL-6 levels, NRS, Rescue Opioid and Motor Sparring in each group.

The normality of the data was tested using the *Chi-Sguare test and unpaired T test* with a significance value of p≥0.05 indicating normally distributed data. If a normal distribution was obtained (p≥0.05), an *independent t-test* was used, if an abnormal distribution was obtained (p≤0.05) a *Mann-Whitney U Test* was used to compare NRS, IL-6 levels and Motor Sparring before and after peripheral nerve block administration in each group. If the data were found to be normally distributed (p ≥ 0.05) the *t-dependent* hypothesis test was used and if the distribution was not normal (p ≤ 0.05) the *Mann-Whitney* test was used for Interelukin levels between the two groups. As for rescue opioid, *Chi-Sguare* test was used.

Results

In this study, there were 30 subjects who would undergo THA surgery with Spinal Anesthesia, divided into 2 groups, namely *S-FIB* and *I-FIB* consisting of 3 men (20%) and 12 women (80%). The age range is between 20-85 years with the average age of patients with *S-FIB* action 59.80 ± 14.38 years, patients with *I-FIB* action 60.272 ± 11.24 years. The nutritional status based on body mass index (BMI), consisting of normal nutritional status in the I-FIB group 1 patient and the S-FIB group 3 patients, overnutrition status in the I-FIB group 9 patients and the S-FIB group 7 patients, and grade 1 obesity nutritional status in the I-FIB group and the S-FIB group 5 patients each.

Table 1. Characteristics of Research Subjects

	I-FIB (Mean ± SD)	**S-FIB (Mean ± SD)**	***p value***
Age (years)	60.272 ± 11.24	59.80 ± 14.38	0.922^{ns}
Gender			
Male (%)	3 (20)	3 (20)	1.000^{ns}
Female (%)	12 (80)	12 (80)	
Nutritional Status (BMI)			
Normal Nutrition (%)	1 (6.67)	3 (20)	0.535^{ns}
Overnutrition (%)	9 (60%)	7 (46.67)	
Obesity Grade I (%)	5 (33.33)	5 (33.33)	

Gender, Nutritional Status (BMI): Chi-Square test, Age: unpaired T-test.^{ns} : not significant (homogeneous data)

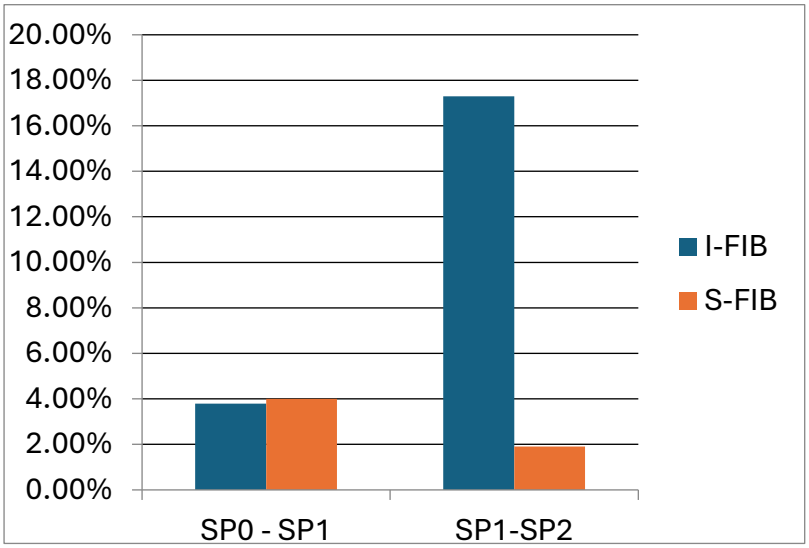
Based on the sample characteristics data above, the results of statistical tests using the *Chi-Square* test for gender, nutritional status (BMI), and age using the unpaired T test, found that there were no significant differences between the two groups of research subjects in terms of where the P value> 0.05 means that the two groups have homogeneous characteristics.

Interleukin-6 Comparison Results between S-FIB and I-FIB

Measurement Time IL-6	**I-FIB**	**S-FIB**	***p-value***
	Median (Min-Max)	**Median (Min-Max)**	
SP0	158 (38 - 895)	49 (40 - 90)	0.001**
SP1	164 (45 - 867)	51 (35 - 86)	0.001**
SP2	193 (42 - 780)	52 (33 - 80)	0.004*

Mann-Whitney test. * significantly different with $p < 0.05$. ** significantly different with $p < 0.001$.

Based on the statistical table data above, the Mann-Whitney test was carried out on both groups to find a decrease in IL-6 levels. As for the difference between the two, we can see where in the SP0 group (IL-6 value before surgery and spinal anaesthesia) where previously obtained initial measurements of IL-6 values were already too high. Thus, there is a significant difference between the I-FIB group and the S-FIB group ($P < 0.05$), which means that the S-FIB group is much more reduced in IL-6 levels than the I-FIB group. In the SP1 test results (IL-6 value 4 hours after peripheral nerve block) and SP2 (IL-6 value 12 hours after peripheral nerve block) there is a significant difference ($P < 0.05$) which means that the S-FIB group is much more decreased IL-6 levels after peripheral nerve block compared to the I-FIB group.



Sampling	I-FIB	S-FIB
SP0-SP1	3,79%	4%
SP1-SP2	17,3%	1,9%

Figure 2. Graph percentage comparison of IL-6 in each group of S-FIB and I-FIB

As for the calculation of the percentage decrease in IL-6 levels, when viewed from the percentage of each group and sampling time, from the SP0 to SP1 test in the I-FIB group the difference was around 3.79%, and the SP1 to SP2 test in the I-FIB group, the difference was around 17.3%, which means that from SP0 to SP2 there is a significant percentage increase so that in the I-FIB group after 12 hours in the peripheral nerve block there is a percentage increase in IL-6 levels. Meanwhile, in the calculation of the percentage decrease in IL-6 levels in the S-FIB group from SP0 to SP1 measurements there was a percentage increase of about 4%, and SP1 to SP2 measurements obtained a percentage increase of 1.9%, proving that in the S-FIB group in SP0 to SP2 sampling there was a decrease in IL-6 levels. Conclusion based on the results of the percentage difference between the two groups, S-FIB is far superior to reducing IL-6 levels compared to the I-IFIB group.

Table 3. Numerical Rating Score (NRS) Comparison Results between S-FIB and I-FIB

Measurement Time NRS	I-FIB	S-FIB	*p-value*
	Median (Min-Max)	Median (Min-Max)	
0	3 (3 - 4)	3 (2 - 4)	0.529
4 Hours	0 (0 - 2)	0 (0 - 0)	0.150
6 Hours	1 (0 - 4)	0 (0 - 0)	0.001*
12 and 24 Hours	3 (0 - 6)	0 (0 - 1)	0.001**

Mann-Whitney test. * significantly different with $p < 0.05$. ** significantly different with $p < 0.001$.

In the table above, the statistical test used the *Mann-Whitney* test. Comparison of NRS between I-FIB and S-FIB, at hour 0 there was no significant difference (P>0.05) which means that in the initial measurement of NRS values in both groups there was no significant difference in pain levels. Similarly, the measurement of NRS 4 hours after peripheral nerve block, there was no significant difference in the two groups (P>0.05), which means that in this group there was no increase in the pain value of the two groups. The measurement results 6 hours, 12 hours and 24 hours after surgery, there is a significant difference in value between I-FIB and S-FIB (P <0.05) meaning that S-FIB is far superior to I-FIB. So that in I-FIB, the 6th, 12th, and 24th hours have increased NRS values compared to the S-FIB group for 24 hours there has been no increase in NRS values.

Table 4. Rescue Opioid Requirement

Opiod Requirement	I-FIB	S-FIB	*p-value*
	N (%)	N (%)	
Yes	4 (26.67)	0 (0)	0.032*
No	11 (73.33)	15 (100)	

Chi-Square test. * significantly different with p < 0.05.

From the data in the statistical test table above, the Chi-Square test was carried out, there was a significant difference between I-FIB and S-FIB on rescue opioids, there was data on the results, namely in I-FIB, it was found that there were 4 patients who were given rescue opioids who received an NRS value ≥ 4, where the P value was <0.05, which means that there is a significant difference between I-FIB and S-FIB on the use of rescue opioids, where I-FIB there were samples that experienced an increase in NRS and rescue opioids were taken, so it can be concluded that S-FIB is much better than I-FIB regarding THA postoperative pain management.

Table 5. Motor-Sparring Comparison Results between S-FIB and I-FIB

Measurement Time Muscle Strength	I-FIB	S-FIB	*p-value*
	Median (Min-Max)	Median (Min-Max)	
0	1.4 (1.2 - 6.4)	1.4 (1.0 - 6.8)	0.330
4 Hours	0.8 (0 - 2.4)	1.4 (1.1 -6.8)	0.002*
6 Hours	1.3 (0.7 - 4.2)	1.6 (1.2 - 6.9)	0.006*
12 and 24 Hours	1.8 (1.2 - 10.4)	1.8 (1.6 - 10.4)	0.379

Mann-Whitney test. * significantly different with p < 0.05. ** significantly different with p < 0.001.

From the results of statistical tests in the table above, using the *Mann-Whitney* test measuring muscle strength in both block groups, where the 0th hour found no significant difference between I-FIB and S-FIB (P>0.05), meaning there was no effect of muscle weakness in the initial test before the peripheral nerve block was performed. After the peripheral nerve block was performed at the 4th and 6th hours, there was a significant difference between I-FIB and S-FIB (P < 0.05), meaning that in I-FIB there was significant muscle weakness compared to S-FIB. Thus, the effect of peripheral nerve block on muscle strength, especially I-FIB, showed symptoms of motor-sparring and experienced weakness of the thigh lift muscles when measured using a *microfet 2 hendel dynamometer* compared to S-FIB who did not experience any weakness of the quadriceps muscles.

Discussion

This study was conducted at Wahidin Sudirohusodo Hospital Makassar, Hasanuddin University Teaching Hospital Makassar, Bhayangkara Hospital Makassar, Pelamonia Hospital Makassar, and Biomedical Laboratory RSPTN Unhas Building A 6th Floor. In this study, where divided into 2 groups, namely I-FIB and S-FIB, each group amounted to 15 samples with the administration of analgesic drug Bupivacaine 0.25% as much as 40 ml per sample.

The comparison of sample characteristics showed no significant differences in terms of age, gender, and nutritional status. In addition, patients also have ASA PS I-II status. This indicates that the groups treated with I-FIB and those treated with S-FIB have homogeneous sample characteristics.

- Interleukin-6 levels

According to Xia et al (2015), IL-6 is a pleiotropic pro-inflammatory cytokine, which is involved in the induction, growth and differentiation of cells in the haematopoietic immune system, as well as initiating and coordinating inflammatory reactions. IL-6 in the central nervous system mainly originates from neurons, astrocytes and microglia and under normal physiological conditions its production in the central nervous system is strictly regulated by the body.[9]

The results of this study indicate from the measurement of IL-6 levels carried out on samples from the two groups tested, where the measurement of IL-6 levels before surgery and after postoperative peripheral nerve block THA. The results obtained from both groups in the laboratory examination showed a decrease in IL-6 levels from each sample group, both I-FIB and S-FIB.

Based on the results of statistical tests showed that of the two groups there was a significant difference in IL-6 levels, where S-FIB was far superior to the decrease in IL-6 levels compared to I-FIB in the second measurement (SP1) and the third measurement (SP2) the value of significance was P <0.05. This shows that S-FIB is far superior in overcoming inflammation and pain by looking at the results of a very significant percentage reduction in IL-6 levels. This is in line with research conducted by Zhu et al (2022), where IL-6 levels were significantly lower in patients who received Fasia Iliaca Compartment Block (FICB) at 1 hour, 6 hours, 24 hours, 48 hours, and 72 hours after surgery compared to the control group ($P < 0.05$), through a randomised controlled study, finding that FICB can improve postoperative pain management and release of inflammatory factors in femoral intertrochanter fractures.[10]

- NRS Value Score

Pain assessment in this study used the NRS scale, in which the treatment group given S-FIB had significantly lower NRS values compared to the treatment group given I-FIB. Especially S-FIB excelled in pain management at the 6th hour, 12th hour and 24th hour and even there were no complaints of pain at all. This is in line with research conducted by Kumar et al (2015), that the suprainguinal approach to the iliac fascia compartment block has much more effective analgesic efficacy compared to the infrainguinal approach to the iliac fascia compartment block assessed based on the patient's Visual Analog Scale (VAS) in 24 hours. Similar results were also reported by Wang et al (2021), where direct suprainguinal injection guided by ultrasound for iliac fascia block resulted in much faster recovery and better pain management compared to no block, in patients undergoing total hip arthoplasty surgery at an advanced age.[4,8]

- Administration of Rescue Opioids

Postoperatively in both groups of blocks, pain observation was carried out, where if there was an increase in the NRS value ≥ 4, rescue opioids were carried out. The results of the I-FIB treatment group found that there were 4 patients whose NRS values increased above 4 so that rescue opioids were carried out, this occurred at the 6th hour and 12th hour after giving the iliaca fascia block. Whereas in the S-FIB treatment group no rescue opioids were obtained up to 24 hours postoperatively. This proves that the S-FIB nerve block is far superior to I-FIB regarding postoperative pain management in patients with fractured neck of femur with THA surgery.

This is in line with research conducted previously by Cagla et al (2021), where in S-FIB compared to the control group in providing additional analgesia, namely opioid consumption 24 hours postoperatively, it was found to be significantly lower in S-FIB. In another study conducted by Sahriat et al (2013), conducting a conventional infrainguinal iliac fascial block and ensuring its spread towards the medial lateral, not towards the cephalad, it was found that the infrainguinal iliac fascial block was less effective than the suprainguinal iliac fascial block, where opioid consumption was very low at around 34%. In addition, a study by Kumar et al (2015), showed S-FIB had about 40% lower intravenous morphine consumption compared to I-FIB which was higher accepting the addition of intravenous morphine postoperatively.[8,13,14,15]

- Motor-Sparring

In support of this research, muscle strength measurements were also carried out on samples that had been carried out by the iliaca fascia block to assess whether there was an effect of muscle weakness from both peripheral nerve blocks. Measurement of muscle strength was carried out on the quadriceps motion muscles which were innervated by the femoral nerve, obturator nerve, lateral cutaneous nerve and sciatic nerve, which was assessed was the strength of the quadriceps lift muscle using a *microfet 2 hendle dynamometer* measuring device. Measurements were taken at 0 hours before surgery, 4 hours, 6 hours and 12 hours after peripheral nerve block.

Based on the results of observations, actions and statistical calculations, it was found that in I-FIB there was weakness of the quadriceps lift muscle at the 4th hour and 6th hour, this was much different from S-FIB where no muscle weakness was found. So that significantly significant differences were obtained in I-FIB who experienced weakness of the quadriceps muscle at the 4th hour and 6th hour compared to S-FIB. In another study conducted by Krishnamurty et al (2022), in discussing the infraingiunal iliac fascial nerve block group, there were several risks or side effects in the form of quadriceps muscle weakness that could affect the recovery process and comfort of the patient.[11]

In another previous study, conducted by Qian et al (2020), on testing the effectiveness of analgesics in blocking the obturator nerve with FICB with Suprainginal and Infrainguinal techniques, as well as the relationship of sensory strength loss after the block, it has been reported that there is adductor muscle weakness when evaluating obturator nerve function in the infrainguinal group may be caused by femoral nerve block, because the femoral nerve innervates the pectineus muscle and contributes to muscle adduction.[12]

Conclusion

Supranguinal Fascia Iliaca Block (S-FIB) is far superior to *Infrainguinal Fascia Iliaca Block (I-FIB)* based on comparison of IL-6 levels, NRS Score, Rescue Opiod and Motor-Sparring in patients undergoing *Total Hip Arthoplasty* surgery. Thus, S-FIB is highly recommended in the management and management of postoperative pain in patients undergoing *Total Hip Arthoplasty.*

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