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ORIGINAL ARTICLE

Ultrasound-guided Lumbar Plexus Block Versus Suprainguinal Facia Iliac Block for Postoperative Analgesia in Hip Surgeries

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Abstract

Introduction: **SIFIB can anaesthetize the obturator nerve as well as the femoral and lateral femoral cutaneous nerves, unlike traditional facia iliac blocks. SIFIB's superiority over the sub-inguinal technique is explained by the improved obturator block. SIFIB is regarded to be non-inferior to lumbar plexus block since it may anesthetize lumbar plexus nerves while causing few side effects. The purpose of this trial was to examine the tolerability and analgesic performance of ultrasound-guided SIFIB against LPB in THA patients.**

Patient and methods: **60 patients were enrolled, undergoing THA, with age (40−80) years, ASA (I−III), and BMI (18−35) kg/m^2. The criteria of exclusion were patient refusal, coagulopathy, sepsis, hepatic/renal failure, local anesthetic allergy, pre-existing femoral/obturator neuropathy, and previous lumbar spine or inguinal surgery.**

Results: **There was no significant distinction between groups in the context of the static and dynamic VAS score. In addition, this study revealed a nonsignificant comparison between LBP and SIFIB groups, regarding the 24 h morphine consumption and the duration to first request of analgesia (7.5 vs. 6.1 mg; 348 vs. 312 min, $P > 0.1$), respectively.**

Conclusion: **In total hip arthroplasty, this findings revealed that analgesia produced by US-guided suprainguinal facia iliac block was not inferior to lumbar plexus block. With excellent-to-good satisfaction reporting, analgesia was significantly sustained in the suprainguinal facia iliac block group 24 h following surgery. To ensure early mobilization following surgery, it is essential to research quadriceps-sparing blocks, as pericapsular nerve group (PENG) block.**

Keywords: Lumbar plexus block, Suprainguinal facia iliac block, Analgesia in hip surgeries

1. Introduction

Hip replacement surgery is a painful major surgery that requires effective pain management. ~10% of hip surgeries report chronic pain.[1] Additionally, postoperative pain after total hip arthroplasty (THA) negatively impacts early patient recovery and rehabilitation. Pain can impair postoperative mobility and increase the risk of thromboembolism.[2] Therefore, appropriate postoperative pain management should be implemented. The most important principle in pain management is the prophylactic use of a multimodal approach widely recognized as the gold standard for pain relief after hip surgery. This strategy targets different nociceptive pathways and neurotransmitters and can reduce the dosage of each specific analgesic. As part of a multimodal approach, peripheral nerve blocks play an important role in pain control and opioid reduction.[3]

The hip is predominantly innervated by lumbar plexus branches, including the femoral, obturator, lateral femoral cutaneous nerves, and sacral plexus, which travels through the nerve into the quadratus femoris. Furthermore, the lumbar plexus branch that innervates skin incisions after hip surgery is the lateral femoral cutaneous nerve. As a result, lumbar plexus block (LBP) is useful in reducing pain after hip surgery. Nonetheless, it is a complex surgery with the possibility of serious side effects such as epidural spread and nerve injury, which limits its

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general use.[4] Furthermore, supra-inguinal facia iliac block (SIFIB) was first presented in 2011 as an alternative to the traditional facia iliac block done below the inguinal ligament.[5] SIFIB can anaesthetize the obturator nerve as well as the femoral and lateral femoral cutaneous nerves, unlike traditional facia iliac blocks. SIFIB's superiority over the sub-inguinal technique is explained by the improved obturator block. SIFIB is regarded to be non-inferior to lumbar plexus block since it may anaesthetize lumbar plexus nerves while causing few side effects.[6] The purpose of this trial was to examine the tolerability and analgesic performance of ultrasound-guided SIFIB against LPB in THA patients.

2. Patients and methods

2.1. Ethical approval

60 patients were enrolled after receiving individual written informed consent and official ethical approval from Al-Azhar University ethics board.

2.2. Sample size calculation

Sample size was calculated using MedCalc program version 11.3.0.0. to establish the representative sample and assure the validity of the results. The expected effect size of the VAS of 5/10 for SIFIB and 4/10 for lumbar plexus block, and adjusting the confidence interval to 95%; power 90% and ratio between groups to 1: 1; a sample of 50 cases was found reliable. Estimating a dropout ratio of 10%, we finally included 60 case (30 cases in each group).

2.3. Eligibility criteria

We enrolled patients, undergoing THA, with age (40–80) years, ASA (I-III), and BMI (18–35) kg/m^2. The criteria of exclusion were patient refusal, coagulopathy, sepsis, hepatic/renal failure, local anesthetic allergy, preexisting femoral/obturator neuropathy, and previous lumbar spine or inguinal surgery.

2.4. Randomization

To allocate individuals, a computer-generated randomization procedure was utilized. The researchers tested a telephone-mediated central allocation strategy for allocation concealment.

2.5. Procedure

All patients were anaesthetized with 2 ml bupivacaine 0.5% and 20 μg of fentanyl intrathecally. All surgical procedures were performed posteriorly and in the lateral decubitus position.

2.6. Lumbar plexus block

After lateral positioning, a curvilinear ultrasound probe (M-Turbo, SonoSite Inc., USA) was considered for visualization of the sonoanatomy of 'shamrock' view. The needle was introduced anteriorly, until the needle reached the medial portion of psoas muscle, where the local anesthetic solution was infiltrated. The anesthetic mixture is composed of 30 ml of 0.25% bupivacaine hydrochloride (SUNNYPIVACAINE 100MG/20 ML, Sunny Pharmaceutical, Cairo, Egypt) with 1: 200 000 epinephrine (5 g/ml).

2.7. Supra-inguinal facia iliac block

The patients were positioned supine. A linear ultrasound probe (M-Turbo, SonoSite Inc., USA) was considered for visualization of the sonoanatomy of 'bow-tie' sign. The needle was introduced caudal to cephalad until its tip is positioned under the fascia iliac to infiltrate the local anesthetic solution in this plane. The anesthetic mixture is composed of 30 ml of 0.25% bupivacaine hydrochloride (SUNNYPIVACAINE 100MG/20 ML, Sunny Pharmaceutical, Cairo, Egypt) with 1: 200 000 epinephrine (5 g/ml).

2.8. Outcome assessment

2.8.1. The primary outcome

(1) The cumulative dose of morphine consumption during the first 24 h.

2.8.2. The secondary outcomes

(1) Time of the procedure (from needle introduction to needle removal).
(2) VAS score, static (at rest), and dynamic (hip motion).
(3) Time to first morphine request.
(4) The incidence of adverse events, including epidural spread, postoperative nausea/vomiting, pruritus and nerve injury.

2.9. Statistical analysis

SPSS version 23.0 considered for analysis. Presentation was based on the type, normality and distribution of the variables. Kolmogorov test was first applied. Normally distributed variables, explicated mean and standard deviation, whilst non-normal data explicated median and IQR. The Mann

Whitney *U* test and the student-*t* test were mentioned in this study for intergroup analysis regarding the nonparametric and parametric numerical variables respectively. In addition, categorical variables were analyzed using the χ^2 test. A point of 0.05 was set as the significant level.

3. Results

After obtaining ethical approval, 60 patients were finally included in this randomized double blinded clinical study. Fig. 1 represented the flow of the study process. Regarding the demographic characteristics, there were no significant distinctions between groups (Table 1).

Table 1. Comparison between both groups according to the baseline and demographic characteristics.

Demographic data	LBP ($n = 30$)	SIFIB ($n = 30$)	*P* value
Age (years)	62.4 ± 13.5	65.9 ± 11.6	0.361
Sex n (%)			
Male	13 (43.3)	10 (33.3)	0.538
Female	17 (56.7)	20 (66.7)	
BMI (kg/m^2)	28.1 ± 3.7	27.2 ± 2.8	0.679
ASA physical status *n* (%)			
ASA I	5 (16.7)	4 (13.3)	0.278
ASA II	25 (83.3)	26 (86.7)	
Duration of surgery (min)	86.3 ± 17.4	82.9 ± 19.4	0.471

Abbreviations; (BMI, Body Mass Index; ASA, American Society of Anesthesiology).

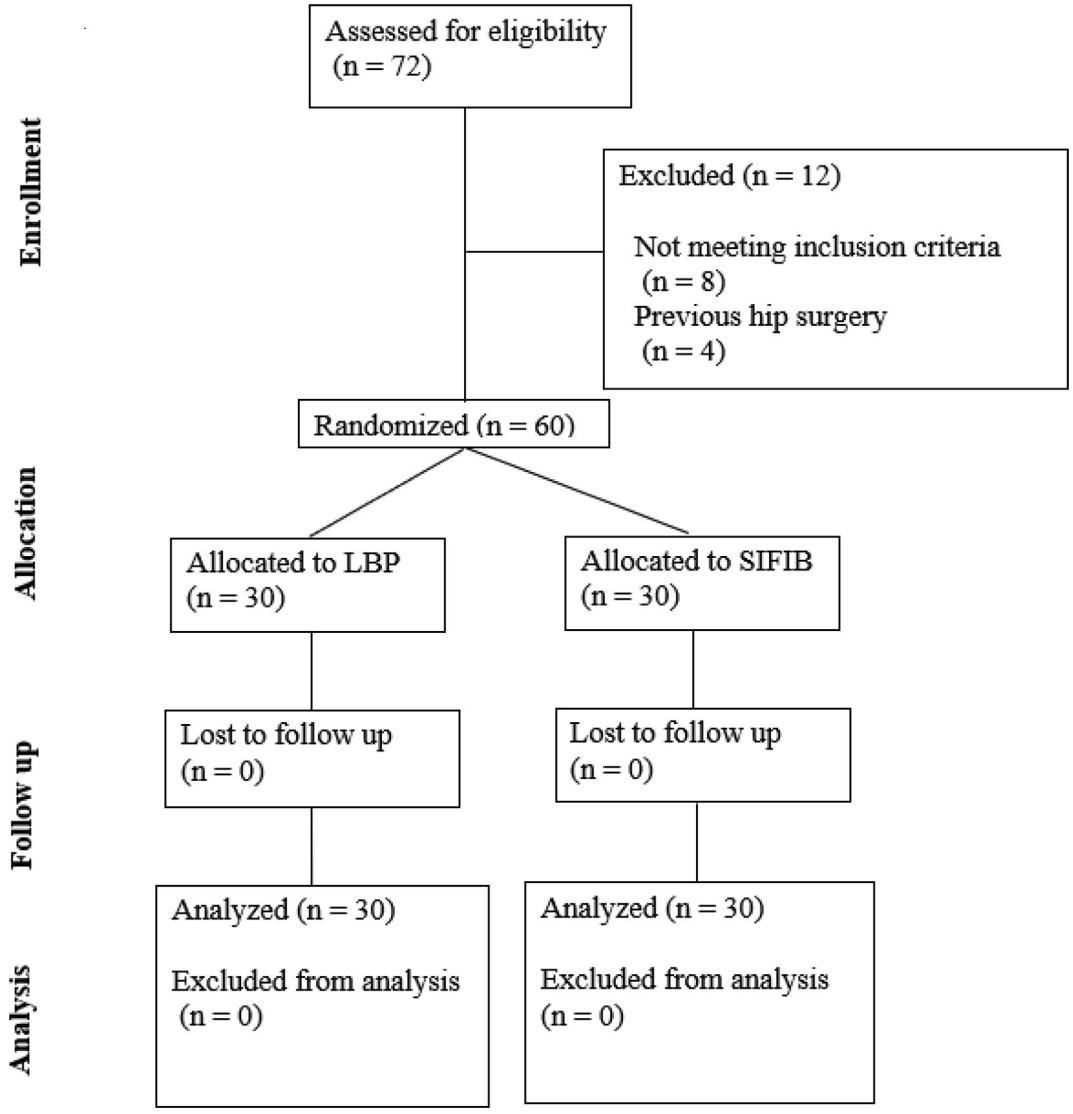

Fig. 1. CONSORT flow diagram.

Table 2. Comparison between the two groups regarding VAS at rest.

VAS $_{static}$	LBP ($n = 33$)	SIFIB ($n = 33$)	P value
After 2 h	2.41 ± 0.76	3.26 ± 0.73	0.961
After 8 h	3.06 ± 1.21	3.44 ± 1.34	0.271
After 16 h	3.90 ± 1.22	4.18 ± 1.08	0.730
After 18 h	3.11 ± 1.31	3.49 ± 1.22	0.116
After 24 h	2.53 ± 0.87	2.90 ± 1.08	0.182

Table 3. Comparison between the two groups regarding VAS at motion.

VAS $_{Dynamic}$	LBP ($n = 33$)	SIFIB ($n = 33$)	P value
After 2 h	2.80 ± 0.67	3.22 ± 0.73	0.761
After 8 h	3.16 ± 1.51	3.34 ± 1.14	0.931
After 16 h	3.28 ± 1.08	3.46 ± 0.68	0.531
After 18 h	3.21 ± 1.21	3.49 ± 1.42	0.495
After 24 h	2.94 ± 0.88	3.16 ± 0.86	0.750

3.1. The primary outcome: morphine consumption

There was no significant distinction between groups in the context of the static and dynamic VAS score (Tables 2 and 3). In addition, this study revealed a nonsignificant comparison between LBP and SIFIB groups, regarding the 24 h morphine consumption and the duration to first request of analgesia (7.5 vs. 6.1 mg; 348 vs. 312 min, $P > 0.1$), respectively (Table 4).

3.2. The secondary outcomes

3.2.1. Time of the procedure

This study revealed that the duration of the procedure was significantly more time-consuming in the lumbar plexus block group, compared with the suprainguinal facia iliac block group (12.3 Vs. 4.8 min, $P = 0.020$), respectively (Table 4).

3.2.2. Sensory and motor block assessment

There was no significant discrepancy among both arms in terms of the anesthesia duration.

Table 5. Comparison between the two groups regarding sensory block grading.

Sensory block N (%)	LBP ($n = 30$)	SIFIB ($n = 30$)	P value
At 3 h			
Anesthesia	13 (43.3)	18 (60)	0.536
Analgesia	12 (40)	11 (36.7)	0.811
No block	5 (16.7)	1 (3.3)	0.072
At 6 h			
Anesthesia	8 (26.7)	9 (30)	0.192
Analgesia	17 (56.6)	18 (60)	0.272
No block	5 (16.7)	3 (10)	0.351
At 24 h			
Anesthesia	0 (0)	1 (3.3)	0.139
Analgesia	4 (13.3)	14 (46.7)	0.001
No block	26 (86.7)	15 (50)	0.511

Abbreviations: LPB, lumbar plexus block; SIFIB, suprainguinal fascia iliac block; Using, Fisher's exact test.

Table 4. Comparison between the two groups regarding analgesic needs.

	LBP ($n = 30$)	SIFIB ($n = 30$)	P value
The cumulative morphine consumption at 24 h (mg)	7.5 ± 4.3	6.1 ± 5.7	0.476
Time to first morphine request (minutes)	348 ± 162	312 ± 168	0.269
Duration of the procedure (minutes)	3.8 ± 1.5	4.8 ± 1.8	0.020

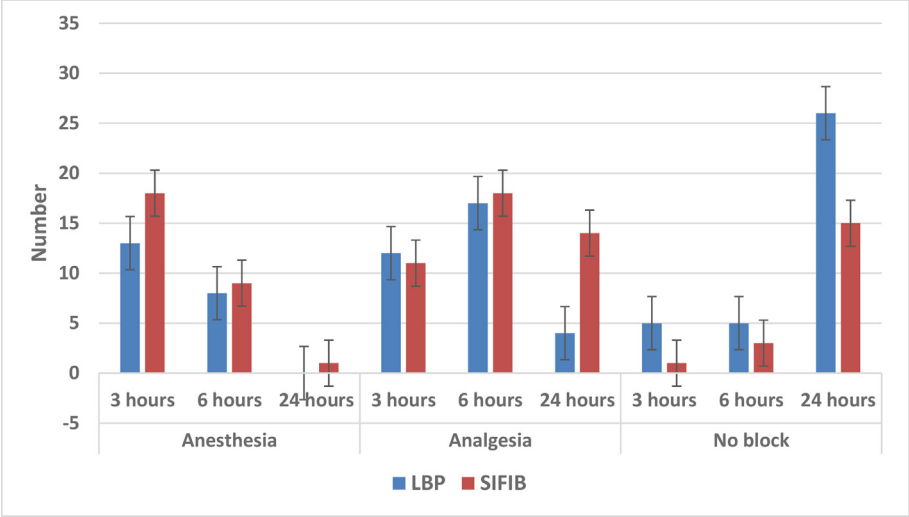

Fig. 2. Distribution of the sensory block grading in the two groups.

Table 6. Comparison between the two groups regarding motor block grading.

Motor block N (%)	LBP ($n = 30$)	SIFIB ($n = 30$)	*P* value
At 3 h			
Paralysis	11 (36.7)	10 (33.3)	0.306
Paresis	15 (50)	17 (56.7)	0.751
No block	4 (13.3)	3 (10)	0.172
At 6 h			
Paralysis	6 (20)	4 (13.3)	0.591
Paresis	17 (56.7)	19 (63.4)	0.170
No block	7 (23.3)	7 (23.3)	0.481
At 24 h			
Paralysis	6 (20)	2 (6.7)	0.339
Paresis	8 (26.7)	10 (33.3)	0.601
No block	16 (53.3)	18 (60)	0.293

Abbreviations: LPB, lumbar plexus block; SIFIB, suprainguinal fascia iliac block; Using, Fisher's exact test.

Table 7. Comparison between both groups according to patient satisfaction and complications.

Parameters	LBP ($n = 30$)	SIFIB ($n = 30$)	*P* value
Satisfaction			
Excellent	12 (40)	18 (60)	>0.1
Good	10 (33.4)	7 (23.3)	
Fair	7 (23.3)	5 (16.7)	
Poor	1 (3.3)	0	
Complications			
PONV	2 (6.7)	1 (3.3)	>0.1
Pruritus	1 (3.3)	1 (3.3)	
Epidural			
Spread	3 (10)	0	
Hypotension	1 (3.3)	0	

Nevertheless, analgesia was significantly maintained in 46.7% in the SIFIB group, compared with 13.3% in the LBP group, after 24 h of the surgery ($P = 0.001$) (Fig. 2) (Table 5). Regarding motor block, this study revealed nonsignificant comparison between LBP and SIFIB groups at 3, 6, and 24 h after surgery (Table 6).

3.2.3. Patient satisfaction

Excellent-to-good satisfaction reporting was more prevalent in SIFIB group, compared with LPB group, with nonsignificant finding (83.3 Vs. 73.4%, $P > 0.1$), respectively (Table 7).

3.2.4. The incidence of adverse events

No life-threatening complications were reported in the two groups. Moreover, epidural spread and weakness of the nonanesthetized limb were reported in 3 cases in LBP group, compared with no cases in SIFIB group. No significant comparison was reported between groups regarding PONV, pruritus, hypotension and epidural spread (Table 7).

4. Discussion

The use of selective localized blockade, such as LPB, to provide analgesia in unilateral hip and femur procedures has progressively grown. Although LPB provides good analgesia, it requires lateral placement, which is technically challenging. It is also necessary to employ a nerve stimulator and identify the lumbar plexus in the paravertebral area Adhikary and colleagues.[7] Because of the deeper trajectory of the needle, potential dangers include intestinal puncture, retroperitoneal hematoma, and kidney injury Njathi and colleagues.[8] Furthermore, diffusion of a local anesthetic drug into the spinal space may result in bilateral lower limb paralysis Rosano and colleagues.[9] It has been shown that ultrasound-guided SIFIB delivers effective analgesia following total hip arthroplasty. The superficial approach simplifies the procedure; the block may be placed with the patient supine, and the potential of adverse effects is lowered by using ultrasound guidance Hebbard and colleagues.[6]

This analysis found that US-guided SIFIB was not inferior to LPB in terms of analgesic effectiveness and rescue analgesia demands. Nonetheless, our findings imply that analgesia was noticeably lengthier in the SIFIB arm than in the LBP arm 24 h after surgery. Furthermore, in the SIFIB group, excellent-to-good satisfaction was more prevalent. The longer duration of analgesia reported in the SIFIB group is thought to be related to the comparably avascular fascia iliac compartment, which results in slower resorption of the local anesthetic. The findings of this study is supported by Badiola and colleagues randomized clinical trial, which included 50 hip arthroscopy patients.[10] They demonstrated that SIFIB has the same analgesic efficacy as LBP for postoperative pain control posthip surgery. Badiola and colleagues found no significant difference in opioid intake 24 h after hip arthroscopy, which is consistent with our findings. Bravo and colleagues, enrolled 60 cases for total hip surgery, distinguishing between US-guided LBP and SIFIB.[11] They also discovered a nonsignificant difference in VAS score and 24 h morphine usage between SIFIB and LBP. Furthermore, Abdelmawgoud and Rashwan[12] conducted a randomized blinded experiment in which they compared LBP SIFIB in patients undergoing femur fracture fixation or total hip arthroplasty. They identified no distinction between the blocks in 24 h meperidine consumption or postoperative VAS score. The distribution of sensory and motor blocks was identical to the current research.

Wolff and colleagues,[13] on the other hand, evaluated the analgesic effectiveness of preoperative SIFIB and LPB blocks following hip arthroscopic surgery

retrospectively. They demonstrated that LBP performed better than SIFIB. This disparity is due to the different procedures utilized by Wolff and colleagues, who performed the fascia iliac block preoperatively. The injection of SIFIB prior to surgery may cause the local anesthetic to be washed away by the irrigation fluid. Furthermore, when compared with prospective controlled trials, the retrospective research design has several flaws Vassar and Holzmann.[14] In terms of complications, the current study identified three occurrences of epidural spread in the LBP group, one of whom developed hypotension. The SIFIB group did not have epidural spread or hypotension. Abdelmawgoud and Rashwan[12] also documented two incidences of epidural spread in the LBP group. Furthermore, in the LBP group, Badiola and colleagues[10] reported just one incidence of epidural dissemination and bilateral lower limb paralysis. There were no further issues noted.

Indeed, in order to offer appropriate analgesia to patients undergoing hip surgery, either LBP or SIFIB is suggested as part of multimodal analgesia. Indeed, sciatic nerve is spared and not anaesthetized by LPB and SIFIB. A fraction of cases feel substantial pain as a result of mechanical tension and disruption to the gluteal and hip rotators, supplied by sciatic nerve Arnuntasupakul and colleagues.[15] Furthermore, 30 ml of 0.25% bupivacaine with 1 : 200 000 epinephrine (5 g/ml) was delivered to both research groups. The amount of local anesthetic used in this research was lower than in previous investigations. Vermeylen and colleagues[16] recommended a 40 ml local anesthetic volume in SIFIB in a cadaveric dose-finding pilot trial for optimum anesthesia. Furthermore, Sauter and colleagues[17] conducted another dose-finding experiment and determined that 36.0 ml of local anesthetic in LBP would be beneficial in 95% of patients. In fact, neither trial used epinephrine as a supplement to the local anesthetic. To limit the risk of systemic toxicity from local anesthetic, we used 30 ml of 0.25% bupivacaine in conjunction with epinephrine 1: 200 000 (5 g/ml), with reasonable analgesic effectiveness.

4.1. Limitations

There were several limitations to this study. First, due to the varied positions necessary to complete the two types of blocks, double blinding was not achieved. Second, in this investigation, a single-injection approach is used. It is suggested that future investigations look into the continuous catheter-based method. For the time being, only a statistical association should be stated due to the minimal absolute differences and multivariate nature of hospital stay and patient release. Finally, both LPB and SIFIB have been linked to muscle weaknesses. Prospective research is necessary to ascertain whether quadriceps-sparing blocks, such as pericapsular nerve group (PENG) blocks Giron-Arango and colleagues,[18] that further target articular branches of the femoral and obturator nerves, might potentially improve mobility and patient release.

4.2. Conclusion

In total hip arthroplasty, this findings revealed that analgesia produced by US-guided suprainguinal facia iliac block was not inferior to lumbar plexus block. With excellent-to-good satisfaction reporting, analgesia was significantly sustained in the suprainguinal facia iliac block group 24 h following surgery. To ensure early mobilization following surgery, it is essential to research quadriceps-sparing blocks, as pericapsular nerve group (PENG) block.

Authors' contribution

The authors equally contributed in this study.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

The authors declared that there were no conflicts of interest.

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