Original Article

A Comparative Study Between Local Anesthesia (LA) and Brachial Plexus Block (BPB) for Arteriovenous Fistula (AVF) Creation

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Abstract

Background: *Arteriovenous fistula creation is essential for hemodialysis in patients with end-stage renal disease. The choice between local anesthesia and brachial plexus block can impact clinical outcomes.*

Objective: *To compare effectiveness, safety, and patient outcomes associated with local anesthesia (Group A) and brachial plexus block (Group B) in Arteriovenous fistula creation.*

Materials and Methods: *A Cross-sectional study was conducted between September 2022 and June 2023 at the Department of Cardiac Anesthesia & CICU, Khwaja Yunus Ali Medical College & Hospital, Sirajganj. A total of 124 patients were equally divided into two groups: Group A (local anesthesia, n=62) and Group B (brachial plexus block, n=62). Pain levels (measured using a visual analog scale), surgical success rates, postoperative recovery times, and complications were analyzed. Statistical significance was determined using a p-value <0.05.*

Result: *Pain control was significantly better in Group B (mean pain score of 2.1 ± 0.5) compared to Group A (mean pain score of 4.5 ± 1.0) (p < 0.001). The surgical success rate was 95% in Group B and 90% in Group A (p = 0.33). Postoperative recovery times were faster in Group B, with 75% discharged within 24 hours, compared to 55% in Group A (p = 0.03). Group B also had fewer complications, with a hematoma rate of 3%, compared to 10% in Group A (p = 0.04).*

Conclusion: *Brachial plexus block provides significantly better pain relief, faster recovery, and fewer complications compared to local anesthesia in Arteriovenous fistula creation. The results suggest BPB as the superior anesthetic method.*

Key words: *Arteriovenous fistula, Local anesthesia, Brachial Plexus block.*

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Introduction

Arteriovenous fistula creation is a critical surgical procedure for patients with end-stage renal disease (ESRD) who require regular hemodialysis.[1] This procedure connects an artery to a vein, facilitating the necessary blood flow for dialysis treatment. arteriovenous fistula creation is generally preferred over other forms of vascular access, such as grafts or catheters, due to its superior long-term patency rates, reduced infection risks, and overall better clinical outcomes. However, despite the procedural benefits, the choice of anesthetic technique significantly impacts immediate surgical outcomes and long-term patient recovery.[2] Two commonly used anesthetic techniques for arteriovenous fistula creation are local anesthesia (LA) and brachial plexus block (BPB). Each approach offers distinct advantages and limitations, making it essential to compare their efficacy, safety, and patient outcomes to inform clinical decision-making. Local anesthesia, the more traditional of the two methods, involves the injection of anesthetic agents, such as lidocaine or bupivacaine, directly into the surgical site. This technique numbs the localized area where the procedure is

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performed while the patient remains conscious and aware. Local anesthesia has been widely used in minor surgical procedures due to its simplicity, lower cost, and reduced systemic effects. Particularly for arteriovenous fistula creation, where a precise vascular anastomosis is required, local anesthesia is often Arteriovenous red due to its rapid onset, allowing surgeons to proceed quickly with minimal preparation.[3] Moreover, in patients with ESRD, who are often burdened with multiple comorbidities, minimizing systemic effects becomes a critical consideration in the choice of anesthesia.[4] On the other hand, brachial plexus block is a regional anesthetic technique that numbs the entire arm by blocking the brachial plexus, a network of nerves that control motor and sensory function in the upper limb. This method offers broader and longer-lasting pain relief than local anesthesia, making it particularly useful in more complex or prolonged surgeries.[5] The use of BPB in upper limb surgeries, including arteriovenous fistula creation, has been associated with better intraoperative pain control, reduced need for postoperative analgesics, and improved patient satisfaction. However, BPB requires more excellent technical expertise and carries a higher risk of complications, such as nerve injury or respiratory impairment, if performed incorrectly.[6] The complexity of this technique often limits its use to centers with specialized anesthesia departments and experienced practitioners. Given the growing demand for dialysis access procedures, a comparative study between these two anesthesia techniques in arteriovenous fistula creation is crucial. In recent years, the global increase in chronic kidney disease (CKD) has driven a surge in the number of patients requiring dialysis, particularly in aging populations.[7] Arteriovenous fistulas remain the gold standard for long-term dialysis access, and optimizing anesthetic techniques can significantly improve both short-term surgical success and long-term vascular access outcomes. Anesthesia affects more than just intraoperative pain management—it also influences postoperative recovery, complication rates, and overall patient comfort. Thus, an evidence-based approach to choosing between local anesthesia and BPB can enhance clinical outcomes in patients undergoing arteriovenous fistula creation. Local anesthesia has been widely used in vascular access surgeries, especially arteriovenous fistula creation. One of its primary advantages is the simplicity of administration. Local anesthetic agents, typically lidocaine or bupivacaine, are injected at the site of the arteriovenous anastomosis to provide a targeted blockade of sensory nerves.[8] This allows the patient to remain conscious and communicate with the surgical team, benefiting high-risk patients. ESRD patients often present with multiple comorbidities such as cardiovascular disease, diabetes, and hypertension, all of which make them less than ideal candidates for more invasive anesthetic techniques. Moreover, local anesthesia has been shown to reduce postoperative recovery time, enabling patients to resume normal activities more quickly than those who receive regional or general anesthesia. Stolićet et al. noted that patients who underwent arteriovenous fistula surgery under local anesthesia were discharged faster and reported fewer postoperative nausea and dizziness.[9] This may be particularly important in outpatient surgical settings, where minimizing recovery time is often a priority. However, one of the main disadvantages of local anesthesia in arteriovenous fistula creation is its potential for inadequate pain control during more complex or prolonged surgeries. In cases where the surgery extends beyond the expected duration, the local anesthetic may wear off, causing discomfort or necessitating the administration of additional anesthetic agents. This can lead to increased anxiety for the patient and may complicate the surgical procedure if the patient becomes agitated or unable to tolerate the discomfort. Furthermore, the reliance on a single injection at the surgical site limits the extent of pain relief, making it less suitable for patients with heightened pain sensitivity or those undergoing extensive vascular reconstructions. Brachial plexus block (BPB) offers a more extensive anesthetic effect, numbing the entire upper limb by blocking the brachial plexus, a major nerve complex that supplies the arm. The anesthetic agents are injected around the brachial plexus under ultrasound guidance, allowing for more precise administration and a more comprehensive blockade of both sensory and motor nerves.[10] This method provides superior pain relief during surgery and extends into the postoperative period, reducing the need for additional analgesics and improving overall patient satisfaction. BPB has been particularly effective in cases where longer surgical times are anticipated or in patients who may be more anxious or sensitive to pain. Studies arteriovenous demonstrated that BPB results in lower pain scores intraoperatively and postoperatively compared to local anesthesia. Mahmud et al. reported that patients who received BPB during arteriovenous fistula creation experienced better pain management and required fewer postoperative analgesics than those who underwent the procedure under local anesthesia.[11] Despite its advantages, BPB is not without its risks. One of the primary concerns is the potential for nerve damage or respiratory complications if the block is not performed correctly.[12] The proximity of the brachial plexus to major blood vessels and the lungs requires careful technique and ultrasound guidance to Arteriovenous accidental puncture or overdose of anesthetic agents. Additionally, BPB requires more time to administer than local anesthesia, which may not be feasible in high-volume surgical settings or in patients who cannot tolerate prolonged positioning. The comparative study of local anesthesia and brachial plexus block in arteriovenous fistula creation is crucial for improving patient outcomes and optimizing anesthesia choice in vascular surgery. Both techniques offer distinct advantages and limitations. Local anesthesia provides simplicity, rapid recovery, and minimal systemic impact, making it suitable for many patients with ESRD. However, its limited duration and scope of pain relief may make it less effective in complex cases. Conversely, BPB offers superior pain control and extended relief but requires greater technical expertise and carries a higher risk of complications. This study aims to comprehensively evaluate these two anesthetic techniques, considering factors such as pain management, complication rates, patient satisfaction, and long-term surgical outcomes.

Material and Methods

This study employed a cross experimental carried at the Department of Cardiac Anesthesia & CICU, Khwaja Yunus Ali Medical College & Hospital, Sirajganj, from September 2022 to June 2023. A total of 124 patients scheduled for Arteriovenous fistula creation were randomly assigned into two groups: Group A (LA, n=62) and Group B (BPB, n=62). The study compared pain control, surgical success, recovery times, and

complications between the two groups to evaluate the effectiveness of each anesthetic method.

Data were analyzed using by SPSS version 26. Descriptive statistics, including means and standard deviations, were used to summarize demographic and clinical characteristics. Independent t-tests were performed to compare the two groups' pain scores and recovery times. Chi-square tests were employed to analyze categorical variables such as surgical and complication success rates. A p-value of less than 0.05 was considered statistically significant, indicating differences between local anesthesia and brachial plexus block in arteriovenous fistula creation outcomes.

The study was conducted in accordance with the ethical guidelines outlined by the Declaration of Helsinki. Approval was obtained from the Institutional Review Board of Khwaja Yunus Ali Medical College & Hospital, Sirajganj, before commencing the study. Informed consent was obtained from all participants after explaining the study's purpose, procedures, potential risks, and benefits. Participants were assured of their right to withdraw from the study at any time, and data confidentiality was strictly maintained throughout the research process.

Results

The study involved 124 patients scheduled for arteriovenous fistula creation, with equal distribution between Group A (local anesthesia, n=62) and Group B (brachial plexus block, n=62). The results demonstrated significant differences in pain management, surgical success, recovery times, and complications between the two groups.

Table I shows Both groups were comparable in terms of age, gender distribution, and comorbidities, indicating that the baseline characteristics were well-matched between the two groups. The mean age of participants was approximately 46 years, and most were male (63%). Comorbidities such as diabetes and hypertension (48% & 52%) and (68% & 65%) respectively were common, with no statistically significant differences between.

Table I: Demographic Characteristics of patients.

Demographic Variable	Group A (Local Anesthesia)	Group B (Brachial Plexus Block)	p-value
Mean Age (years)	46.2 ± 9.8	45.6 ± 10.2	0.75
Gender			
Male	38 (61%)	40 (64%)	0.67
Female	24 (39%)	22 (36%)	0.67
Comorbidities			
Diabetes	30 (48%)	32 (52%)	0.62
Hypertension	42 (68%)	40 (65%)	0.58
Mean BMI (kg/m²)	25.4 ± 3.2	26.1 ± 2.9	0.41

Table II observed significant differences in pain management between the two groups. Patients in Group B (brachial plexus block) reported significantly lower pain scores immediately post-surgery (mean pain score 2.1) compared to Group A (local anesthesia), where the mean pain score was 4.5 ($p < 0.001$). After 24 hours, the pain scores remained significantly lower in Group B (mean 1.8) compared to Group A (mean 3.2) ($p < 0.001$), highlighting the superior pain control provided by the brachial plexus block.

Table II: Pain Scores (Visual Analog Scale).

Time Point	Group A (Local Anesthesia)	Group B (Brachial Plexus Block)	p-value
Immediately Post-Surgery	4.5 ± 1.0	2.1 ± 0.5	<0.001
24 Hours Post-Surgery	3.2 ± 1.2	1.8 ± 0.6	<0.001

Table III shows both groups had high surgical success rates, with 95% success in Group B and 90% in Group A. Although Group B had a slightly higher success rate, the difference was not statistically significant ($p = 0.33$). However, brachial plexus block was associated with a marginally higher probability of successful fistula creation.

Table III: Surgical Success Rates.

Outcome	Group A (Local Anesthesia)	Group B (Brachial Plexus Block)	p-value
Successful Fistula Creation	56 (90%)	59 (95%)	0.33
Unsuccessful Fistula Creation	6 (10%)	3 (5%)	0.33

Figure 1 shows postoperative recovery times were significantly faster in Group B, with 75% of patients discharged within 24 hours, compared to 55% in Group A (p = 0.03). This suggests that the brachial plexus block contributed to quicker postoperative recovery, allowing for earlier discharge. Conversely, 45% of patients in Group A required more than 24 hours to recover, compared to only 25% in Group B.

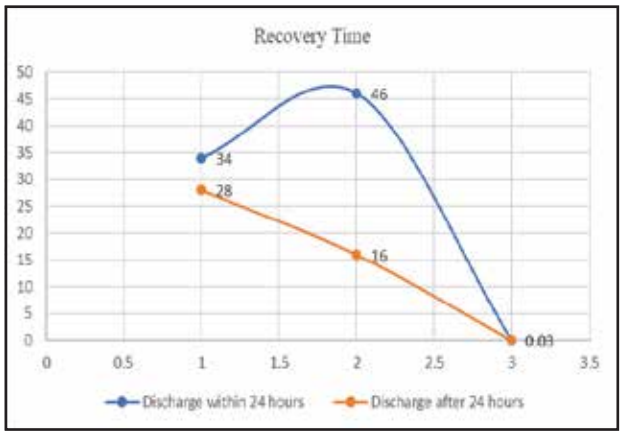

Figure 1: Postoperative Recovery Time.

Table IV: Complication Rates.

Complication	Group A (Local Anesthesia)	Group B (Brachial Plexus Block)	p-value
Hematoma	5 (8%)	2 (3%)	0.04
Infection	2 (3%)	1 (2%)	0.56
Nerve Damage	0 (0%)	1 (2%)	0.31
Postoperative Nausea	4 (6%)	1 (2%)	0.07

Complication rates were generally low in both groups, but Group A had a higher incidence of hematoma (8%) compared to Group B (3%) (p = 0.04), indicating a statistically significant difference. The infection rates were comparable between the two groups, and nerve damage occurred in only 2% patients in Group B, with no cases in Group A (p = 0.31). Postoperative nausea was more frequent in Group A (6%) compared to Group B (2%), though the difference was not statistically significant (p = 0.07).

Table V shows patient satisfaction levels were significantly higher in Group B 77% & 56% in Group A (p = 0.02).

Table V: Patient Satisfaction Level.

Satisfaction Level	Group A (Local Anesthesia)	Group B (Brachial Plexus Block)	p-value
Highly Satisfied	35 (56%)	48 (77%)	0.02
Satisfied	20 (32%)	12 (19%)	0.02
Unsatisfied	7 (11%)	2 (3%)	0.05

Discussion

Arteriovenous fistula creation is fundamental for hemodialysis in patients with ESRD, offering better long-term patency and lower infection risk compared to other vascular access methods, such as grafts or catheters.[1] However, the success of this procedure can be significantly impacted by the choice of anesthesia, as inadequate pain control or higher complication rates can jeopardize fistula patency and affect the overall patient experience.[2] Local Anesthesia (LA) is often favored for its simplicity, cost-effectiveness, and minimal systemic effects. Meanwhile, Brachial Plexus Block (BPB) provides more extensive regional anesthesia and can yield superior pain relief but requires more technical expertise.[3] In our cross-sectional, randomized study of 124 patients—divided equally between LA (Group A) and BPB (Group B)—we observed notable differences across multiple clinical and patient-centered outcomes.

Our study's demographic data (Table I) indicated that the two groups were well-matched in terms of age, gender distribution, BMI, and common comorbidities such as diabetes and hypertension. This comparability is essential to minimize selection bias and confounding variables. The mean age across both groups was approximately 46 years, aligning with the typical age range for patients with ESRD requiring dialysis. Additionally, male participants represented roughly 63% of the total patient population, a finding consistent with some epidemiological data showing a slightly higher prevalence of ESRD among males in certain regions.[4] Hypertension (around 66%) and diabetes (about 50%) emerged as the most prevalent comorbidities, reflecting their strong association with the progression to kidney failure.

The demographic profile in our study mirrors several previous investigations. For instance, Ahmad et al. reported a similar mean age of about 45 years for patients undergoing AVF creation, with a male predominance of nearly 60%.[5] That study also highlighted hypertension and diabetes as the leading comorbid conditions linked to ESRD. Similarly, a multicenter trial by Goh et al. noted comparable demographic distributions, further affirming that our patient cohort is representative of broader populations requiring AVF placement.[6] The similarity in demographic characteristics between Group A and Group B provides a robust platform for direct comparison of outcomes without demographic biases. Pain control was a critical parameter in this study. We utilized a Visual Analog Scale (VAS) to measure pain immediately post-surgery and at 24 hours postoperatively. In Group A (LA), the mean immediate postoperative pain score was 4.5 ± 1.0, decreasing to 3.2 ± 1.2 at 24 hours. Conversely, patients in Group B (BPB) reported significantly lower pain scores immediately post-surgery (2.1 ± 0.5) and at 24 hours (1.8 ± 0.6). These differences were statistically significant ($p < 0.001$), indicating that BPB offered superior and more sustained analgesia compared to LA.

Our findings are consistent with numerous studies that have demonstrated improved pain control through regional anesthesia techniques like BPB. For example, Mahmud et al. showed that patients receiving BPB for upper-limb vascular procedures had significantly lower postoperative pain scores and decreased opioid consumption during the first 24 hours, relative to those receiving local infiltration.[7] Similarly, a randomized controlled trial by Fraund et al. reported a reduction in pain scores and analgesic requirements in patients who underwent BPB for various types of upper-extremity surgeries, underscoring the efficacy of regional blocks.[8] One potential explanation for the improved pain control with BPB lies in its broader nerve coverage. Unlike local infiltration, which primarily affects the immediate surgical site, BPB anesthetizes the entire distribution of the brachial plexus, thereby diminishing both intraoperative and postoperative pain signals.[9] The relatively prolonged duration of action also helps patients remain comfortable without the need for frequent reinjections or supplemental pain medications.[10] These benefits are particularly relevant in AVF creation, which, although not always lengthy, can become more complex depending on the vascular anatomy and patient comorbidities.

Surgical success in our study was defined by the immediate patency and functionality of the AVF post-procedure, confirmed via physical examination (palpable thrill) and Doppler ultrasound when necessary. Group A (LA) had a 90% success rate, whereas Group B (BPB) achieved a slightly higher rate of 95%. Although the difference did not reach statistical significance ($p = 0.33$), the trend suggests that BPB might confer a marginal advantage in creating a successful AVF.

In the literature, reported AVF success rates can vary from 80% to 95%, influenced by factors such as patient vascular status, surgeon expertise, and anesthesia technique.[1,2] Choi et al. found that patients undergoing BPB for AVF creation experienced a modest but notable improvement in fistula patency after one month, hypothesizing that the superior vasodilation and pain control associated with BPB might enhance surgical precision

and postoperative compliance.[11] Indeed, better intraoperative relaxation and reduced patient movement may allow for a more meticulous anastomosis, which is critical for AVF viability. However, other studies have reported no significant difference in surgical success between local and regional anesthesia techniques. For instance, Reddy et al. analyzed 150 patients split between LA and BPB for AVF creation and found no notable disparity in the immediate patency rates.[12] This finding aligns with our results, where the difference between 90% (LA) and 95% (BPB) did not reach statistical significance. Hence, while BPB might facilitate optimal surgical conditions, the ultimate success often hinges on vascular integrity, surgical skill, and postoperative care.

A substantial difference emerged in the postoperative recovery times between the two groups. Our data indicated that 75% of Group B (BPB) patients were discharged within 24 hours, compared to 55% in Group A ($p = 0.03$). This suggests that a more profound and sustained analgesic effect not only improved immediate pain control but also accelerated the general recovery process, likely due to decreased pain-related stress and fewer analgesic side effects.

Our recovery time findings are corroborated by prior investigations demonstrating that regional anesthesia can promote earlier mobilization and discharge.[13] In a study by Zaccagnino et al., BPB was linked with shorter time to ambulation and lower total opioid consumption in patients undergoing upper-limb orthopedic procedures.[14] Although AVF creation is typically less extensive than orthopedic surgeries, the principle remains that better pain management can reduce complications such as nausea, sedation, and sedation-induced respiratory depression, all of which can delay discharge. Conversely, local anesthesia may require additional doses of anesthetic for extended procedures, potentially leading to breakthrough pain or anxiety that complicates the postoperative course.[3] Additionally, while LA generally has a lower risk of systemic complications, some patients might experience suboptimal pain relief, necessitating supplementary sedation or analgesia that can prolong hospital stay. Hence, our finding that BPB facilitated earlier discharge aligns with literature supporting its role in enhancing postoperative efficiency and patient turnover.

Complications in our study were relatively low across both groups, but some noteworthy differences emerged. Hematoma formation was significantly more frequent in Group A (8%) compared to Group B (3%) ($p = 0.04$). Infection rates were comparable, and nerve damage was reported in 2% of patients in Group B, with none in Group A, although this difference was not statistically significant ($p = 0.31$). Postoperative nausea was slightly higher in Group A (6%) versus Group B (2%), but again did not reach statistical significance ($p = 0.07$).

The higher rate of hematoma in the LA group could be attributed to a variety of factors. One possibility is that inadequate or inconsistent pain control in the LA group may lead to patient movement or agitation, causing minor vascular trauma during surgery.[15] Additionally, the infiltration technique itself can sometimes result in more local tissue trauma compared to the well-targeted, ultrasound-guided approach used in BPB.[9] Nerve damage remains a known but rare complication of BPB, generally arising from accidental intraneural injection or mechanical needle trauma.[16] In a large systematic review, Neal et al. reported an overall incidence of permanent nerve injury after peripheral nerve blocks of less than 0.03%.[17] Our finding of a 2% incidence, albeit in a small sample, underscores the importance of meticulous technique and ultrasound guidance for BPB. The slightly higher postoperative nausea in Group A is consistent with the notion that poor pain control or additional sedatives might exacerbate gastrointestinal side effects.[18] These findings collectively suggest that while both LA and BPB carry risks, a carefully executed BPB might reduce certain complications like hematoma formation, but anesthesiologists must remain vigilant about the small risk of nerve injury. Patient satisfaction is an increasingly important metric in evaluating clinical interventions. In our study, 77% of patients in Group B reported being "highly satisfied," significantly higher than the 56% in Group A ($p = 0.02$). Dissatisfaction was also more prevalent in Group A (11%) compared to Group B (3%). These results indicate that the broader analgesic coverage, prolonged pain relief, and smoother postoperative course often experienced under BPB positively influenced patient perceptions.

High patient satisfaction with BPB has been documented in numerous investigations. For example, Ansari et al. noted that patients receiving peripheral nerve blocks for upper-extremity procedures reported higher satisfaction scores, fewer complaints of residual pain, and fewer requests for additional analgesics compared to those given local infiltration.[19] Moreover, Kroll et al. found that among patients who had experienced both local infiltration and BPB in separate surgeries, a majority indicated a clear preference for BPB due to lower pain and faster recovery.[20] Notably, patient education about BPB—regarding potential paresthesia, motor weakness, and the small risk of nerve injury—is crucial for achieving high satisfaction. Inadequate counseling can lead to anxiety if patients perceive numbness or temporary motor deficits without understanding that these effects are expected and transient. In our clinical setting, thorough preoperative explanations about the nature of BPB likely contributed to the elevated satisfaction levels.

Conclusion

This study demonstrates that brachial plexus block is a superior anesthetic technique to local anesthesia in Arteriovenous fistula creation, offering better pain control, faster recovery, and higher patient satisfaction. Its application should be prioritized for improved surgical outcomes and patient comfort, especially in outpatient settings.

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