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ORIGINAL RESEARCH

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Effects of popliteal nerve blocks on postoperative pain management in fibula-free flap patients for head and neck cancer reconstruction

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Abstract

Objective: To determine if performing popliteal nerve blocks preoperatively in patients undergoing fibula-free flap surgery for head and neck cancer reconstruction decreases subjective pain scores decreases narcotic usage, and improves mobility in the acute postoperative time period when compared to alternative pain control regimens.

Methods: A retrospective review of the medical records of patients who underwent fibula-free flap reconstruction for head and neck malignancy at SUNY Upstate Medical University during the time period from 2015 to 2022 was performed. Collected data consisted of patient demographics and clinical characteristics, postoperative pain management modalities, reported pain scores, postoperative narcotic usage, length of hospital stay, and days until out of bed without personal assistance.

Results: A total of 40 patients were included in the study. The average reported pain score was reduced in the nerve block group compared to the control group (1.7 vs. 4.0, p-value = .003). Similarly, the average maximum reported pain score was also lower in patients who received a nerve block (3.4 vs. 6.9, p-value = .002). None of the patients who received popliteal nerve blocks required pain control with parenteral narcotics postoperatively, whereas 82.9% of patients without a nerve block did. Patients who received a popliteal nerve block consumed an average of 103.5 MME, whereas those who did not receive a block consumed an average of 523.0 MME. No statistically significant difference was found between the groups regarding time from surgery until transfer without personal assistance or length of hospital stay.

Conclusion: Popliteal nerve blocks can reduce postoperative pain in patients undergoing fibula-free flap reconstruction for head and neck cancer.

KEYWORDS

fibula free flaps, head and neck cancer, pain management, peripheral nerve block, postoperative rehabilitation

1 | INTRODUCTION

Head and neck cancer accounts for roughly 4% of all cancers in the United States annually.[1] Although reconstruction with free tissue transfers following surgically resected locally advanced head and neck cancers is commonly implemented, this modality is associated with significant pain from both the resection and donor sites. The inability to obtain postoperative pain control can potentially complicate care and create additional morbidity for the patient. Postoperative pain after free flap reconstruction has traditionally been treated with both opioid and nonopioid medications through both enteral and intravenous means.[2] However, despite regular usage, these pain management strategies have commonly led to suboptimal pain control.[2] Moreover, regular opioid usage has side effects, including nausea, vomiting, constipation, and—most concerningly—the potential for addiction and chronic reliance on pain control.[3] Each of these side effects may interfere with patients' recoveries and cause a decline in their quality of life.

In an effort to improve pain management during the postoperative time period, recent studies have evaluated the utility of peripheral anesthetic blocks and found that they can significantly reduce postoperative pain.[4] In particular, the success of popliteal nerve blocks for pain control after surgery involving the lower extremity has been observed in the field of orthopedics.[4] Popliteal nerve blocks have, therefore, been implemented following fibula-free flap reconstruction in recent studies. These studies have had mixed results in regards to pain control and opioid consumption postoperatively, and many do not evaluate the effects that popliteal nerve blocks have on other measures for fibular free flap patients, such as hospital length of stay and days postoperatively until independent ambulation.[5–7]

The primary aim of this study was to analyze if the use of popliteal nerve blocks would lead to decreased post operative pain scores and opioid usage. The secondary aims included the time until patients were able to ambulate independently and hospital length of stay in those who received popliteal nerve blocks compared to those who did not.

2 | METHODS

2.1 | Study Design

Data for patients with head and neck cancer who underwent fibula-free flap reconstruction at Upstate Medical University from 2015 to 2022 were obtained from the electronic medical record system for retrospective review. This study was IRB-exempt at our institution based on the lack of patient identifiers.

2.2 | Variables

The primary independent variable in this analysis was the administration of a popliteal nerve block. Our primary dependent variable was the average postoperative pain score for the first 7 days after surgery. The scores were based on the validated Numerated Rating Scale (NRS) pain assessment tool and were obtained by the nursing staff when obtaining vital signs as well as prior to pain medication administration.[8] The values were reported on a scale from 0 to 10 with increasing severity.

Several covariates were included in the analysis to assess for attenuation of the relationship between administration of the nerve block and postoperative pain. We collected patient demographic data as well as HNC primary site and staging. Many covariates were included as binary variables. Sex was defined as either male or female. Report of postoperative nausea or vomiting was included as yes or no. Finally, pain management with patient-controlled analgesia was included as yes or no. Covariates included as continuous variables included maximum reported pain, mean reported pain, length of stay in days, days until out of bed unassisted, morphine milliequivalents (MMEs) over the first 7 days postoperatively, and age in years.

The popliteal sciatic nerve block was performed by the regional anesthesia services with ultrasound guidance using an in-plane needle technique. Patients were supine with the knee placed in 30-degree flexion using a foam block under the ipsilateral leg. The ultrasound was used to scan and identify where the sciatic nerve divided into the common peroneal and tibial nerves. A 20 mL bolus of 0.25% ropivacaine was administered once appropriate needle positioning was noted and the spread of the local anesthetic within the epineural sheath was visualized. A catheter was then threaded through the needle and left in place; catheter placement was once again confirmed with ultrasound to identify the proper positioning of the catheter within the sheath. An infusion of 0.2% ropivacaine at a rate of 6 mL/h was used. The acute pain service continued to evaluate these patients, whereas the peripheral nerve block catheter remained in place to assess for any side effects and adequate analgesia. These peripheral nerve block catheters remained in place between 5 and 6 days. Contraindications to the placement of popliteal nerve blocks included reported allergy to local anesthetic, active soft tissue infection in the region, and patient refusal.

2.3 | DATA ANALYSIS

Statistical analyses were conducted using IBM SPSS Statistics version 28. Bivariate tests performed included chi-square and independent samples *t*-tests. The above covariates were then used to generate a multiple linear regression model to assess for the influence of popliteal nerve blocks on mean postoperative pain scores.

3 | RESULTS

3.1 | Sample characteristics

Of the 40 patients included in this sample, 12.5% had a popliteal nerve block administered. Within the sample, 65% of patients

TABLE 1 Sample characteristics.

	N (%)
Nerve block administered	
No	35 (87.5)
Yes	5 (12.5)
Sex	
Male	26 (65.0)
Female	14 (35.0)
Nausea or vomiting reported	
No	30 (75.0)
Yes	10 (25.0)
Patient controlled analgesia	
No	33 (82.5)
Yes	7 (17.5)

TABLE 2 Sample characteristics.

	Mean (SD)
Maximum reported pain	6.4 (2.5)
Mean reported pain	3.8 (1.7)
Length of stay in days	12.9 (7.8)
Days until out of bed unassisted	8.3 (7.8)
Morphine milliequivalents[a]	470.6 (470.5)
Age in years	59.2 (10.2)

[a]Over the first 7 days postoperatively.

identified as male, and the remaining 35% identified as female. Only 17.5% of patients were managed with patient-controlled analgesia (PCA). None of the patients with a popliteal nerve block needed a PCA pump (Table 1). Overall, patients reported a mean postoperative pain score of 3.8, with a mean maximum reported pain score of 6.4. On average, patients stayed in the hospital for 12.9 days and took 8.3 days to get out of bed unassisted. The mean MME utilized over the first 7 days postoperatively was 470.6. The mean MME varied dramatically, with some patients utilizing 0 MME, whereas others utilized over 2100 MME. The mean age of patients in this sample was 59.2 years (Table 2).

None of the patients who received popliteal nerve blocks required pain control with parenteral narcotics postoperatively, whereas 82.9% of patients without a nerve block did. Patients who received a popliteal nerve block consumed an average of 103.5 MME, whereas those who did not receive a block consumed an average of 523.0 MME. However, this was not found to be a statistically significant difference, $t_{(38)} = 1.9$, $p = .061$.

We did not encounter contraindications to the placement of a popliteal nerve block, and none of the patients had been prescribed narcotics greater than 6 weeks prior to surgery. None of the patients within our experimental cohort experienced complications that could be directly attributed to the popliteal nerve block, such as skin irritation or local infection, deep venous thrombosis, hematoma formation, mechanical falls, persistent neuropathy, or dysesthesia.

3.2 | Bivariate statistics

No significant associations between the placement of popliteal nerve block with sex, reports of nausea or vomiting, or use of patient-controlled analgesia were identified. However, patients who had a popliteal nerve block had a mean maximum reported pain score of 3.4, which was significantly lower than their counterparts who did not receive a popliteal nerve block, who reported a maximum mean pain score of 6.9, $t_{(38)} = 3.3$, $p = .002$. Correspondingly, patients who received a popliteal nerve block reported a lower overall mean pain score than their counterparts who did not receive a block, 1.7 and 4.0, respectively. The difference in mean pain score between the two groups was also statistically significant, $t_{(38)} = 3.2$, $p = .003$. No significant associations were identified between the placement of the popliteal nerve block and the length of stay, days until out of bed unassisted, MME, or age. The pathologies associated with an extended length of stay (defined by one standard deviation above the mean) in six patients in the control group included pulmonary emboli, a urinary tract infection, orocutaneous fistulas (2), and cardiomyopathy. In the experimental group, one patient had an extended length of stay secondary to pulmonary edema postoperatively (Tables 3 and 4).

3.3 | Multivariate statistics

A linear regression model was developed to assess the impact of popliteal nerve block on mean postoperative pain scores. The linear regression model was statistically significant, $F_{(7)} = 3.46$, $p = .007$. The covariates listed in Table 5 explain 43.1% of the variation in mean postoperative pain, adjusted $R^2 = 0.431$.

When controlling for the covariates listed in Table 5, those who had a popliteal nerve block placed reported on average a 2.026 point significantly lower mean postoperative pain score when compared to their counterparts that did not have popliteal nerve blocks placed, ($b = -2.026$, 95% CI -3.50, -0.557, $p = .008$). Conversely, for every increase in MME administered, patients reported a 0.002 higher mean postoperative pain rating ($b = 0.002$, 95% CI 0.000, 0.003, $p = .01$).

4 | DISCUSSION

Our results demonstrate the positive impact that popliteal nerve blocks have on postoperative pain among patients undergoing fibular free flap for head and neck cancer reconstruction. Patients with popliteal nerve blocks reported both lower mean pain scores and reduced maximum pain scores when compared to patients who received a standard pain control regimen. Peripheral nerve blocks were not associated with complications such as increased hospital length of stay or increased time until unassisted ambulation postoperatively. Although

TABLE 3 Chi-square analysis of clinical covariates by nerve block.

	Popliteal nerve block	No popliteal nerve block	χ^2	*p*-value
Sex				
Male	3 (60.0)	23 (65.7)	0.06	.80
Female	2 (40.0)	12 (34.3)		
Nausea or vomiting reported				
No	4 (80.0)	26 (74.3)	0.08	.78
Yes	1 (20.0)	9 (25.7)		
Patient controlled analgesia				
No	5 (100.0)	28 (80.0)	1.2	.27
Yes	0 (0.0)	7 (20.0)		

TABLE 4 Independent samples *t*-test analysis of clinical covariates by nerve block.

	Popliteal nerve block		No popliteal nerve block				
	Mean	SD	Mean	SD	$t_{(38)}$	*p*-value	Cohen's *d*
Maximum reported pain	3.4	1.7	6.9	2.3	3.3	**.002**	2.2
Mean reported pain	1.7	1.4	4.0	1.5	3.2	**.003**	1.5
Length of stay	8.0	1.9	13.6	8.1	1.5	.14	7.7
Days until out of bed unassisted	5.6	3.5	8.7	6.0	1.1	.27	5.8
Morphine milligram equivalents	103.5	171.1	523.0	477.3	1.9	.061	454.9
Age	57.6	13.3	59.4	9.9	0.36	.72	10.3

Note: Bold indicates statistically significant *p* value of <0.05.

TABLE 5 Multiple linear regression assessing the influence of study covariates on mean postoperative pain.

	B	95% CI	*p*-value
Nerve block placed			
No	Reference	Reference	Reference
Yes	−2.026	−3.50, −0.557	**.008**
Sex			
Male	Reference	Reference	Reference
Female	−0.077	−1.06, 0.905	.87
Patient controlled analgesia			
No	Reference	Reference	Reference
Yes	−0.070	−1.39, 1.25	.92
Age	−0.014	−0.063, 0.035	.56
Length of stay	−0.083	−0.171, 0.004	.06
Days until out of bed unassisted	0.046	−0.066, 0.157	.41
MME	0.002	0.000, 0.003	**.01**

Note: Bold indicates statistically significant *p* value of <0.05.
Abbreviation: MME, morphine milliequivalents.

there appeared to be a large difference between MME consumed in the first 7 days postoperatively in the popliteal nerve block group compared to the control (103.5 vs. 523.0 MME), this was not a statistically significant finding. We predict that a larger sample size would help to demonstrate the true association between the administration of popliteal nerve blocks and decreased opioid usage postoperatively.

The efficacy of regional anesthesia in the head and neck cancer population following reconstructive surgery has had mixed results in several recent studies in the literature. A 2018 randomized control study by Zhang et al.[6] used femoral and common peroneal nerve blocks in 40 patients undergoing fibular free flap reconstruction. A single injection of ropivacaine was the anesthetic used for each block, whereas the patients in our study received a continuous infusion of ropivacaine via a peripheral nerve catheter in our study. Similar to our results for the first 7 days postoperatively, the authors noted improved pain severity scores within the first 12 h after surgery in

patients with nerve blocks. However, there was no significant difference in pain scores at 24 or 48 h postoperatively. Zhang et al. did find a decreased opioid consumption in the nerve block group within the first 48 h postoperatively when compared to the control group.

Persson et al.[7] conducted another randomized control trial to investigate the utility of popliteal nerve blocks alone. Patients received a continuous infusion of levobupivacaine and ropivacaine in a popliteal block with an indwelling catheter. As in our present study, the Numerated Rating Scale (NRS) was used, and postoperative pain and opioid consumption were analyzed for the first postoperative week. Both decreased pain severity scores and opioid consumption were significantly reduced in the local anesthetic group compared to the placebo group. Finally, and as our study also found, Persson et al. did not reveal impaired early postoperative mobility or other complications, such as nausea or vomiting, in the experimental group.

Interestingly, another randomized control trial using ropivacaine as a popliteal nerve block in 56 fibula-free flap patients did not demonstrate improved pain scores after 1 day following the operation and also did not find differences in narcotic usage between the groups.[4] Notably, the nerve block—continuous infusion of ropivacaine through a popliteal catheter placed intraoperatively—was removed at 48 h postoperatively, compared to our study where patients received continued infusion for the first 5–6 days after surgery. Local infusions of ropivacaine at the fibula donor site were also not found to help with pain control or decrease narcotic usage in Roof et al.[5] A total of 8 fibula-free flap patients were involved in this randomized control trial, 4 in each study arm. In Roof et al., the pain catheters were placed at the superior aspect within the subfascial plane of the donor site by the surgeon intraoperatively to deliver a continuous infusion of ropivacaine (or saline in the control group). The authors concluded that the lack of benefit may have been due in part secondary to the delivery of local anesthetic to the compartment, which may not have been optimal either due to sensory nerve disruption secondary to the surgical procedure versus not being able to provide adequate local anesthetic volume.

Taking the results of these recent studies together with our review, there is evidence of variability regarding the timing and placement of the regional anesthesia block. In both our study and Persson et al., indwelling popliteal catheters were placed during the preoperative time period under ultrasound guidance, and similar prolonged postoperative pain control benefit was appreciated. Ultrasound-guided peripheral nerve block catheters provide a myriad of benefits compared to other types of analgesic techniques. Ultrasound guidance facilitates direct visualization of nerves and vascular structures, avoidance of intraneuronal injection, and reduction of local anesthetic dose, thereby improving block quality and safety.[9] Furthermore, the superior analgesia afforded by peripheral nerve blocks in contrast to systemic narcotics results in higher patient satisfaction and mobility while also limiting the negative effects of opioids, including respiratory depression, pruritis, nausea, and sedation.[10] These catheters can be placed preoperatively, allowing for preventive analgesia and preventing subsequent central sensitization as a result of inflammatory injury perioperatively.[11] By preventing the transmission of pain signals proximally to the central nervous system, there is less central and peripheral sensitization, leading to a lower likelihood of the development of hyperalgesia and chronic pain.[12] In addition, the longer duration and titratable nature of analgesia provided via peripheral nerve block catheters offer a significant advantage over single-shot peripheral nerve blocks or local infiltration.[9,13]

As discussed, a small experimental cohort sample size was a limitation of the current study. In addition, due to the retrospective nature of the study, the data collected from the electronic medical record system is susceptible to inaccuracies and reporting errors. Another limitation to be considered is the reliance on self-reported pain scores. Although there is inherent variability in subjective pain assessments, the Numerated Rating Scale (NRS), which is used at our institution, has been validated and found to be sensitive and reliable in the literature.[8]

The results of this study demonstrate peripheral nerve blocks may offer patients undergoing fibula-free flap reconstruction an effective pain management option whereas potentially reducing narcotic usage during the postoperative time period. Additional studies investigating the utility of peripheral nerve blocks in reconstructive surgery for head and neck cancer—such as brachial plexus blocks for radial forearm free flaps—may lead to significant improvements in the postoperative course for these patients.

5 | CONCLUSION

In the present study, preoperative placement of popliteal nerve blocks was seen to reduce postoperative pain in head and neck cancer patients undergoing fibular-free flap reconstruction.

CONFLICT OF INTEREST STATEMENT

The authors have no financial disclosures or conflict of interest.

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