

# Postoperative Hematoma-induced Vasospasm after Sarcoma Reconstruction Using a Pedicled Anterolateral Thigh Flap

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**Summary:** Hematoma-induced vasospasm is a significant factor that can compromise the success of flap reconstructive surgery. Despite advances in microsurgical techniques and knowledge, vasospasm remains a direct cause of flap loss. Hematoma-induced vasospasm occurs due to the presence of blood breakdown products, which can lead to arterial constriction and reduced blood flow to the transplanted tissue. A 77-year-old man with a history of coronary angina developed soft tissue sarcoma on the right groin. Postoperative hematoma-induced vasospasm occurred subsequent to the reconstruction using a pedicled anterolateral thigh flap for the defect after wide resection. The hematoma was evacuated, and blood flow to the flap was restored with topical application of warm saline and vasodilators. Postoperative administration of intravenous alprostadil was used to counteract the vasospasm, and the flap completely survived without any problems with blood flow. It is important to recognize the triggers of vasospasm, such as hematomas, which may occur intra- or postoperatively, and to take appropriate measures to prevent or treat them. Treatment of vasospasm includes the intraoperative topical application of warm saline or vasodilators and the administration of intravenous alprostadil or 4% lidocaine postoperatively. Nevertheless, in the case of hematoma-induced vasospasm, it is important to remove the hematoma. (*Plast Reconstr Surg Glob Open* 2023; 11:e5271; doi: [10.1097/GOX.0000000000005271](https://doi.org/10.1097/GOX.0000000000005271); Published online 13 September 2023.)

Flap reconstruction has become essential in the treatment of tissue defects caused by trauma or oncological resection. Despite advances in microsurgical techniques and knowledge, vasospasm remains a direct cause of flap loss.<sup>1</sup> Vasospasm is an abnormal vasoconstriction that compromises hemoperfusion of the transplanted tissue.<sup>2</sup> Here, we report a case in which reconstruction using a pedicled anterolateral thigh (ALT) flap for the defect after sarcoma resection on the right groin resulted in transient flap ischemia due to hematoma-induced vasospasm.

## CASE REPORT

A 77-year-old man with a history of diabetes mellitus, dyslipidemia, and coronary angina pectoris, and who was a current smoker with a 20 × 59-year smoking history,

developed a soft tissue sarcoma on the right groin. He underwent reconstruction with a pedicled ALT flap for the defect after wide resection (Fig. 1A). After the tumor ablation, a 9 × 14 cm ALT flap with a preserved distal part of the vastus lateralis muscle was elevated. The flap was advanced, rotated 180 degrees, with the base of pedicle as a pivot point and transferred to the defect. Three 15 Fr drains were put in place, and the raw surface of the outer caudal side of the flap was covered with a full-thickness skin graft (Fig. 1B). Intraoperative indocyanine green (ICG) angiography showed good perfusion after both the elevation and the inset of the flap. On postoperative day 1, the periphery of the flap exhibited mild swelling, bloody exudate was observed, and the flap showed ischemic findings; the color was pale, the pinprick test showed no bleeding, and Doppler ultrasonography revealed an absence of pulsatile sounds. The wound was opened partially at the bedside, and the hematoma was drained and washed out with saline; however, this intervention failed to ameliorate perfusion of the flap. Salvage surgery was performed immediately to confirm the pedicle of the flap and the point of bleeding. The hematoma was stored in the dead space caudal to the iliac crest, with oozing from the vastus medialis and

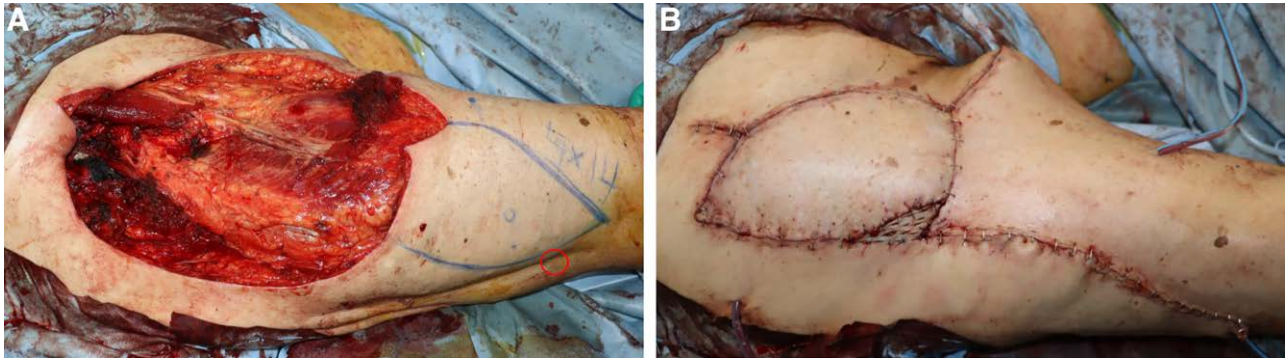
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**Fig. 1.** Intraoperative view of the reconstructive surgery. A, pedicled ALT flap including one perforator (red circle) was designed after wide resection. B, After the operation.



**Fig. 2.** Intraoperative view of salvage surgery. Lateral femoral circumflex artery (green arrow) was overlaid with hematoma.

vastus lateralis muscle. A small amount of hematoma was also present around the feeding vessels, but not enough to compress the pedicle (Fig. 2). There was no kinking of the pedicle, and it was not in traction. After removal of the hematoma, the wound was washed with warm saline, hemostasis was achieved, drainage tubes were put in place, and the wound was closed. The pinprick test showed persistent fresh bleeding, and ICG angiography showed contrast throughout the flap, confirming improved blood perfusion in the flap. The vasodilator alprostadil ( $0.001 \mu\text{g}/\text{kg}/\text{min}$ ,  $120 \mu\text{g}/\text{day}$ ) was administered postoperatively to prevent vasospasm, and the flap completely survived without any problems (Fig. 3).

## DISCUSSION

The triggers of vasospasm have been reported in various studies, but many unknown factors make it difficult to restore the vasospasm when it occurs unexpectedly during or after surgery. Vasospasm is often observed during surgery involving blood vessels in the extremities,<sup>3</sup> and cold stimuli and invasive stimuli such as traction or dissection of blood vessels are well-known factors that can trigger vasospasm. When vasospasm occurs during surgery, the vessel should be immersed in warm saline, and vasodilators,<sup>4</sup> such as phosphodiesterase inhibitors (papaverine,



**Fig. 3.** Postoperative view at 3 months after the surgery.

pentoxifylline, and aminone), local anesthetics (lidocaine), and calcium channel blockers should be used.<sup>5</sup> Surgeons have reported technical issues as the most likely cause of 62% of vasospasms during surgery.<sup>3</sup> However, chemical pathways by hematoma can also induce vasospasm. Blood degradation products have been reported to be involved in the development of vasospasm after subarachnoid hemorrhage through direct and indirect pathways.<sup>6</sup> Experimental animal models have shown that oxyhemoglobin can significantly inhibit the vasorelaxation response from outside the vessel, leading to vasospasm.<sup>7</sup>

**Table 1. Postoperative Vasospasm-induced Ischemia after Pedicled Flap Transfer**

Type	Strong Pedicle Tension	Pedicle Compression	Blood Degradation Products' Impact on Pedicle
Cause	Short pedicle proximity to moving parts gravity. Postoperative physical action	Tissue swelling, large hematoma	Small to moderate hematoma around the pedicle
Finding	Flap ischemia	Flap ischemia, significant tissue swelling, bloody exudate	Flap ischemia, slight tissue swelling, bloody exudate
Management	Flap repositioning administration of vasodilators	Decompression through flap unfastening. Removal of hematoma. Administration of vasodilators	Removal of hematoma around the pedicle. Administration of vasodilators

Vasospasm has also been induced by peripedicle hematoma in a rat flap model.<sup>8</sup>

It is reported that 65% of respondents have encountered cases where postoperative arterial vasospasm was clearly the cause of flap ischemia.<sup>9</sup> We show the three types of postoperative vasospasm along with the cause, findings, and corresponding management strategy for each type (Table 1). In the present case, there is no evidence of kinking, pulling, or compression of the pedicle. Taking all factors into account, hematoma-induced vasospasm due to blood degradation products was considered the most likely cause of the flap ischemia. Countermeasures for postoperative vasospasm include the administration of intravenous alprostadil. It has been reported to increase blood flow velocity after free flap reconstruction<sup>10</sup> and improve flap survival ratio in a rat epigastric artery perforator flap model<sup>11</sup> as well as topical lidocaine.<sup>12</sup> Postoperative flap problems related to hematoma should also be considered when the feeding vessels are physically compressed or when chemical vasospasm is induced in the feeding vessels. In the case of physical compression, the initial finding is congestion due to the compression of the veins before the arteries. On the other hand, chemical vasospasm causes the arterial constriction, which results in flap ischemia. Previous research with an animal model of vasospasm indicated less severe vasospasm under conditions of pressure stimulation compared with direct exposure to blood.<sup>8</sup> In our current study, considering these findings, we concluded that vasospasm was induced by hematoma, specifically attributing its cause to the degradation products of blood.

The first step in the treatment of hematoma-induced vasospasm is to remove the cause of the vasospasm; the hematoma is removed, and the perivascular area is cleaned, followed by immersion in warm saline solution and topical application of a vasodilator around the pedicle. In addition, as soon as ischemia is suspected, vasodilators such as alprostadil should be administered intravenously. During the surgery, attention should be paid to vasospasm caused by hematoma, especially around the feeding vessels, and to patronizing manipulation of the vessels. To prevent hematoma formation, it is recommended to insert open drains around the feeding vessels while ensuring meticulous hemostasis.

In the present case, as a precautionary measure, vasodilators should have been administered before and after the operation, taking into account preexisting conditions related to vasospasm, such as coronary angina and

atherosclerosis.<sup>13</sup> On the other hand, we posit that anticoagulants are unnecessary due to their limited efficacy in preventing intravascular thrombus formation, coupled with their potential to increase the risk of postoperative hemorrhage. In flap reconstruction, hematoma-induced vasospasm should be kept in mind during surgery and postoperative management.

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#### DISCLOSURE

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

#### REFERENCES

- Hurst LN, Evans HB, Brown DH. Vasospasm control by intraarterial reserpine. *Plast Reconstr Surg.* 1982;70:595–599.
- May JW, Chait LA, O'Brien BM, et al. The no-reflow phenomenon in experimental free flaps. *Plast Reconstr Surg.* 1978;61:256–267.
- Jacob R, Eric GH. Topical vasodilators in microsurgery: what is the evidence? *J Reconstr Microsurg.* 2017;33:1–7.
- Cigna E, Torto FL, Parisi P, et al. Management of microanastomosis in patients affected by vessel diseases. *Eur Rev Med Pharmacol Sci.* 2014;18:3399–3405.
- Christina RV, Lorio ML, Bernard, TL. A systematic review of topical vasodilators for the treatment of intraoperative vasospasm in reconstructive microsurgery. *Plast Reconstr Surg.* 2015;136:411–422.
- Angelos GK, Jon S, Antonio B. Pathogenesis of cerebral vasospasm following aneurysmal subarachnoid hemorrhage: putative mechanisms and novel approaches. *J Neurosci Res.* 2009;87:1–11.
- Hongo K, Ogawa H, Kassell NF, et al. Comparison of the intraluminal and extraluminal inhibitory effect of hemoglobin on the endothelium-dependent relaxation of the rabbit basilar artery. *Stroke.* 1988;19:1550–1555.
- Hýža P, Streit L, Schwarz D, et al. Vasospasm of the flap pedicle—the new experimental model on rat. *Acta Chir Plast.* 2014;56:3–11.
- Sergey YT, Robert LW, Gregory AD, et al. Current practices in the management of postoperative arterial vasospasm in microsurgery. *J Reconstr Microsurg.* 2018;34:242–249.
- Seok JJ, Hyunsuk PS, Joonho L, et al. Lipo-prostaglandin E1 increases immediate arterial maximal flow velocity of free flap in patients undergoing reconstructive surgery. *Acta Anaesthesiol Scand.* 2019;63:40–45.

11. Bülent D, Murat SE, Musa KK, et al. Comparison of the effects of different vasoactive and antiplatelet drugs on perforator flap viability. An experimental study. *Hand Surg Rehabil.* 2016;35:55–59.
12. Yokoyama T, Tosa Y, Kadomatsu K, et al. A novel approach for preventing the development of persistent vasospasms after microsurgery for the extremities: intermittent topical lidocaine application. *J Reconstr Microsurg.* 2010;26:79–85.
13. Zhang Y, Janssen L, Chu FV. Atherosclerosis of radial arterial graft may increase the potential of vessel spasm in coronary bypass surgery. *J Thorac Cardiovasc Surg.* 2005;130:1477–1478.