OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Research

The Use of Hemostatic Agents to Decrease Surgical Drain Time in General Plastic Surgery Procedures

Austin Olano, MD*
Saman Namazian, BS†
Alexander Martin, MD†
Caroline A. King, MD, MBA*
Elsa M. Chahine, MD*
Salvatore Nardello, DO, MBS*

Background: Drains can be used in general plastic surgery procedures given the extensive undermining of tissue. Our primary goal was to investigate whether hemostatic agents used during general plastic surgery procedures could decrease drain time length. Secondary goals were to investigate whether hemostatic agents decreased seromas and hematomas.

Methods: A retrospective chart review was conducted including patients undergoing bilateral breast reduction (BBR), abdominoplasty, or panniculectomy. Data collected included use of hemostatic agent (fibrin sealant [EVICEL] or combination powder [HEMOBLAST Bellows]), time to surgical drain removal, and postoperative complications (seroma, hematoma, and operative reintervention). Statistical analyses included *t* tests and Fisher exact test where appropriate.

Results: A total of 351 patients were included. For both the abdominoplasty/panniculectomy and BBR groups, there were statistically significant reductions in surgical drain duration with combination powder compared with no hemostatic agent—13.5 versus 27.9 days for abdominoplasty/panniculectomy ($P < 0.001$), 7.1 versus 8.7 days for BBR ($P = 0.042$). There were no statistically significant differences in incidence of hematomas, seromas, or operative reintervention among any groups.

Conclusions: The use of hemostatic agents such as fibrin sealant or combination powder in general plastic surgery procedures is associated with a statistically significant reduction in postoperative surgical drain duration. *(Plast Reconstr Surg Glob Open 2026;14:e7792; doi: 10.1097/GOX.0000000000007792; Published online 28 May 2026.)*

INTRODUCTION

Postoperative complications such as hematomas and seromas are common among plastic surgery procedures involving extensive tissue manipulation, including breast reductions, abdominoplasties, and panniculectomies.[1,2] Incidence rates of these complications vary by procedure; for breast reductions there have been reported rates of 3.7% and 1.2% for hematomas and seromas, respectively, and for abdominoplasties, rates of 2.8% and 38.1%.[3–5] These complications can impede wound healing, prolong recovery times, and increase patient morbidity.[3–5] Although data are limited describing its efficacy, the use of surgical drains is often implemented to mitigate these complications and prevent fluid accumulation.[6,7] Drain removal typically occurs when output is less than 30 mL/d but may vary depending on surgeon preference.[7] Extended surgical drain use can lead to patient discomfort, heightened infection risk, and delayed return to normal activities. Early drain removal has been associated with an increased quality of life score.[8]

In an effort to combat postoperative complications including hematoma and seroma formation, a number of topical hemostatic agents have been introduced and incorporated into surgical practice.[9,10] In a previous study, Bloom et al found that the use of these agents, specifically a fibrin sealant (FS; Evicel, Ethicon) and a combination powder (CP; Hemoblast Bellows, Dilon Technologies), may reduce the risk of hematoma and seroma formation after general plastic surgery procedures.[11] Additionally, they found that there was a statistically significant reduction in the duration of surgical drain use with the application of a hemostatic agent.[11]

This study aimed to expand on the work of Bloom et al. by incorporating additional patient data. We seek to validate the previous findings with our primary objective being to determine whether the intraoperative use of

*From the *Tufts Medical Center, Department of Surgery, Boston, MA; and †Tufts University School of Medicine, Boston, MA*

Received for publication June 29, 2025; accepted April 1, 2026.

DOI: 10.1097/GOX.0000000000007792

Disclosure statements are at the end of this article, following the correspondence information.

hemostatic agents can effectively decrease the duration of surgical drain use. Secondary objectives included assessing the impact of these agents on the incidence of postoperative hematoma or seroma development.

Takeaways

Question: How does the application of hemostatic agents impact postoperative outcomes of general plastic surgery procedures?

Findings: After a chart review of patients having undergone general plastic surgery procedures including abdominoplasty/panniculectomy or bilateral breast reduction, there was a significant reduction in surgical drain duration when hemostatic agents were applied. Although not statistically significant, there was an overall lower incidence of postoperative complications when hemostatic agents were used.

Meaning: The use of hemostatic agents such as fibrin sealant or combination powder in general plastic surgery procedures is associated with a statistically significant reduction in postoperative surgical drain duration.

METHODS

A retrospective chart review was conducted following institutional review board approval. Patients were selected from a single surgeon's case database. Those who underwent bilateral breast reduction (BBR), abdominoplasty, or panniculectomy between 2015 and 2023 were included in the analysis. A total of 351 patients were included. Patients on anticoagulation therapy or those undergoing other procedures were excluded to maintain a homogeneous study population.

Breast reductions were performed using a Wise pattern incision with either an inferior or superomedial pedicle based on the degree of ptosis and individual patient anatomy. Abdominoplasties and panniculectomies were performed in the standard fashion. Care was taken to ensure that patients were normotensive intraoperatively, to identify and control any potential bleeding vessels that might not be apparent under hypotensive conditions, and hemostasis was ensured before closure. No tumescent fluid was used during any of the procedures. All patients were instructed to maintain surgical site compression postoperatively, using either a compression wrap, surgical bra, or abdominal binder until their follow-up appointment, typically about 2 weeks following surgery. Surgical drains were placed intraoperatively in patients the surgeon subjectively deemed to be at increased risk of hematoma or seroma formation given the extent of the dissection and amount of tissue displaced. Drains were monitored postoperatively and subsequently removed in the clinic when output was less than 30 mL/day for 2 consecutive days.

Data collected included indication for surgery and which operation was performed; type of hemostatic agent used; length of follow-up; surgical drain duration; postoperative complications, including hematoma or seroma formation; and return to the operating room.

Patients were categorized based on the intraoperative use of hemostatic agents. The hemostatic agents used included FS (Evicel, Ethicon) and CP (Hemoblast Bellows, Dilon Technologies). Patients who underwent surgery before June 2017 did not receive any hemostatic agent. Those who underwent surgery between June 2017 through September 2019 received FS, and those from August 2019 through the duration of the study received CP.

Duration of drain usage between different groups was analyzed using the Welch *t* test. Incidence of postoperative complications were analyzed using the Fisher exact test. A statistically significant difference was defined as a *P* value of less than 0.05.

RESULTS

For patients undergoing BBR (n = 251), there was a statistically significant reduction in the duration of surgical drain use for patients who received FS when compared with no hemostatic agent (6.9 ± 3.0 versus 8.7 ± 3.7 days, $P = 0.007$) (Table 1; Fig. 1). The use of CP also demonstrated a reduction in drain duration when compared with no hemostatic agent (7.1 ± 3.5 versus 8.7 ± 3.7 days, $P = 0.042$) (Table 2). There was no statistically significant difference between the CP and FS groups in regard to drain duration (Table 3). Additionally, there were no statistically significant differences among the study groups when looking at hematoma or seroma formation or the need for operative reintervention for patients who underwent BBR.

For patients who underwent abdominoplasty or panniculectomy, there was again a statistically significant reduction noted in the duration of drain use for patients who received CP compared with those who did not receive a hemostatic agent (13.5 ± 8.2 versus 27.9 ± 14.3 days, $P < 0.001$) (Table 2; Fig. 2). Notably, the use of FS

Table 1. Postoperative Outcomes Following Common Plastic Surgery Procedures Comparing the Use of No Hemostatic Agent Versus FS (Evicel)

	Abdominoplasty/Panniculectomy			Bilateral Breast Reduction		
	No Agent (n = 61)	FS (n = 4)	*P* value	No Agent (n = 61)	FS (n = 66)	*P* value
Follow-up (wk)	13.2	12.8	—	11.3	9.0	—
Seroma	4 (6.6%)	1 (25.0%)	0.280	4 (6.6%)	3 (4.5%)	0.710
Hematoma	5 (8.2%)	1 (25.0%)	0.328	1 (1.6%)	1 (1.5%)	1.000
Surgical drain duration (d)	27.9 ± 14.3	18.3 ± 13.5	0.196	8.7 ± 3.7	6.9 ± 3.0	0.007
Return to operating room	3 (4.9%)	1 (25.0%)	0.229	1 (1.6%)	0 (0.0%)	0.480

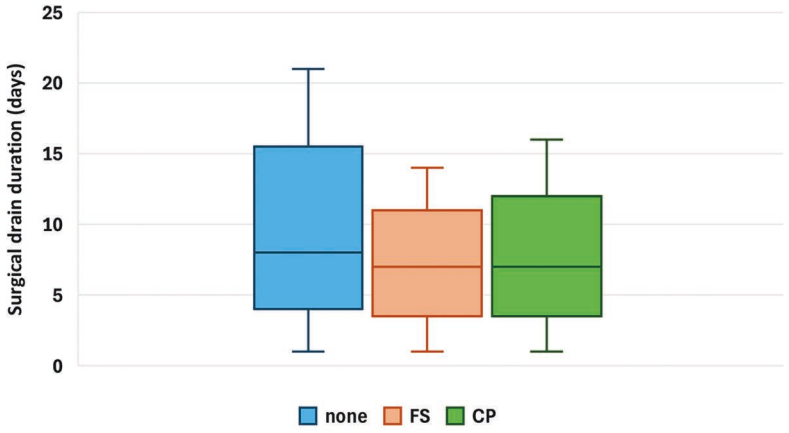

Fig. 1. Surgical drain duration in days following abdominoplasty/panniculectomy comparing the use of no hemostatic agent, FS, or CP.

Table 2. Postoperative Outcomes Following Common Plastic Surgery Procedures Comparing the Use of No Hemostatic Agent versus CP (Hemoblast Bellows)

	Abdominoplasty/Panniculectomy			BBR		
	No Agent (n = 61)	CP (n = 35)	*P* value	No Agent (n = 61)	CP (n = 124)	*P* value
Follow-up (wk)	13.2	8.1	—	11.3	7.2	—
Seroma	4 (6.6%)	0 (0.0%)	0.293	4 (6.6%)	4 (3.2%)	0.442
Hematoma	5 (8.2%)	2 (5.7%)	1.000	1 (1.6%)	3 (2.4%)	1.000
Surgical drain duration (d)	27.9 ± 14.3	13.5 ± 8.2	<0.001	8.7 ± 3.7	7.1 ± 3.5	0.042
Return to operating room	3 (4.9%)	0 (0.0%)	0.298	1 (1.6%)	1 (0.1%)	0.552

Table 3. Postoperative Outcomes Following Common Plastic Surgery Procedures Comparing the Use of FS (Evicel) versus CP (Hemoblast Bellows)

	Abdominoplasty/Panniculectomy			BBR		
	FS (n = 4)	CP (n = 35)	*P* value	FS (n = 66)	CP (n = 124)	*P* value
Follow-up (wk)	12.8	8.1	—	9.0	7.2	—
Seroma	1 (25.0%)	0 (0.0%)	0.103	3 (4.5%)	4 (3.2%)	0.695
Hematoma	1 (25.0%)	2 (5.7%)	0.284	1 (1.5%)	3 (2.4%)	1.000
Surgical drain duration (d)	18.3 ± 13.5	13.5 ± 8.2	0.311	6.9 ± 3.0	7.1 ± 3.5	0.745
Return to operating room	1 (25.0%)	0 (0.0%)	0.103	0 (0.0%)	1 (0.1%)	1.000

was associated with a reduction in drain duration compared with no hemostatic agent, although this was not found to be statistically significant (18.3 ± 13.5 versus 27.9 ± 14.3 days, $P = 0.196$) (Table 1). There was no statistical significance in drain duration between the CP and FS groups (Table 3). Similarly to those who underwent BBR, there were no statistically significant differences in seroma or hematoma formation or the need for operative reintervention among the study groups for those who underwent abdominoplasty or panniculectomy (Table 3).

DISCUSSION

Our study contributes to the growing body of evidence supporting the use of topical hemostatic agents in plastic surgery. By incorporating a larger patient cohort, this study expands upon the work of Bloom et al, by evaluating the efficacy of hemostatic agents, specifically CP and FS, in reducing postoperative drain duration and complications in general plastic surgery procedures.[11] Our findings indicate that the intraoperative use of hemostatic agents significantly decreases the duration of surgical drain usage in both abdominoplasty/panniculectomy and BBR surgeries.

In the abdominoplasty/panniculectomy cohort, patients who received CP exhibited a significantly shorter mean drain duration than those that did not receive a hemostatic agent. This substantial reduction suggests that CP effectively promotes hemostasis and minimizes serous fluid accumulation, facilitating earlier drain removal. Similarly, in BBR procedures, both the FS and CP groups had a significantly reduced mean drain duration compared with the no-agent group, corroborating the findings of Bloom et al, who also reported decreased drain duration with the use of hemostatic agents.[11]

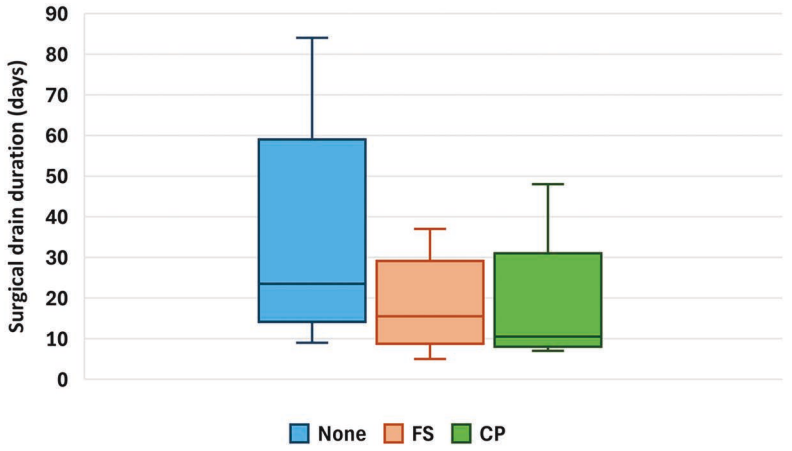

Fig. 2. Surgical drain duration in days following BBR, comparing the use of no hemostatic agent, FS, or CP.

The mechanism by which CP may reduce drain duration and complications is likely multifactorial. CP contains human-derived thrombin, porcine-derived collagen, and chondroitin sulfate, which collectively enhance the coagulation cascade and promote tissue adherence.[10] This combination facilitates hemostasis and helps collapse potential dead spaces, thereby reducing fluid accumulation and the risk of seroma formation. Reduced need for prolonged drainage can improve patient comfort, decrease infection risk, and expedite recovery.

It is important to mention that there is an added cost of using these products intraoperatively. Hemoblast Bellows, for example, costs around US $270 per unit, which covers an area of approximately 50 cm^2. Evicel costs around US $400 per unit, covering an area of approximately 20 cm^2. Although the upfront costs of utilizing these hemostatic agents may be higher, the overall cost-effectiveness should be evaluated by considering potential savings from reduced complications and expedited recovery. Similar products have been shown to ultimately reduce overall healthcare costs when used compared with standard of care.[12] Additionally, shorter drain duration has been associated with decreased risk of surgical site infections.[13]

Several limitations of this study warrant consideration. The retrospective design may introduce selection bias and limits the ability to establish causality. Data were collected from a single institution and involved procedures performed by a single surgeon, potentially affecting the generalizability of the findings. Additionally, the sample size for some comparisons, particularly involving the FS group in abdominoplasty/panniculectomy procedures, was small, reducing the statistical power to detect significant differences in complication rates. These data were ultimately retained in the study for completeness. The lack of randomization and blinding could introduce bias in postoperative management and outcome reporting. Although drain removal criteria were standardized, variations in patient factors and intraoperative techniques may also have influenced results. For example, this study took place over the span of eight years. It is possible that subtle changes in surgical technique could have resulted in more efficient hemostasis as the surgeon became more experienced. Additionally, the results were not stratified or analyzed based on patient demographics such as body mass index or age. Given the already somewhat small cohort sizes, it was felt that such analyses would reduce statistical power and were, therefore, not performed. Future prospective, randomized controlled trials with larger, multicenter cohorts are necessary to confirm the study findings and address these limitations.

Further research, including randomized controlled trials, to investigate postoperative outcomes associated with hemostatic agent use in plastic surgery is warranted and could strengthen the argument for its utility in these procedures. Studies assessing patient-reported outcomes, cost-effectiveness, and the impact on healthcare resource use are needed. Additionally, there are multiple topical hemostatic agents on the market that are being used intraoperatively. This study only looks at two of these. Investigating the efficacy of CP or FS in other plastic surgery procedures and comparing it with alternative hemostatic agents such as topical tranexamic acid, which has also been shown to decrease surgical drain duration, could provide valuable insights for optimizing surgical care.[14]

CONCLUSIONS

The intraoperative use of hemostatic agents in general plastic surgery procedures such as BBR, abdominoplasty, and panniculectomy significantly reduces the duration of surgical drain use and may reduce postoperative complications, including the development hematomas or seromas or the need for operative reintervention.

Austin Olano, MD
Tufts Medical Center
Department of Surgery
800 Washington Street
Boston, MA 02111
E-mail: Austin.Olano@TuftsMedicine.org
@AustinOlanoMD

DISCLOSURE

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

REFERENCES

1. Jordan SW, Khavanin N, Kim JY. Seroma in prosthetic breast reconstruction. *Plast Reconstr Surg.* 2016;137:1104–1116.
2. Seth AK, Hirsch EM, Kim JYS, et al. Hematoma after mastectomy with immediate reconstruction: an analysis of risk factors in 883 patients. *Ann Plast Surg.* 2013;71:20–23.
3. Di Martino M, Nahas FX, Kimura AK, et al. Natural evolution of seroma in abdominoplasty. *Plast Reconstr Surg.* 2015;135:691e–698e.
4. Hood K, Kumar NG, Kaoutzanis C, et al. Hematomas in aesthetic surgery. *Aesthet Surg J.* 2018;38:1013–1025.
5. Cunningham BL, Gear AJ, Kerrigan CL, et al. Analysis of breast reduction complications derived from the BRAVO study. *Plast Reconstr Surg.* 2005;115:1597–1604.
6. Paffile J, McGuire C, Bezuhly M. Systematic review of patient safety and quality improvement initiatives in breast reconstruction. *Ann Plast Surg.* 2022;89:121–136.
7. Phillips BT, Wang ED, Mirrer J, et al. Current practice among plastic surgeons of antibiotic prophylaxis and closed-suction drains in breast reconstruction: experience, evidence, and implications for postoperative care. *Ann Plast Surg.* 2011;66:460–465.
8. Vos H, Smeets A, Neven P, et al. Early drain removal improves quality of life and clinical outcomes in patients with breast cancer—results from a randomised controlled trial. *Eur J Oncol Nurs.* 2018;36:112–118.
9. Moore M, Burak WE, Nelson E, et al. Fibrin sealant reduces the duration and amount of fluid drainage after axillary dissection: a randomized prospective clinical trial. *J Am Coll Surg.* 2001;192:591–599.
10. Tompeck AJ, Gajdhar A, Dowling M, et al. A comprehensive review of topical hemostatic agents: the good, the bad, and the novel. *J Trauma Acute Care Surg.* 2020;88:e1–e21.
11. Bloom JA, Erlichman Z, Foroutanjazi S, et al. The use of hemostatic agents to decrease bleeding complications in general plastic surgery procedures. *Plast Reconstr Surg Glob Open.* 2021;9:e3744.
12. Ikeme S, Weltert L, Lewis KM, et al. Cost-effectiveness analysis of a sealing hemostat patch (HEMOPATCH) vs standard of care in cardiac surgery. *J Med Econ.* 2018;21:273–281.
13. Chen CF, Lin SF, Hung CF, et al. Risk of infection is associated more with drain duration than daily drainage volume in prosthesis-based breast reconstruction: a cohort study. *Medicine (Baltim).* 2016;95:e5605.
14. Manfellotto V, Cuomo R, Vastarella MG, et al. Abdominoplasty after weight loss in post-bariatric surgery: an optimized surgery procedure and clinical protocol—a large single-center study. *Aesthetic Plast Surg.* 2025;49:6905–6911.