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Real-World Economic and Clinical Outcomes Associated with Current Hemostatic Matrix Use in Cardiovascular Surgery

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Background

- Cardiovascular disease is the leading cause of death in the United States and worldwide.[1] Cardiovascular surgeries represent significant clinical and economic burden both to the patients and the healthcare system.
- Patients undergoing invasive surgeries such as cardiovascular surgery are at significant risk of blood loss, particularly in complex and long procedures or surgeries with anticoagulant therapies preoperatively and intraoperatively. [2-6]
- Surgical hemostasis is often required to prevent bleeding events and reduce avoidable complications and associated economic burden.[7-9]
- Very few studies have evaluated both the clinical and economic value of Surgiflo® compared to Floseal in cardiovascular surgery.

Objective

To compare the economic and clinical outcomes of patients treated with current formulation of Surgiflo® versus Floseal during cardiovascular surgeries

Methods

- This is a retrospective study using Premier Healthcare Database (PHD).
- Eligible patients included individuals:
  - With an inpatient cardiovascular surgery between 1/1/2013-06/1/2018
  - ≥ 18 years at the time of procedure
  - Received Surgiflo® or Floseal during surgery
- Patients were excluded if they had an outlier value for operating room time (<1 or > 12 hours), had incomplete information on hospital stay, had a non-specific hemostatic product description, or received both products in same surgery
- Patients in the two groups were matched using their calculated propensity scores (1:3 variable ratio matching) with exact match on surgery year and type of surgery (i.e., aortic, coronary artery bypass grafting, valve, other); sampling weights were applied, rendering the weighted post-match sample to be 1:1.
- Outcomes included bleeding event, blood transfusion, length of stay (LOS), intensive care unit (ICU) admission, total costs, operating room time, and readmission within 30-60-90 days.
- Outcomes were reported using descriptive analysis and compared between the groups using generalized estimating equations.

Results

Patient Demographics

- The final weighted matched sample included 5,768 patients for each group (post-match mean age=66.6 years; 66% males).
- After propensity score matching, all baseline patient and hospital characteristics were balanced between the two groups except hospital location (rural or urban: Surgiflo® 89.9% vs, Floseal 93.2%; standardized difference: -12.10).
- In the post-matching sample, more than 84% were White, at least 62% had Medicare coverage, and 63% underwent elective surgery across both groups.
- Charlson Comorbidity Index was similar in both of the groups (mean Surgiflo®=2.1, Floseal =2.2)
- CABG procedures accounted for 49.6% of the surgeries in both groups, followed by 22.8% valve, 1.9% aortic and 25.7% other

Hospital Characteristics

- More than half of the patients in both groups received surgeries in the Southern region of the United States, and over 90% had surgeries in urban hospitals.
- Majority of the procedures included in the analysis were performed at mid-size hospitals (i.e., 101-500 beds).

The Surgiflo® group had significantly lower admission cost, but slightly longer operating room time compared to Floseal (Table 1)

- Surgiflo® patients had an average of $2,682 lower hospitalization cost ($44,146 vs. $46,828 P<0.05), longer operating room time (306 vs. 299 minutes, P<0.05), slightly shorter LOS, and although ICU admissions were 11% higher, Surgiflo® patients had a shorter duration of stay in ICU (p>0.05).

Table 1: Multivariable Regression for Continuous Outcomes

Outcomes[a]	Surgiflo® Mean (SD) N = 5,768	Floseal Mean (SD) N = 5,768	IRR[b]	95% CI Low	95% CI High	P-Value*
Length of stay (LOS) (days)	7.51 (5.71)	7.68 (4.04)	1	0.97	1.02	0.7147
Number of days in ICU (days)[c]	4.28 (6.65)	4.48 (4.14)	0.98	0.92	1.04	0.4183
Total cost (USD)	44,146 (42,362.69)	46,828 (55,089.79)	0.95	0.9	0.99	0.0187*
Operating room time (hours)	5.10 (2.22)	4.99 (1.56)	1.03	1.02	1.05	<.0001*

a. Based on a Generalized linear model with Generalized Estimating Equations (negative binomial distribution and log link for LOS, number of ICU days, operating room time; gamma distribution and log link for costs) weighted and adjusted for unbalanced characteristics after PSM and marital status.
b. Incidence Rate Ratio indicates the relative risk of an outcome in Surgiflo® as compared to Floseal
c. ICU admission is defined using chargemaster description
* p<0.05 is significant

Bleeding was comparable between the two groups (Table 2)

- Overall, bleeding rates were similar in the two groups, with slightly lower odds of experiencing bleeding in Surgiflo® group compared to the Floseal group (p>0.05).

Transfusions were comparable between the two groups (Table 2)

- Overall, transfusions required on or within four days of surgery were comparable across Surgiflo® and Floseal (34.7% vs. 33.3%, p>0.05).
- The PRBC transfusions required on or within four days of surgery were comparable across Surgiflo® and Floseal (8.5% vs. 8.4%, p>0.05).

Readmissions were consistently lower in the Surgiflo® group compared to Floseal (Table 2)

- Surgiflo® patients had significantly lower risk of readmission at 30-60-90 days post-discharge (27%, 13% and 12% lower odds respectively; all p<0.05).
- Mortality was comparable between the Surgiflo® and Floseal groups (p>0.05).

Table 2: Multivariable Regression for Binary Outcomes

Outcomes[a]	Surgiflo®, N (%) N = 5,768	Floseal, N (%) N = 5,768	OR[b]	95% CI Low	95% CI High	P-Value*
Any Bleeding[c]	370 (6.4%)	385 (6.7%)	0.97	0.85	1.11	0.6596
Any post operative bleeding[d]	23 (0.4%)	34 (0.6%)	0.67	0.42	1.09	0.107
Any transfusion[e]	2,207 (38.3%)	2,061 (35.7%)	1.15	1.08	1.23	<.0001*
Any transfusion on or within 4 days of surgery	2,004(34.7%)	1,918(33.3%)	1.04	0.96	1.12	0.3329
PRBC transfusion on or within 4 days of surgery	488(8.5%)	483(8.4%)	1.04	0.93	1.17	0.4586
Any ICU admission	4,202 (72.9%)	3,547 (61.5%)	1.68	1.56	1.8	<.0001*
Mortality	173 (3.0%)	187 (3.2%)	0.96	0.79	1.16	0.6688
Any Readmission						
Within 30 days	278 (4.8%)	370 (6.4%)	0.73	0.63	0.85	<.0001*
Within 60 days	817 (14.2%)	914 (15.8%)	0.87	0.79	0.96	0.0037*
Within 90 days	974 (16.9%)	1,072 (18.6%)	0.88	0.81	0.96	0.0053*

a. Based on a GLM with GEE (binomial distribution and logit link), weighted and adjusted for unbalanced characteristics after PSM and marital status.
b. The odds ratios indicates the probability of having an outcome in Surgiflo® as compared to Floseal
c. Any bleeding event identified using ICD 9/10 diagnosis not present on admission OR any ICD procedures during the hospitalization
d. Bleeding event identified using ICD procedures when the procedure was performed after the day of the index surgery
e. Blood transfusion was identified using ICD procedure codes and searching for text strings in hospital charge description

Discussion and Conclusion

- Our study is one of the largest retrospective studies presenting real-world clinical and economic evidence related to Surgiflo® versus Floseal use in patients undergoing cardiovascular surgeries.
- Compared to prior analyses, this study considers the latest product formulations, allowing fair time for market penetration.
- The robust PSM matching methodology accounts for potential confounders such as type of surgery, patient, and hospital characteristics.
- This study suggest that Surgiflo® is associated with lower hospitalization costs and decreased risk of readmissions among patients receiving cardiovascular surgeries, compared to Floseal.
- Overall the probability of requiring transfusion within the first four days of surgery is comparable across Surgiflo® and Floseal. Additional research may be necessary since there is considerable inter-hospital variability in how transfusions are documented and reported in the data.
- The study had inherent limitations of using retrospective data such as PHD, including non-random assignment to Surgiflo® or Floseal groups, using text searches to define outcome variables, information limited to only continuously contributing hospitals and underestimation of re-hospitalization rate involving multiple hospitals.
- Despite the limitations, this study suggests that Surgiflo® is associated with reduced cost and resource use compared to Floseal.

References

1. (WHO), W.H.O., Cardiovascular disease (CVD). 2017.
2. Verma, K., et al., A prospective, randomized, double-blinded single-site control study comparing blood loss prevention of tranexamic acid (TXA) to epsilon aminocaproic acid (EACA) for corrective spinal surgery. BMC Surg, 2010. 10: p. 13.
3. Hassan, N., et al., Blood management in pediatric spinal deformity surgery: review of a 2-year experience. Transfusion, 2011. 51(10): p. 2133-2141.
4. Neilipovitz, D.T., et al., A Randomized Trial of Tranexamic Acid to Reduce Blood Transfusion for Scoliosis Surgery. Anesthesia & Analgesia, 2001. 93(1): p. 82-87.
5. Boldt, J., et al., Influence of different anticoagulation regimens on platelet function during cardiac surgery. British Journal of Anaesthesia, 1994. 73(5): p. 639-644.
6. Gravlee, G.P., et al., Heparin dosing and monitoring for cardiopulmonary bypass: A comparison of techniques with measurement of subclinical plasma coagulation. The Journal of Thoracic and Cardiovascular Surgery, 1990. 99(3): p. 518-527.
7. Krishnan, S., et al., Choice of Hemostatic Agent and Hospital Length of Stay in Cardiovascular Surgery. Seminars in Cardiothoracic and Vascular Anesthesia, 2009. 13(4): p. 225-230.
8. Li, G., et al., Efficacy of antifibrinolytic agents on surgical bleeding and transfusion requirements in spine surgery: a meta-analysis. European Spine Journal, 2017. 26(1): p. 140-154.
9. Makhija, D., et al., Cost-consequence analysis of two different active flowable hemostatic matrices in spine surgery patients. Journal of Medical Economics, 2017. 20(6): p. 606-613.