Impact of great saphenous vein ablation on healing and recurrence of venous leg ulcers in patients with post-thrombotic syndrome: A retrospective comparative study

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ABSTRACT

Background: The optimal treatment approach for patients with active venous leg ulcers (VLUs) and post-thrombotic syndrome (PTS) associated with great saphenous vein (GSV) reflux remains unclear. To address this gap, we retrospectively compared the outcomes of patients with post-thrombotic VLU with an intact GSV vs those with a stripped or ablated GSV.

Methods: We retrospectively analyzed data from 48 patients with active VLUs and documented PTS, who were treated at a single center between January 2018 and December 2022. Clinical information, including ulcer photographs, was recorded in a prospectively maintained digital database at the initial and follow-up visits. Two patient groups—group A (with an intact GSV) and group B (with a stripped or ablated GSV)—were compared in terms of time to complete healing, proportion of ulcers achieving complete healing, and ulcer recurrence during the follow-up period.

Results: There were no significant differences in age, gender, initial ulcer size, or ulcer duration between the two groups. All included patients had femoropopliteal post-thrombotic changes. Group A had significantly more completely healed ulcers (33 of 34 ulcers, 97%) compared with group B (10 of 14 ulcers, 71%) ($P = .008$). Group A also exhibited a significantly shorter time to complete ulcer healing (median: 42.5 days, interquartile range [IQR]: 65) compared with group B (median: 161 days, IQR: 530.5) ($P = .0177$), with a greater probability of ulcer healing ($P = .0084$). Long-term follow-up data were available for 45 of 48 patients (93.7%), with a mean duration of 39.6 months (range: 5.7-67.4 months). The proportion of ulcers that failed to heal or recurred during the follow-up period was significantly lower in group A (9 of 32 ulcers, 27%) compared with group B (11 of 13 ulcers, 85%) ($P = .0009$). In addition, in a subgroup analysis, patients with an intact but refluxing GSV (12 of 34) had a significantly shorter time to heal (median: 34 days, IQR: 57.25) ($P = .0242$), with a greater probability of ulcer healing ($P = .0091$) and significantly fewer recurrences (2 of 12, 16%) ($P = .006$) compared with group B.

Conclusions: Our findings suggest that removal of the GSV through stripping or ablation in patients with post-thrombotic deep venous systems affecting the femoropopliteal segment may result in delayed ulcer healing and increased ulcer recurrence. Patients with an intact GSV had better outcomes, even when the refluxing GSV was left untreated. These findings emphasize the potential impact of GSV treatment on the management of VLUs in individuals with PTS. Further investigation is needed to validate these results and explore alternative therapeutic strategies to optimize outcomes for this patient population. (J Vasc Surg Venous Lymphat Disord 2024;12:101859.)

Keywords: Venous leg ulcer; Great saphenous vein; Post-thrombotic syndrome; Ulcer; Great saphenous vein ablation

Venous leg ulcers (VLUs) are a significant health problem, affecting 1% of the population, and their prevalence increases to 2% in the elderly population.[1] They are the commonest cause of leg ulcers, accounting for 60% to 80% of all leg ulcers.[2] VLUs can cause significant pain, reduced mobility, and a decreased quality of life.[3,4] Moreover, nonhealing VLUs are associated with a substantial financial burden on health care systems.[5]

The etiology of VLU is multifactorial, with the critical element being ambulatory venous hypertension, which may be caused by venous reflux or obstruction, or a combination of both.[6] A number of factors, such as aging, obesity, diabetes, impaired mobility and/or calf muscle pump failure, and peripheral artery disease, can also increase the risk of developing VLUs.[7,8]

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The management of VLUs aims to address the underlying venous pathology, promote wound healing, and prevent recurrence. Compression therapy is the cornerstone of VLU management, as it reduces venous hypertension and promotes ulcer healing.[9] Other important components of VLU management include wound debridement, treatment of infection, and addressing any comorbidities.[10]

Recent studies have shown that early removal of the refluxing great saphenous vein (GSV) by ablation, stripping, or other methods can promote the healing of VLUs.[11,12] However, the effect of GSV ablation on VLU healing in patients having residual obstructive post-thrombotic changes in the deep venous system has not been well studied. The GSV may potentially act in this particular situation as a collateral pathway for the underlying partially recanalized deep venous system (especially if involving the femoropopliteal segment). Therefore, the aim of this study was to investigate the effect of GSV stripping or ablation on VLU healing in patients with post-thrombotic deep venous system changes.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of prospectively collected registry data
- **Key Findings:** Retrospective analysis of 48 patients with symptomatic post-thrombotic obstruction involving the femoropopliteal venous segment and active venous leg ulcers demonstrated that limbs with an intact great saphenous vein (GSV) exhibited a greater probability of ulcer healing ($P = .0084$), higher rates of complete ulcer healing (97% vs 71%; $P = .008$), shorter time to complete ulcer healing (median 42.5 days vs 161 days; $P = .0177$), and fewer long-term recurrences (27% vs 85%; $P = .0009$) compared with limbs that underwent GSV ablation or stripping.
- **Take Home Message:** Our findings suggest that removal of the GSV through stripping or ablation in patients with CEAP C6 disease in the setting of post-thrombotic femoropopliteal deep venous obstruction can result in delayed ulcer healing and increased ulcer recurrence.

METHODS

Study design. This retrospective comparative study involved a review of patient data from a single center. The study focused on patients with active VLUs who had post-thrombotic changes in their deep venous system. Ethical committee approval was obtained to conduct the study, and patient consent was obtained for relevant procedures.

Study end points. The primary end point was the time to complete ulcer healing. The secondary end points were the number of patients who achieved complete ulcer healing during the study period and the number of ulcers that recurred or did not heal. Complete ulcer healing was defined as the presence of complete epithelialization and skin coverage.

Data collection. Data were extracted from a prospectively maintained digital database that contained information on patients treated for chronic venous insufficiency over a 5-year period from January 2018 to December 2022. Duplex ultrasound scan was performed using a Xario200 Toshiba scanner (Canon Medical Systems) by an experienced operator (WT). Superficial, perforator, and deep venous systems in addition to perilulcer venous drainage were carefully evaluated. Post-thrombotic changes were diagnosed when one or more of the following criteria were present: post-thrombotic occlusion, recanalization with evidence of synechiae, and post-thrombotic secondary reflux. The ankle-brachial pressure index was also used to assess foot perfusion.

Treatment protocol. The treatment protocol involved initial ulcer debridement if necessary and a short course of antibiotics if there was evidence of infection. This was followed by compression therapy using multilayer short-stretch bandages and foam dressings. Wound care, ulcer photography, and application of short-stretch bandages were performed on a weekly basis. Ultrasound-guided foam sclerotherapy (UGFS) was used to treat incompetent periulcer veins and incompetent perforators in all the patients. Polidocanol in a concentration of 1% to 2% was used for UGFS, typically in one session, occasionally requiring two to three sessions. The same physicians (RAB and WT) and nurses provided wound care, compression therapy, and UGFS for all 48 patients at the same center.

Data collection parameters. Data regarding patient age, gender, affected side, ulcer size, ulcer location, ulcer duration, detailed duplex findings of the superficial and deep venous systems, and time to complete ulcer healing were obtained. Ulcer size in cm^2 was measured using digital software. In June and July 2023, a telephone interview was conducted with all patients to inquire about any ulcer recurrence.

Statistical analysis. Statistical analysis was performed using GraphPad Prism version 10.1.1. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Normality testing of the data was performed. Non-normally distributed

Table I. Characteristics of groups A and B

Characteristic	Group A, GSV intact (n = 34)	Group B, GSV stripped or ablated (n = 14)	*P* value
Age, year, mean (SD)	49.2 (12.6)	48.7 (11.6)	.98
Male gender, No. (%)	30 (88)	10 (71)	.15
Ulcer duration, months, mean (SD)	15.7 (10.2)	20 (11)	.12
Ulcer size, cm^2, mean (SD)	16.6 (10.9)	18.9 (12.3)	.64

GSV, Great saphenous vein; *SD*, standard deviation.
There is no significant difference between the baseline characteristics of the two groups.

data were expressed as median and interquartile range (IQR). The Mann-Whitney test was used to compare time to complete ulcer healing between the groups. Kaplan-Meier curves and the log-rank test were used to visualize and compare the probability of ulcer healing between groups, respectively. The significance level for all statistical tests was set at $\alpha = 0.05$.

RESULTS

Among the 1321 consecutive patients treated for chronic venous insufficiency, 106 patients presented with active VLUs and, of those, 48 had post-thrombotic changes in their deep venous system, as confirmed by color flow duplex imaging. These 48 patients (48 limbs) were divided into two groups: group A, comprising 34 patients with an intact GSV, and group B, comprising 14 patients who had undergone GSV stripping or ablation. The characteristics of both groups are depicted in Table I. There were no significant differences between the groups in terms of age, gender, ulcer size, and ulcer duration. The duplex findings of groups A and B are summarized in Table II. All patients in both groups had post-thrombotic involvement of the femoropopliteal vein segment, which was either occluded or recanalized.

Intact vs stripped or ablated GSV. Group A demonstrated a significantly shorter time to complete ulcer healing compared with group B (median: 42.5 days, IQR: 65 vs median: 161 days, IQR: 530.5; $P = .0177$), with a greater probability of ulcer healing ($P = .0084$) (Fig 1). The number of ulcers that achieved complete healing was significantly higher in group A: 33 of 34 patients (97%), compared with 10 of 14 patients (71%) in group B ($P = .008$).

Long-term follow-up data were available for 45 of 48 patients (93.7%). The mean duration of long-term follow-up was 39.6 months (range: 5.7-67.4 months). The number of ulcers that either did not heal or recurred during the follow-up period was significantly lower in group A (9 of 32 patients, 27%) compared with group B (11 of 13 patients, 85%) ($P = .0009$).

Intact and refluxing vs stripped or ablated GSV. In a subgroup analysis, we identified 12 patients from group A who had an intact but refluxing GSV. This subgroup, referred to as group C, was compared with group B, which consisted of patients with a stripped or ablated GSV. Group C patients demonstrated a significantly shorter time to achieve complete healing (median: 34 days, IQR: 57.25) compared with group B ($P = .0242$), as well as a greater probability of ulcer healing ($P =$

Table II. Summary of duplex ultrasound findings of groups A and B

	Group A, GSV intact (n = 34)	Group B, GSV stripped or ablated (n = 14)	*P* value
GSV stripped	0	12 (85)	N/A
GSV ablated	0	2 (14)	N/A
GSV intact not refluxing	22 (64)	0	N/A
GSV intact refluxing	12 (35)	0	N/A
Iliac vein patent	26 (76)	13 (92)	.18
Iliac vein occluded	4 (11)	0	N/A
Iliac vein recanalized	3 (8)	1 (7)	.84
Iliac vein stented, patent	1 (2)	0	N/A
Femoropopliteal vein patent recanalized	31 (91)	13 (92)	.84
Femoropopliteal vein occluded	3 (8)	1 (7)	.84

GSV, Great saphenous vein; *N/A*, not applicable.
Data are presented as number (%).
All the patients in both groups had post-thrombotic changes affecting the femoropopliteal segment.

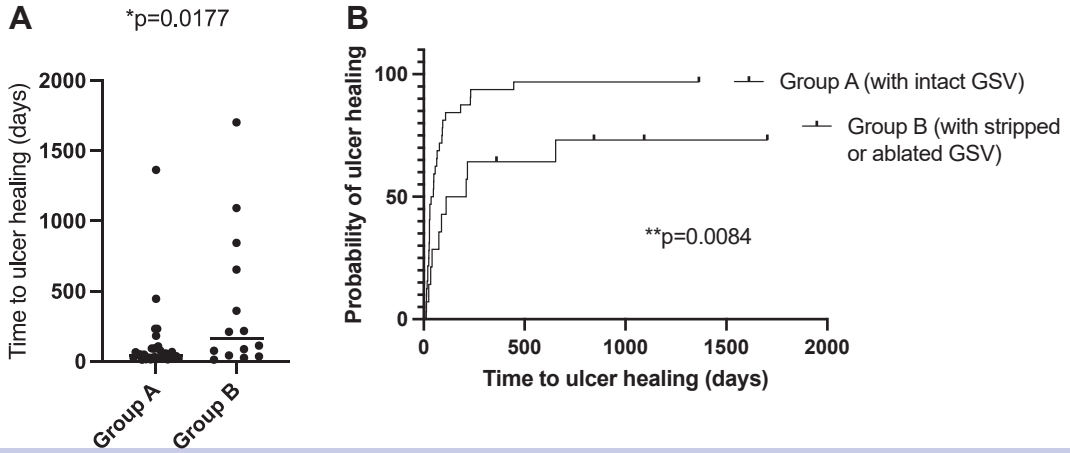

Fig 1. Comparing group A (with an intact great saphenous vein [*GSV*]) and group B (with a stripped or ablated GSV) with respect to time to complete ulcer healing **(A)** and probability of ulcer healing **(B)**.

.0091) (Fig 2). Furthermore, group C had a significantly fewer ulcer recurrences (2 of 12 patients, 16%) compared with group B ($P = .006$).

Intact vs stripped or ablated GSV in the context of a recanalized femoral vein. To address the issue of the impact of the underlying femoral vein pathology, we excluded patients with persistent nonrecanalized occlusion of the femoropopliteal vein segment. We then compared group A patients with an intact GSV and underlying patent recanalized femoral vein with group B patients with a stripped or ablated GSV and underlying patent recanalized femoral vein. Group A (n = 31) showed a nonstatistically significant trend toward a shorter healing time compared with group B (n = 13) (median: 49 days, IQR: 66.5 vs median: 112 days, IQR 319; $P = .0627$), with a greater probability of ulcer healing ($P = .0257$) (Fig 3).

Long-term data for patients with patent recanalized femoral veins were available on 30 of 31 patients in group A and 12 of 13 patients in group B. The number of ulcers that either did not heal or recurred during the follow-up period was significantly lower in group A (8 of 30 patients) compared with group B (10 of 12 patients) ($P = .0008$).

Intact and refluxing vs stripped or ablated GSV in the context of a recanalized femoral vein. We also compared group C patients with an intact and refluxing GSV and underlying patent recanalized femoral vein with group B patients with a stripped or ablated GSV and underlying patent recanalized femoral vein. Again, group C patients (n = 10) showed a nonstatistically significant trend toward a shorter healing time compared with group B (n = 13) (median: 47 days, IQR: 110.75 vs median: 112 days, IQR: 564; $P = .0982$), with a greater probability of ulcer healing ($P = .0498$) (Fig 4). Long-term data were available on all 10 patients in group C with patent recanalized femoral veins. There was significantly less long-term recurrence in group C (1 of 10) compared with group B (10 of 12) ($P = .006$).

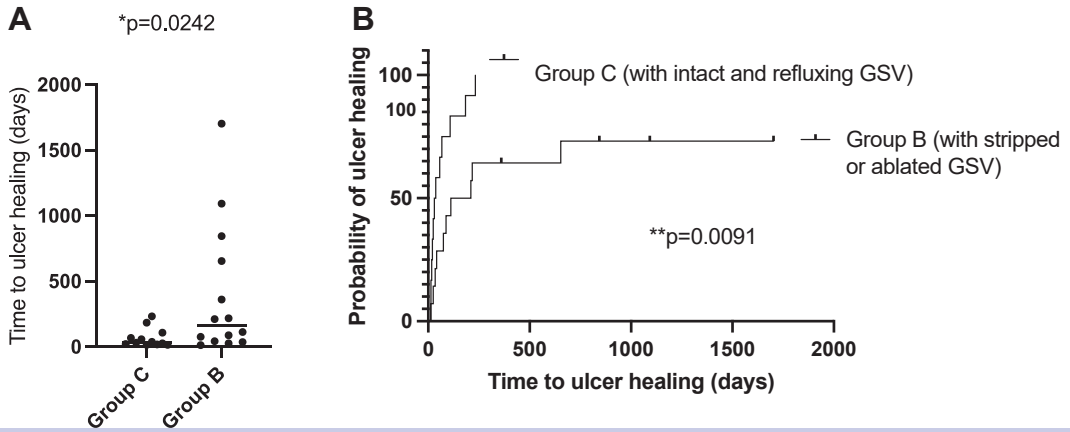

Fig 2. Comparing group C (with an intact and refluxing great saphenous vein [*GSV*]) and group B (with a stripped or ablated GSV) with respect to time to complete ulcer healing **(A)** and probability of ulcer healing **(B)**.

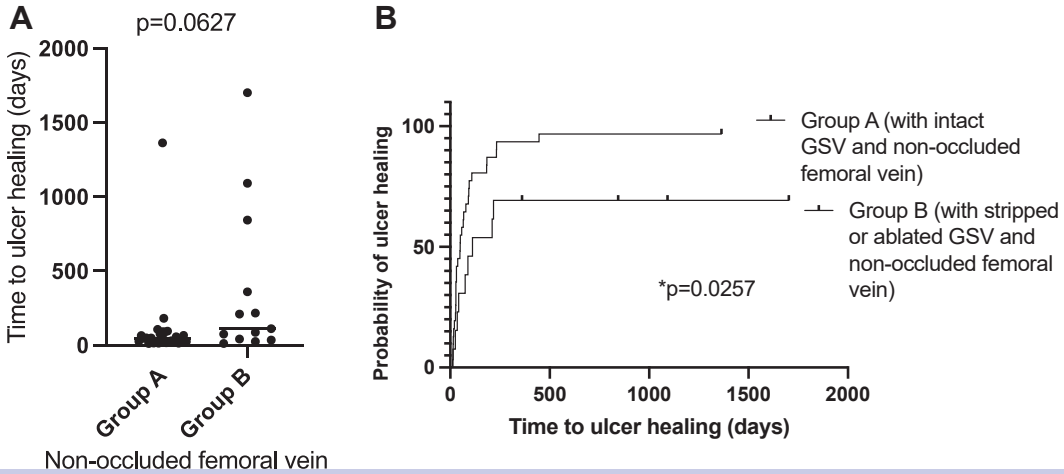

Fig 3. Comparing group A (with an intact great saphenous vein [*GSV*] and nonoccluded femoral vein) and group B (with a stripped or ablated GSV and nonoccluded femoral vein) with respect to time to complete ulcer healing **(A)** and probability of ulcer healing **(B)**.

DISCUSSION

Recanalization of the deep venous system after thrombosis is a complex process that varies in different segments. Incomplete recanalization often leads to functional obstruction, even when blood flow is partially restored.[13,14] The role of the GSV as a collateral channel in post-thrombotic femoropopliteal segments with partial or nonrecanalization is an important consideration. This study aimed to investigate the impact of GSV removal through ablation or stripping on the healing of VLUs in patients with post-thrombotic syndrome.

The Early Venous Reflux Ablation trial randomized patients with active VLU into a group that had early treatment of the refluxing GSV or a second group with no or delayed treatment of the refluxing GSV. They showed that early treatment of the GSV resulted in improved ulcer healing.[11] However, the trial did not specifically analyze the subgroup of patients with post-thrombotic deep venous systems. Similarly, to the best of our knowledge, no previous studies assessed the effect of treating the GSV in the presence of post-thrombotic changes in the deep venous system.

In this study, we assessed the effect of removal of the GSV on VLU healing in patients with post-thrombotic syndrome by comparing patients with an intact GSV (group A) with patients with an ablated GSV (group B). It was shown that ablation of the GSV was associated with significantly delayed VLU healing and significantly

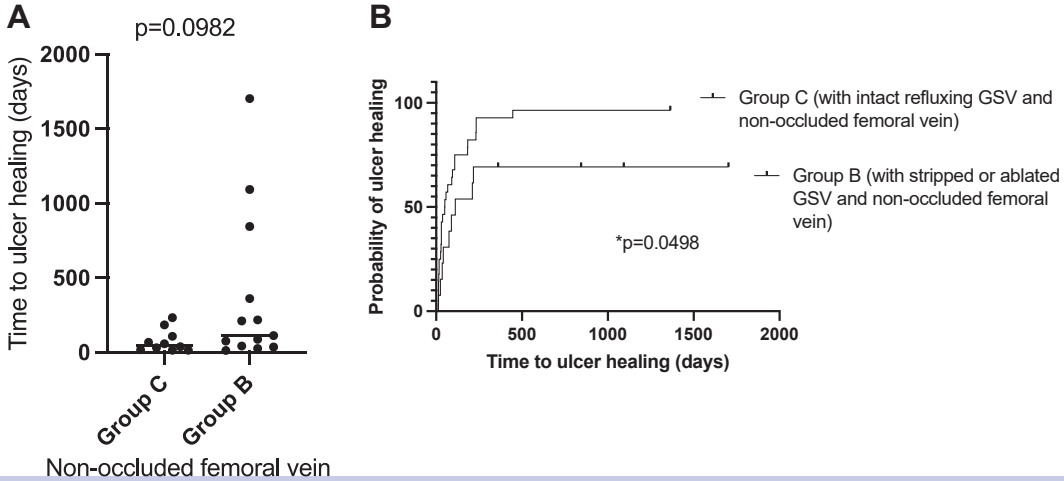

Fig 4. Comparing group C (with an intact refluxing GSV and nonoccluded femoral vein) and group B (with a stripped or ablated GSV and nonoccluded femoral vein) with respect to time to complete ulcer healing **(A)** and probability of ulcer healing **(B)**.

more ulcer recurrences in patients with post-thrombotic vein changes involving the femoropopliteal vein segment.

It is worth noting that the observed difference in outcomes between group A (intact GSV) and group B (ablated GSV) may not solely be attributed to the removal of the GSV. A plausible argument can be made that the difference reflects the severity of the underlying pathophysiology, as group B initially presented with involvement of both the superficial and deep venous systems, necessitating GSV treatment. To further investigate this, a subgroup analysis was conducted to compare patients with an intact but refluxing GSV (group C) with those with treated GSV (group B). The analysis revealed that patients with an intact GSV had better outcomes compared with those with an ablated GSV, even in the presence of untreated reflux. This suggests that the preservation of the intact GSV may contribute to improved outcomes, independent of the presence of reflux.

To address the question of how to approach a patient with a refluxing GSV and an underlying post-thrombotic but recanalized femoropopliteal segment, another analysis was performed by excluding patients with occluded nonrecanalized femoropopliteal veins from all groups. This analysis also showed a nonsignificant trend in favor of an intact GSV in terms of long-term recurrence rate and healing time, likely owing to the small numbers in each group.

These findings may appear to be contradictory to the recent guidelines from the European Society for Vascular Surgery,[15] which recommend considering the treatment of incompetent superficial veins in patients with combined superficial and deep venous incompetence. However, it is important to note that in group C, the superficial venous reflux in the periulcer area was treated using foam injection by UGFS without ablating the GSV. This approach allowed for the treatment of superficial venous reflux in the proximity of the ulcer while preserving the axial superficial veins, the latter of which may act as collateral pathways to compensate for the compromised deep venous system. Therefore, these findings still align with the guidelines, except for the ablation of axial reflux, which did not show benefit in this study.

It is crucial to highlight that all patients in this study had post-thrombotic changes in the femoropopliteal segment (Table II), which may explain the negative effect of removing the GSV on VLU healing in this group of patients.

A substantial number of our patients never healed their VLU or had ulcer recurrences during the follow-up period (27% in group A and 85% in group B). This can be attributed to the underlying pathology of the post-thrombotic deep venous system, which is known to cause delays in ulcer healing and increase the risk of recurrences.[16]

Limitations. There are several limitations of this study. The relatively small sample size may limit the generalizability of the findings. A larger prospective study would be valuable to validate these results. In addition, the study's retrospective design introduces the possibility of inherent biases and confounding factors that may have influenced the outcomes. Despite these limitations, the study provides important insights into the potential impact of GSV removal in the context of post-thrombotic deep venous systems, highlighting the need for further investigation in this area.

CONCLUSIONS

These data suggest that removal of the GSV through stripping or ablation in patients with post-thrombotic deep venous systems affecting the femoropoliteal segment may lead to delayed VLU healing and increased ulcer recurrence. This effect may be explained by the GSV serving as a collateral venous drainage pathway in the presence of a deep venous system, the lumen of which is compromised as a sequela of prior deep venous thrombosis. This finding needs to be further confirmed by a larger prospective study.

AUTHOR CONTRIBUTIONS

Conception and design: RB, WT
Analysis and interpretation: RB, AG, MT, JS
Data collection: RB, WT
Writing the article: RB, AG
Critical revision of the article: RB, AG, WT, MT, JS
Final approval of the article: RB, AG, WT, MT, JS
Statistical analysis: RB
Obtained funding: Not applicable
Overall responsibility: RB

DISCLOSURES

None.

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