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Venous Thrombosis in Handsewn vs. Coupled Venous Anastomoses in 857 Consecutive Breast Free Flaps

Anita R Kulkarni, MD[1], **Babak J Mehrara, MD**[1], **Andrea L Pusic, MD, MHS**[1], **Peter G Cordeiro, MD**[1], **Evan Matros, MD, MA**[1], **Colleen M McCarthy, MD, MS**[1], and **Joseph J Disa, MD**[1]

[1]Memorial Sloan-Kettering Cancer Center, New York, NY

Abstract

Background—The Anastomotic Coupling Device has demonstrated safety and efficacy; however, the coupler has never been compared directly to handsewn venous anastomoses exclusively in breast reconstruction. We hypothesized that rates of venous thrombosis would be lower using the coupler versus handsewn anastomoses in free flap breast reconstruction.

Methods—We performed a retrospective review utilizing clinic records, hospital records, and operative reports for 857 consecutive breast free flaps at a single institution from 1997-2012. Data was collected on reconstruction type, recipient vessels, timing, laterality, preoperative radiation, chemotherapy, venous thrombosis, and flap outcome. We compared rates of venous thrombosis between handsewn and coupled anastomoses for breast free flaps. Chi square test was used to calculate statistical significance.

Results—A total of 857 consecutive free flaps were performed for breast reconstruction in 647 patients over 16 years. The venous anastomosis was handsewn in 303 flaps, and the anastomotic coupler was used in 554 flaps. The rate of venous thrombosis requiring anastomotic revision in the handsewn group was 0.04% (12/303), compared to 0.01% in the coupled group (8/554; p=0.02).

Conclusion—The anastomotic coupler was more effective in preventing venous thrombosis than handsewn anastomoses in our series. While our study demonstrates improved patency rates using the venous coupler in breast reconstruction, we were unable to definitively separate this finding from potential confounding variables due to the low rates of thrombosis in both groups. Our data is consistent with current literature, which suggests that the coupler is a safe and effective alternative to hand sutured anastomoses.

Keywords

venous thrombosis; anastomotic coupling device; breast reconstruction

Corresponding Author Contact Information: Anita R. Kulkarni MD, ADDRESS: 11210 Old Georgetown Road, N Bethesda MD 20852, anitakulkarnimd@gmail.com, PHONE: 301-881-7770, FAX: 301-984-8601.

Introduction

The Anastomotic Coupling Device (ACD) has gained widespread popularity in venous anastomoses for microvascular free tissue transfer. Since the first metal coupling device was introduced in 1962 [1], several adaptations of materials and design have improved the efficacy and ease-of-use of anastomotic coupling devices. The currently favored device at Memorial Sloan-Kettering Cancer Center is the GEM Microvascular Anastomotic Coupler System (Synovis Micro Companies Alliance, Birmingham AL), a high-density polyethylene ring with interlocking stainless steel pins (Figure 1a). The system includes a vessel measurement gauge for coupler size selection, an anastomotic instrument to apply the coupler, and a coupler forceps to ensure accurate placement of vessel edges on the steel pins (Figure 1b).

The safety and efficacy of the ACD has been evaluated by several large series in recent years. The device has been shown to reduce operative time while maintaining a high level of vessel patency [2]. A recent meta-analysis including more than 3500 free flaps showed flap survival and revision-free application in more than 99% of cases [3]. Jandali et al reviewed 1000 consecutive breast free flaps using the ACD for venous anastomosis, and found a thrombosis rate of 0.6% [2]. Rozen et al compared coupled vs. handsewn anastomoses in 1000 reconstructive free tissue transfers to the breast, head and neck, and extremities, and found a coupler thrombosis rate of 2.9%, which was not significantly different than the handsewn group [4]. A similar comparison by Yap et al showed no difference in thrombosis rates of coupled vs. handsewn venous anastomoses in more than 700 free flaps [5]. The device has been evaluated extensively in head and neck reconstruction with similar positive findings [6-8].

The predominance of literature suggests excellent outcomes with use of the ACD for venous anastomoses. Possible reasons for high patency rates include rigidity of the anastomosis and improved intimal contact. The literature is unclear regarding utility of the ACD when a vessel size and thickness mismatch is present. While some reports suggest that ACDs protect against thrombosis in vessel mismatch by creating a rigid lumen, other studies have suggested that size and thickness mismatch can lead to crimping of the intima, subsequently increasing potential risk of thrombosis [9 10].

While the body of literature affirming the safety of ACDs is growing, to our knowledge, there has not been a large series directly comparing coupled vs. handsewn anastomoses exclusively in breast reconstruction. This comparison is particularly important to plastic surgeons given that microsurgical breast reconstruction is one of the most common uses of free tissue transfers among plastic surgeons nationally. While other applications of microsurgery, such as head and neck reconstruction, have extended to the scope of practice of other specialties, microsurgical breast reconstruction remains nearly exclusively the domain of plastic surgeons.

Our institution transitioned to the routine use of the coupler for venous anastomosis in breast reconstruction around 2007. We hypothesized that rates of venous thrombosis requiring revision would be lower using the coupler versus handsewn anastomoses.

Methods

We performed a retrospective review utilizing clinic records, hospital records, and operative reports for 857 consecutive breast free flaps at Memorial Sloan-Kettering Cancer Center from 1997-2012. Surgeries were performed at a single institution by 6 surgeons with the assistance of microsurgical fellows. All surgeons performed both handsewn and coupled venous anastomoses. After approval by the institutional review board, data was collected on type of reconstruction (Transverse Rectus Abdominis Myocutaneous flap vs. Muscle-Sparing Transverse Rectus Abdominis Myocutaneous flap vs. Deep Inferior Epigastric Perforator vs. Superior Gluteal Artery Perforator), recipient vessels (internal mammary vs. thoracodorsal), timing (immediate vs. delayed), laterality (unilateral vs. bilateral), preoperative radiation, and preoperative chemotherapy. The technique of venous anastomosis (venous coupler vs. handsewn), and the size of coupler (2.0 mm – 3.5 mm) were evaluated. Outcomes of interest were venous thrombosis requiring reoperation with revision of anastomosis, and flap salvage.

Venous thrombosis was defined as clinically significant venous congestion requiring return to the operating room and revision of anastomosis. Cases in which the venous circulation was compromised secondary to arterial occlusion were excluded. Cases in which venous congestion was suspected preoperatively, but no thrombosis was identified intra-operatively and no revision of anastomosis was performed, were also excluded. We compared rates of true venous thrombosis requiring reoperation among patients with coupled anastomoses vs. handsewn anastomoses. Chi square test was used to calculate statistical significance ($p<0.05$).

Results

A total of 857 consecutive free flaps were performed for breast reconstruction in 647 patients over 16 years. The venous anastomosis was handsewn using 8.0 or 9.0 nylon suture in 303 flaps, and the anastomotic coupler was used in 554 flaps. Most free flaps performed were muscle-sparing transverse rectus abdominis myocutaneous (MS-TRAM, 50.4%) or deep inferior epigastric perforator (DIEP, 41.3%) flaps. The handsewn group was more likely to utilize the thoracodorsal system for recipient vessels (51.2%), while the coupled group was more likely to utilize the internal mammary system (92.4%). The coupled group was more likely than the handsewn group to be reconstructed in a delayed fashion (36.3% vs. 20%), to be bilateral (56.7% vs. 37%), and to receive chemotherapy and radiation (34.7% vs. 25.1%; 37.2% vs. 26.7%) (Table 1).

The rate of venous thrombosis requiring anastomotic revision in the handsewn group was 0.04% (12/303), compared to 0.01% in the coupled group (8/554; p=0.02). The venous thrombosis events were distributed across flap types in both the handsewn and coupled groups (Table 2). Most thrombotic events occurred in MS-TRAM or DIEP flaps; however, this is likely due to the low numbers of alternative flaps evaluated in this study. Immediate reconstruction in both groups was more likely to result in venous thrombosis vs. delayed reconstruction. Similar numbers of thrombotic events occurred in radiated patients in both groups. Descriptive analysis of the individual thrombotic events in the handsewn vs. coupled

group did not reveal any differences between them; however, analysis for statistical significance was not possible due to the low numbers of thrombotic events in each group.

The size of the venous coupler utilized for anastomosis did not appear to have an effect on rate of venous thrombosis (Figure 2). More than 85% of anastomoses in both the non-thrombosed and thrombosed group were performed with 2.5 mm or 3.0 mm couplers. The distribution of coupler size was roughly equivalent in both groups.

Discussion

The venous anastomosis remains one of the most challenging and critical aspects of microsurgery. Venous thrombosis continues to be the leading cause of free flap failure; therefore, technical advancements that potentially reduce risk of venous thrombosis are particularly valuable to microsurgeons [11 12]. The goal of any microsurgical device is to maintain vessel patency while simultaneously improving technical ease and reducing operative time. The anastomotic coupler meets these requirements and has therefore gained widespread popularity [3 13-16].

In our series of breast free flaps, use of the anastomotic coupler resulted in fewer venous thrombosis events than handsewn anastomoses. Previous studies have shown similar rates of thrombosis between coupled and handsewn anastomoses, though no study to our knowledge has focused exclusively on breast reconstruction to compare the two techniques[2 4 5 17-19]. While our study demonstrates improved patency rates using the venous coupler in breast reconstruction, we were unable to definitively separate this finding from potential confounding variables due to the low rates of thrombosis in both groups. Our data is consistent with current literature, which suggests that the coupler is a safe and effective alternative to hand sutured anastomoses.

The success of the venous coupler in achieving vessel patency may be related to a number of factors that have been discussed in the literature. The learning curve for device utilization is fairly rapid owing to the technical ease of application. Our thrombotic events in the coupled group were evenly distributed over the time period of the study, suggesting that thrombotic events did not decrease with user experience. There may be greater intimal contact versus traditional suture techniques, as the device forces eversion of vessel edges prior to anastomotic connection. This ensures continuous contact along the entire vessel, which may be more difficult to achieve with hand-placed sutures distributed at self-selected intervals. The rigidity of the rings may prevent turbulent flow at the anastomosis that could contribute to venous thrombosis, and may further protect against vasospasm at the anastomotic site. Finally, by creating an anastomosis with a rigid circumference determined by the diameter of the ring, vessel size mismatches can be effectively addressed without relying largely on technical skill [9].

Our study is chiefly limited by the small number of thrombotic events in both groups. This limited our ability to perform detailed statistical analysis, including multiple logistic regression, to eliminate confounding variables that may have affected our conclusion.

Conclusions

This is the largest series to date directly comparing rates of venous thrombosis in coupled vs. handsewn anastomoses exclusively in breast reconstruction. Our study adds to the growing body of literature supporting widespread use of the coupler as a safe, effective, reliable, and reproducible means of vessel anastomosis.

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Abbreviations

ACD	Anastomotic Coupling Device
TRAM	Transverse Rectus Abdominis Myocutaneous flap
MS-TRAM	Muscle-Sparing Transverse Rectus Abdominis Myocutaneous flap
DIEP	Deep Inferior Epigastric Perforator flap

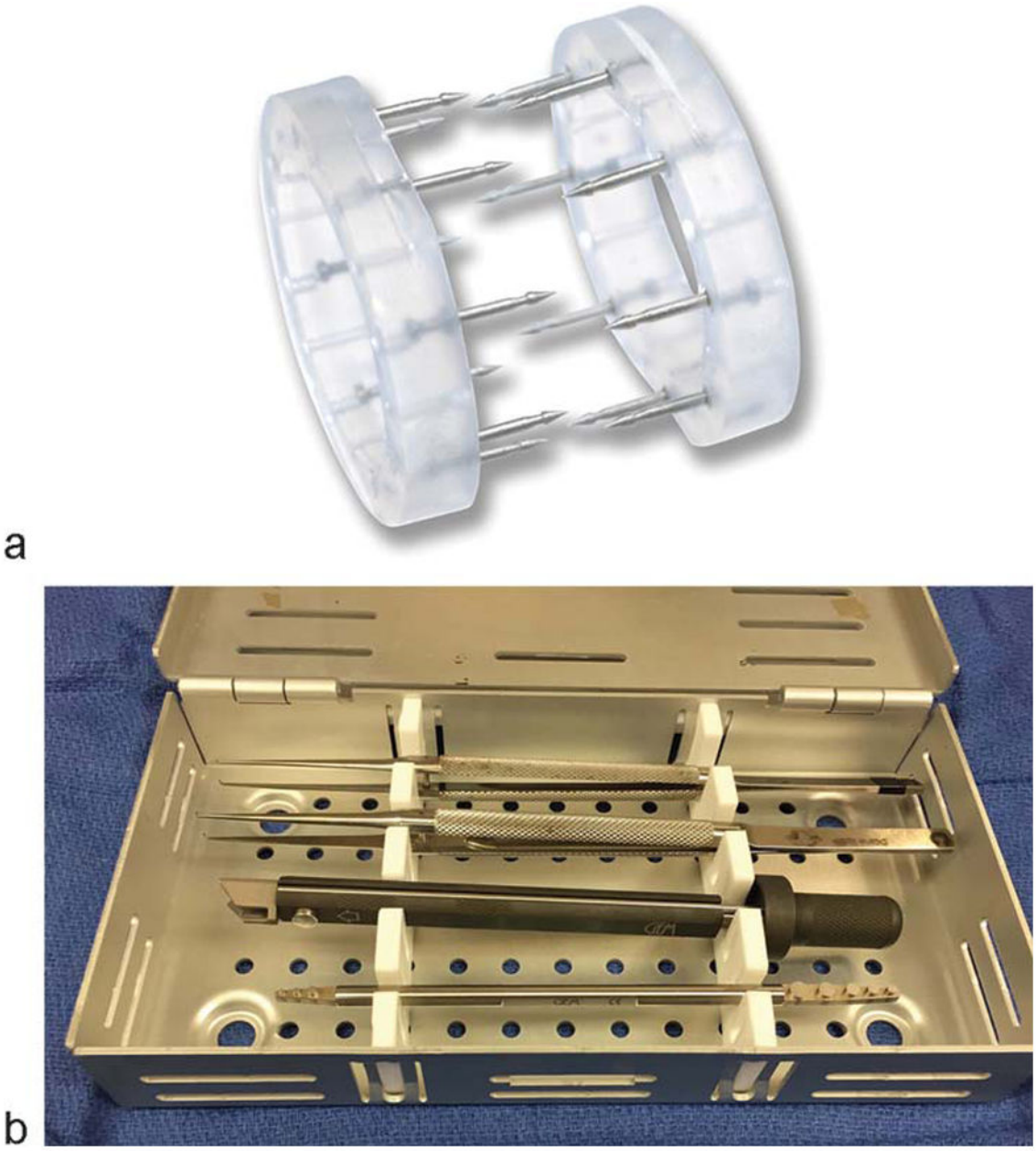

Figure 1.
(a) GEM Microvascular Anastomotic Coupler (Synovis Micro Companies Alliance, Birmingham AL). (b) Coupler instrument tray including coupler forceps (2), anastomotic instrument, and vessel measuring gauge.

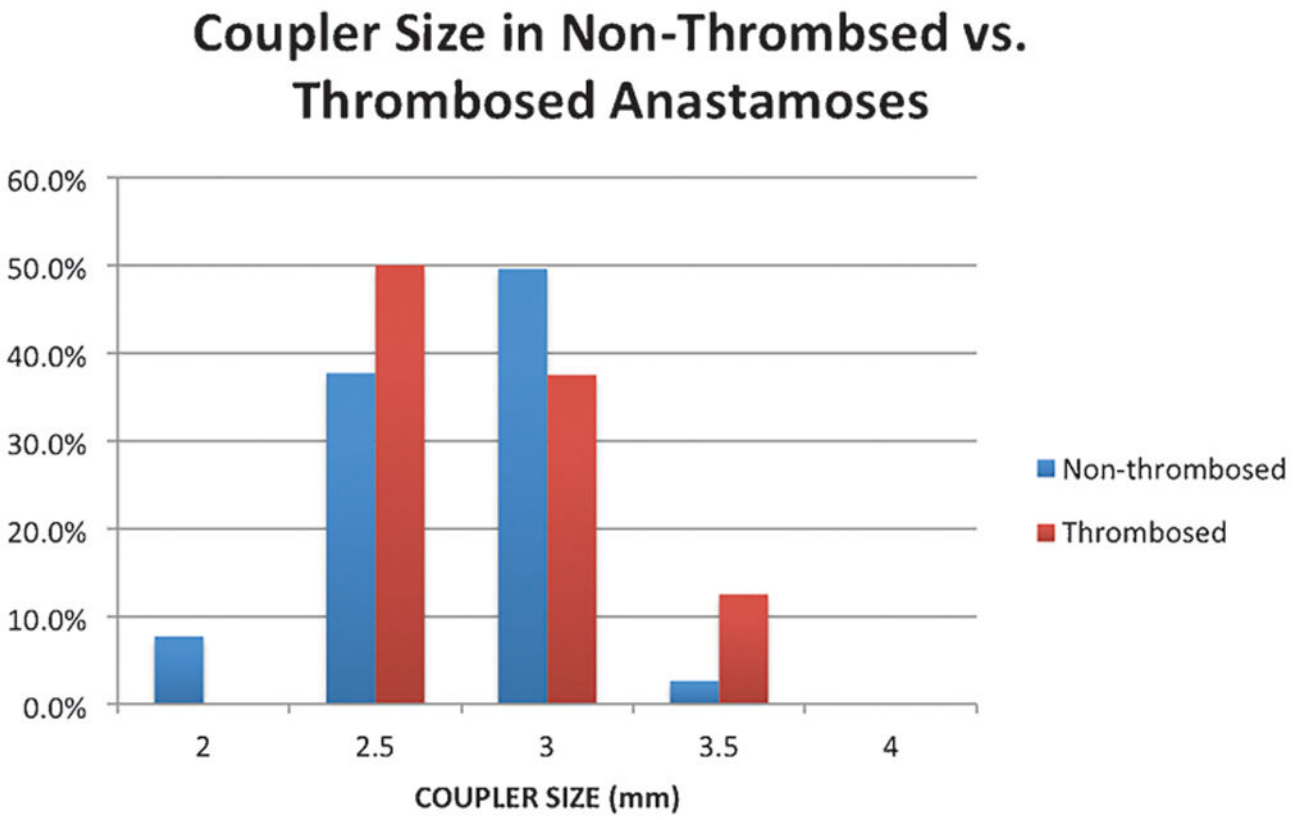

Figure 2. Diameter of venous coupler used in successful venous anastomoses vs. anastomoses that experienced thrombosis

Table 1

Study sample demographics of handsewn vs. coupled venous anastomoses. Study Sample Demographics (N=857 flaps)

Variables	HANDSEWN (n=303)		COUPLED (n=554)		p-value
Type of Reconstruction					
MS-TRAM	160	(52.8%)	272	(49.1%)	0.30
DIEP	92	(30.4%)	262	(47.3%)	<0.001
Free TRAM	41	(13.5%)	10	(0.02%)	<0.001
SIEA	4	(0.01%)	4	(0.01%)	0.38
SGAP	6	(0.02%)	1	(0.001%)	0.005
TUG	0	(0%)	5	(0.01%)	0.10
Recipient Vessel					
IMA/IMV	147	(48.5%)	512	(92.4%)	<0.001
TDA/TDV	155	(51.2%)	41	(7.4%)	<0.001
Other	1	(0.3%)	1	(0.2%)	0.66
Timing of Reconstruction					
Immediate	242	(80%)	353	(63.7%)	<0.001
Delayed	61	(20%)	201	(36.3%)	
Laterality					
Unilateral	191	(63%)	240	(43.3%)	<0.001
Bilateral	112	(37%)	314	(56.7%)	
Preoperative Radiation	81	(26.7%)	206	(37.2%)	0.002
Preoperative Chemotherapy	76	(25.1%)	192	(34.7%)	0.002
Venous thrombosis requiring revision	12	(0.04%)	8	(0.01%)	0.02

Table 2

Descriptive variables of venous thrombosis events in handsewn vs. coupled anastomoses

Variables	HANDSEWN (n=12)	COUPLED (n=8)
Type of Reconstruction		
MS-TRAM	5	3
DIEP	3	5
Free TRAM	2	-
SIEA	-	-
SGAP	2	-
TUG	-	-
Recipient Vessels		
IMA/IMV	10	8
TDA/TDV	2	-
Other		
Timing of Reconstruction		
Immediate	10	6
Delayed	2	2
Laterality		
Unilateral	4	4
Bilateral	8	4
Preoperative Radiation	5	5
Preoperative Chemotherapy	3	4
Flap Salvage	10	4