Status in the US of the RelayBranch Investigational Device for Repair of Aortic Lesions.

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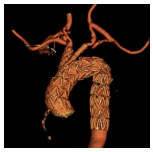
Disclosure Statement

- ***Consultant***
  - Cook
  - Terumo Aortic
  - W. L. Gore

RelayBranch Investigational Device

Double Branch Devices

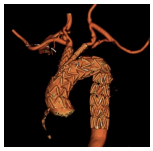
- Terumo Relay Branch - Zone 0
- Advantages
  - ✓ Accuracy of deployment
  - ✓ Single window for port access
  - ✓ Conformability in the arch
  - ✓ Off the shelf design
  - ✓ Dual antegrade cerebral perfusion



RelayBranch Investigational Device

Double Branch Devices

- Terumo Relay Branch device - Zone 0
- Disadvantages
  - ✓ Arch manipulations
  - ✓ Retrograde carotid access
  - ✓ No arm access to the descending aorta
  - ✓ Need to cross the valve for deployment
  - ✓ Profile/delivery system of the branch components -14Fr



RelayBranch Early Feasibility Study

STUDY DEFINITION
/// Early Feasibility Study of the Relay Branch Thoracic Stent-Graft System in Subjects with Thoracic Aortic Pathologies Requiring Treatment Proximal to the Origin of the Innominate Artery

STUDY DESIGN
/// Prospective, Multicenter, Non-Blinded, Non-Randomized Early Feasibility Study

 # PATIENTS

/// Enrollment was initiated in January 2018 and completed
/// 30th subject completed 30-day follow-up (September 2022)
/// FDA approved enrollment expansion to 40

SITES
/// 12 initial investigational sites in the United States:

Cleveland Clinic Foundation, Washington University/Barnes Jewish Hospital University, University of Pennsylvania/Penn Presbyterian Medical Center, Massachusetts General Hospital, Emory University, Columbia Medical Center, Baylor St. Luke's Medical Center, Duke University, Baylor Scott & White, University of Maryland – Baltimore, University of Florida, and USC

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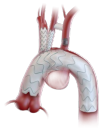
RelayBranch EFS Snapshot

Pathologies: complex and extensive disease

		N=30 n (%)
Aneurysm		26 (86.7)
PAU with IMH		4 (13.3)
PAU without IMH		1 (3.3)
Dissection		6 (20.0)
IMH (only)		1 (3.3)
Arch Zones		
	Zone 0	2 (6.7)
	Zone 1	2 (6.7)
	Zone 2	19 (63.3)
	Zone 3	7 (23.3)

*Subjects could have more than one lesion type.



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RelayBranch EFS Snapshot

Early Experience

	N=30
Technical Success [a]	
Main Body	27 (90.0%)
Entire Device System	24 (80.0%)
All-cause mortality [b]	2 (6.7%)
Myocardial infarct [b]	1 (3.3%)
Procedural blood loss >1,000 mL [b]	2 (6.7%)
Paralysis (temporary) [b]	1 (3.3%)
Renal failure [b]	1 (3.3%)
Neurological events [b]	14 (46.7%)
Fatal [c]	1 (3.3%)
Continuing	5 (16.7%)
Resolved	8 (26.7%)

[a] Site Reported Data.
[b] All other events adjudicated by the Clinical Events Committee (CEC)
[c] Subject's B01-002 and B03-001 had neurological events at POD 0 and POD 20. They expired at POD 11 and POD 246 respectively.

Snapshot of 30-day outcomes (day 0- day 30) on first 30 patients

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Terumo RelayBranch EFS Snapshot

Neurological events overview and outcomes

Total number of subjects with neurological events, n=19

- 14 subject's neurological events were within 30-days
  - 11 were embolic strokes (1 fatal, 6 resolved, 4 continuing)
  - 2 were hemorrhagic strokes (1 resolved, and 1 continuing)
  - 1 was a retinal occlusion (resolved)
- 5 subject's neurological events were greater than 30-days
  - 2 subject's neuro events within 1-year
    - 2 were embolic strokes (1 resolved, 1 continued)
  - 3 subject's neuro events greater than 1-year
    - 3 were embolic strokes (2 resolved, 1 continued)

The **location** and **size** of the infarcts varied quite widely so the exact etiology of the events has been difficult to discern, especially for embolic strokes

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Terumo RelayBranch EFS

Patient Selection Advisory Committee (PSAC)

- The PSAC assesses the individual benefit/risk ratio for each patient.
- Includes investigators, clinical stroke neurologists, and experienced RelayBranch users from Europe.
- Patient assessments include determining the individual benefit/risk ratio for that patient based on pathology, comorbidities, risk factors, and anatomy.
- PSAC assessment includes elements that can compound risk (CAD, atherosclerotic disease, renal insufficiency, large aortic diameter) but are not by themselves exclusion criteria but may trigger additional mitigation strategies such as:
  - Appropriateness of antiplatelet treatment regime, TCD monitoring, staging, vascular access, sizing requirements, additional neuroprotective measures, and other strategies recommended by the committee or treating physician.

Only subjects considered high risk or prohibitive risk for conventional surgery by treating physician or aortic team are enrolled.

Terumo RelayBranch EFS Snapshot

Snapshot of neurological events

	Total Subjects N=30 n (%)	Prior to PSAC n=18 n (%)	After PSAC n=12 n (%)	First 6 subjects after PSAC n=6 n (%)	Last 6 subjects after PSAC n=6 n (%)
Neurological events[a]	19 (63.3)	12 (66.7)	7 (58.3)	5 (83.3)	2 (33.3)
<48 hours	10 (33.3)	7 (38.9)	3 (25.0)	2 (33.3)	1 (16.7)
>48 hours	4 (13.3)	3 (16.7)	1 (8.3)	1 (16.7)	0
>30 days	2 (6.7)	0	2 (16.7)	2 (33.3)	0
>1 year	3 (10.0)	2 (11.1)	1 (8.3)	0	1 (16.7)
Related to Death [b]	2 (6.7)	2 (11.1)	0	0	0

[a] *Five subjects had multiple neurological events (B02-002, B03-001, B03-002, B08-001, B10-002). Only the first event is included in this table.*
[b] *Patients B01-002 and B03-001 had neurological events at POD 0 and POD 20. They expired at POD 11 and POD 246 respectively.*

46.6% of initial neurological events were within 30-days (n=14/30)

When comparing the first and last subjects enrolled after the implementation of the PSAC, the NE rate **DECREASED**

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RelayBranch EFS Snapshot

Device Integrity and performance

	30-Day	6-Month	1-Year	2-Year	3-Year	4-Year	5-Year
Number of Subjects with Adequate Imaging [a]	28	24	18	14	10	5	5
Loss of Patency							
Main Body	0	0	0	0	0	0	0
Innominate Branch	0	1*	0	0	0	0	0
LCCA Branch	0	0	0	1	0	0	0
Subjects with Adequate Imaging	27	23	18	14	9	5	5
Migration (protocol-defined)							
Main Body, Proximal	NA	0	0	0	0	0	0
Main Body, Distal	NA	0	0	0	0	0	0
Innominate Branch	NA	0	0	0	0	0	0
LCCA Branch	NA	0	0	0	0	0	0
Subjects with Adequate Imaging	25	20	18	12	8	5	4
Stent Fracture							
Main Body	0	0	0	0	0	0	0
Innominate Branch	0	0	0	0	0	0	0
LCCA Branch	0	0	0	0	0	0	0
Subjects with Adequate Imaging	28	24	18	14	10	5	1
Graft Kink / Twist	0	0	0	0	0	0	0
Component Separation	0	0	0	0	0	0	0
Misalignment / Birdbreaking	0	0	0	0	0	0	0
Extrusion / Erosion	0	0	0	0	0	0	0
Subjects w/o Device Integrity Observations	28 (100.0)	23 (95.8)	18 (100.0)	13 (92.9)	10 (100.0)	5 (100.0)	5 (100.0)

*Includes Unscheduled visits. Core Lab Reported data.

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RelayBranch EFS Snapshot

Endoleaks: overall good performance outcome

	Intra-operative n (%)	30 days n (%)	6 months n (%)	1-Year n (%)	2-Year n (%)	3-Year n (%)	4-Year n (%)	5-Year n (%)
Adequate imaging[1]	30	28	24	18	14	10	5	5
Type Ia	0	0	0	0	0	0	0	0
Type Ib	1 (3.3)	1 (3.6)	1 (4.2)	1 (5.6)	1 (7.1)	0	0	0
Type Ic	1 (3.3)	0	0	0	0	0	0	0
Type II	0	1 (3.6)	0	0	1 (7.1)	0	0	0
Type III	0	0	0	0	0	0	0	0
Type IV	0	0	0	0	0	0	0	0
Unknown	0	1 (3.6)	0	0	0	0	0	0
No endoleaks	28 (93.3)	26 (92.9)	23 (95.8)	17 (94.4)	12 (85.7)	10 (100)	5 (100)	5 (100)

[1] *Core Laboratory reported data.*

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Terumo RelayBranch Technology

Technical Tips for Success

- **Preoperative Preparation and patient selection**
  - ✓ Patient assessment: echocardiography, carotid duplex, laboratory work-up, CT/MRI
  - ✓ Staging bypass/revascularization
  - ✓ CSF drainage and central nervous system monitoring (i.e., cerebral oximetry, TCD, etc.)
  - ✓ Multilumen central venous catheter in CFV
  - ✓ Recommended endovascular toolkit
- **Procedure Considerations/ Bailouts**
  - ✓ Access options (femoral, RCCA, and LCCA)
  - ✓ Clamping of CCA
  - ✓ Rapid ventricular pacing
  - ✓ Arterial flushing and cerebral perfusion
  - ✓ Staged branch deployment and extensions


Technical tips and clinical experience with the Terumo Relay®Branch aortic endovascular graft

Holzem KH, Sanchez LA, Cardiovasc Surg 2023

Terumo RelayBranch Technology

Key takeaways

- The initial feasibility study enrollment for RelayBranch (n=30) is complete
  - ✓ 30-day follow-up data presented here
  - ✓ Overall results have shown excellent effectiveness
  - ✓ Enrollment is paused until further analysis on NE can be completed
  - ✓ Compassionate use cases continue to be assessed
- The rate of the neurological events is high
  - ✓ Slight improvement in incidence of early stroke
  - ✓ Late stroke (>30 days) remains a concern
- What has been done
  - ✓ More sophisticated patient selection (Patient Selection Advisory Committee)
  - ✓ Tighter eligibility
  - ✓ Greater awareness of how risk factors compound
  - ✓ More prescriptive procedure, more attention to antiplatelet therapy, and precedents of TAVR and carotid stenting, for example

This procedure is very complex (Zone 0 TEVAR + stenting both carotids), therefore it should be reserved for patients that do not have any reasonable alternative treatment options.

Terumo RelayBranch Technology

Future Work

- Modeling the risk of Stroke
  - ✓ **Elucid** is an FDA-cleared, non-invasive CTA analysis software that provides specificity of plaque stability and vessel structure, based on histology.

Terumo RelayBranch Technology

Future Work

- ✓ ***Terumo Aortic*** has partnered with ***ELUCID***, who will assess, map, and model the atherosclerotic burden in ***RelayBranch*** subjects, using preoperative CT imaging and clinical parameters, with the aim of developing a predictive algorithm for patient outcomes, specifically for stroke.
- ✓ Additionally, ***Terumo Aortic*** is looking into a possible redesign of the device branches or potential partnership with an existing branch technology.