Aortic Dissections after Transcatheter Aortic Valve Replacement

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Introduction

- Incidence of Aortic Dissection after TAVR: 0.2 – 1.9%
  - Based solely on registry studies without granular data
  - No differentiation of type A or B dissection

- Characteristics & Management
  - Poorly understood (only successfully managed case reports published)

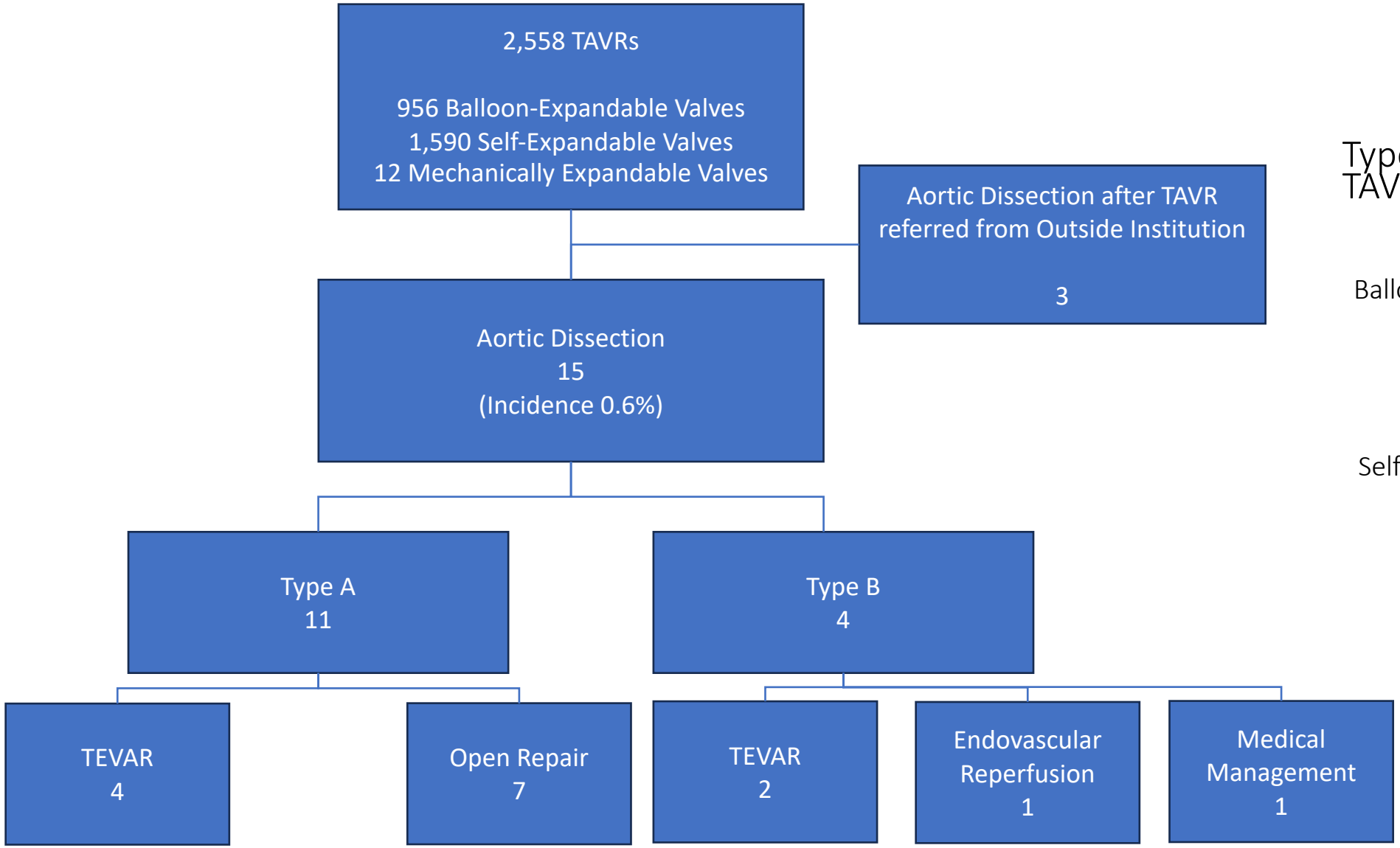
Langer NB, et al. Injuries to the Aorta, Aortic Annulus, and Left Ventricle During Transcatheter Aortic Valve Replacement: Management and Outcomes. Circ Cardiovasc Interv. 2017 Jan;10(1):e004735.

Objectives —Aortic Dissections and TAVR

- Describe the incidence, characteristics, management and outcomes of aortic dissections based on our 12-year TAVR experience

- Share lessons learned from this series

Cohort —Aortic Dissections and TAVR



Type A Aortic dissection by TAVR valve type

Balloon-expandable: 0.1% (1/956)

VS

Self-expandable: 0.6% (10/1,590)

P=0.062

Timing of Diagnosis and Interventions

	Type A 11	Type B 4
Intraoperative:		
Pre-deployment	TEVAR (n=1)	
Post-deployment	TEVAR (n=2) Open Repair (n=2)	TEVAR (n=1) Endovascular Reperfusion (n=1) Medical Management (n=1)
Post Discharge		
Less than 3 months	TEVAR (n=1) Open Repair (n=3)	TEVAR (n=1)
Greater than 3 months	Open Repair (n=2)	

Demographics —Aortic Dissections and TAVR

Characteristics	N=15 (%)
Age (Years)	79.5 (IQR 72.3 – 90.5)
Female	6 (40.0%)
Diabetes	3 (20.0%)
Frailty	9 (60.0%)
Previous stroke	3 (20.0%)
Coronary artery disease	7 (46.6%)
Chronic kidney disease	6 (40.0%)
Dialysis	1 (6.7%)
Home O2 therapy	3 (20.0%)
STS-PROM (%)	8.5 (IQR 7.3 – 14.3)
Previous cardiovascular surgery	
SAVR	2 (13.3%)
Aortic root repair	2 (13.3%)
Ascending and partial aortic arch repair	1 (6.7%)
CABG	2 (13.3%)
Endovascular abdominal aortic repair	3 (20.0%)

Characterized by
- High-risk
- Frail
- Multiple comorbidities

Aortic Characteristics: Type A Group (n=11)

Patient	Age Gender	Aortic risk factors	Associated aortic complications	Intimal tear location	Aortic dissection mechanism	Dx timing (Dx imaging)
1	86 M	- h/o ascending IMH - Moderately dilated ascending aorta (46 mm) - Horizontal aorta	Cerebral malperfusion	STJ (greater curvature)	TAVR valve deployment	Post-deployment (aortography, dampened right radial pressure)
2	79 F	- Mildly dilated ascending aorta (43 mm) - Horizontal aorta - Immunosuppression	Cerebral malperfusion, hemopericardium	Mid ascending (greater curvature)	TAVR device delivery system passage	Post-deployment (aortography, dampened right radial pressure)
3	71 F	- Moderately dilated ascending aorta (45 mm)	None	Root (greater curvature)	TAVR device delivery system passage	Pre-deployment (pre-deployment aortography)
4	93 F	- Moderately dilated ascending aorta (45 mm) - Horizontal aorta	None	STJ (greater curvature)	Distal TAVR stent frame contact to the aorta	1.5 months post-TAVR (CTA)
5	72 M	- Mildly dilated ascending aorta (43 mm) - Intimal plaque at STJ	Large pseudoaneurysm	STJ (greater curvature)	Distal TAVR stent frame contact to the aorta	Late (CTA)
6	85 F	- Horizontal aorta	None	STJ (greater curvature)	Snaring for distal migration	2 days post-TAVR (CTA)
7	25 M	- Large aortic root (47 mm) - Horizontal aorta	None	STJ (greater curvature)	Repeat deployment and recapturing	Late (CTA)
8	71 M	- Horizontal aorta - Elongated aorta	None	STJ (greater curvature)	Repeat deployment and recapturing	10 days post-TAVR (CTA)
9	78 F	- Moderately dilated ascending aorta (48 mm)	Cerebral malperfusion	STJ (greater curvature)	Retrograde migration requiring 2nd TAVR	Late (CTA)
10	78 M	- Moderately dilated ascending aorta (45 mm)	Rupture Hemopericardium	Root (greater curvature)	TAVR valve deployment	Post-deployment (echo)
11	76 M	- Infrarenal aortic aneurysm	None	Root (greater curvature)	Repeat deployment and recapturing	Post-deployment (echo)

All patients had ascending aortic dilatation/horizontal aorta/Entry tear all located along greater curvature

Interventions and Outcomes: Type A Group (n=11)

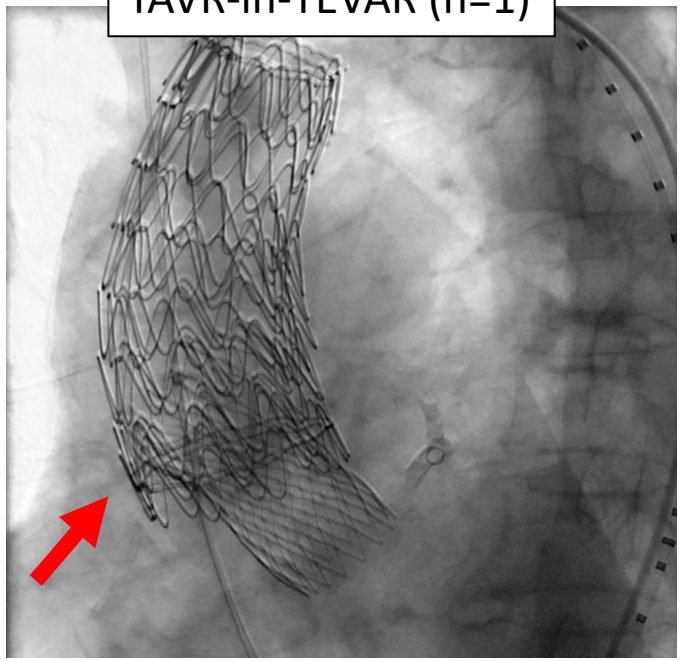
Patient	Management	Dx timing Entry tear location	Procedural success	Outcomes
1	TEVAR	Post-TAVR deployment STJ	No (incomplete entry tear coverage)	Death on POD#2 (sudden cardiac arrest)
2	TEVAR, innominate artery stenting	Post-TAVR deployment Mid ascending	Yes	Death on POD#5 (massive stroke)
3	TEVAR	Pre-TAVR deployment Root	Yes	Death on POD#5 (sudden cardiac arrest)
4	TEVAR	Post-TAVR deployment (1.5 months) STJ	No (incomplete entry tear coverage)	Death on POD#18 (palliative care)
5	Root & ascending repair	Late STJ	Yes	Alive (3 years)
6	Ascending & hemiarch repair	Post-discharge (2 days) STJ	Yes	Alive (2 years)
7	Root & ascending repair	Late STJ	Yes	Alive (7 months)
8	Ascending repair	Post-discharge (10 days) STJ	Yes	Alive (4 months)
9	Ascending & hemiarch repair	Late STJ	Yes	Alive (4 months)
10	Root & ascending repair	Post-TAVR deployment Root	Yes	Alive (1 month)
11	Root & ascending repair	Post-TAVR deployment STJ	Yes	Alive

TEVAR, thoracic endovascular aortic repair; POD, postoperative day

Lessons Learned: Type A Group

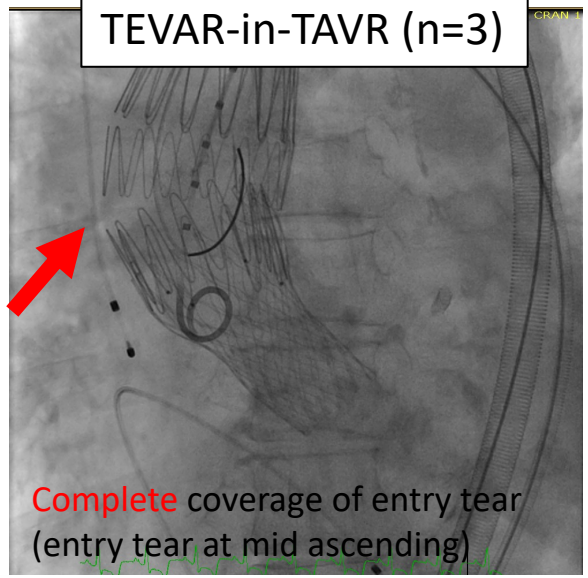
- All had ascending aorta pathology at baseline
- Most patients demonstrated unfavorable features for conservative management (malperfusion, hemopericardium, proximal entry tears)
- Entry tears mostly located at proximal aorta (STJ or more proximal) always along greater curvature
- Presence of TAVR valve and associated proximal landing difficulty (TEVAR-in-TAVR configuration, figures)
- Lack of dedicated CTA to assess TEVAR feasibility for immediate TEVAR management
- Lack of dedicated aortic prosthesis for ascending TEVAR
- Open repair is highly warranted if patients are surgical candidates

TAVR-in-TEVAR (n=1)



Complete coverage of entry tear at STJ
(Aortic dissection recognized prior to TAVR implantation)

TEVAR-in-TAVR (n=3)



Complete coverage of entry tear (entry tear at mid ascending)

Incomplete coverage of entry tear (entry tear at STJ)

Aortic Characteristics: Type B Group (n=4)

Patient	Age, gender	Aortic risk factors	Associated aortic complications	Intimal tear location	Aortic dissection mechanism	Timing of Dx (imaging)
12	80, M	Ascending aortic dilatation (43 mm)	Rapidly growing aneurysm (3.5 cm → 7.4 cm/3months), leg malperfusion	Zone 3	Intimal tear from embolized & snared TAVR stent frame	3 months (CTA)
13	92, F	Severe aortic calcification	Retrograde type A aortic dissection	Zone 3	TAVR device delivery system passage	Post-deployment (completion aortography)
14	73, M	Severe aortic tortuosity	Leg malperfusion	Zone 3	TAVR device delivery system passage	Post-deployment (lack of femoral pulse)
15	86, M	Severe aortic tortuosity, ascending aortic aneurysm (55 mm)	Renal malperfusion	Zone 3	Repetitive TAVR device delivery system passage (aorta too long and the device did not reach the valve)	Pre-deployment (aortography)

Outcomes: Type B Group (n=4)

Patient	Management	Procedural success	Outcomes
12	Zone 1 trans-embolized TAVR TEVAR using laser aortic septotomy	Yes	Alive, positive aortic remodeling (2 years)
13	Zone 2 TEVAR	Yes	Alive, positive aortic remodeling (4 years)
14	Endovascular reperfusion using dissection flap fenestration/true lumen & bilateral iliac stenting (No TEVAR)	Yes	Alive for 8 years, died of aortic rupture (known 6 cm aneurysm)
15	Medical management	N/A	Died of end-organ malperfusion and multi-organ failure

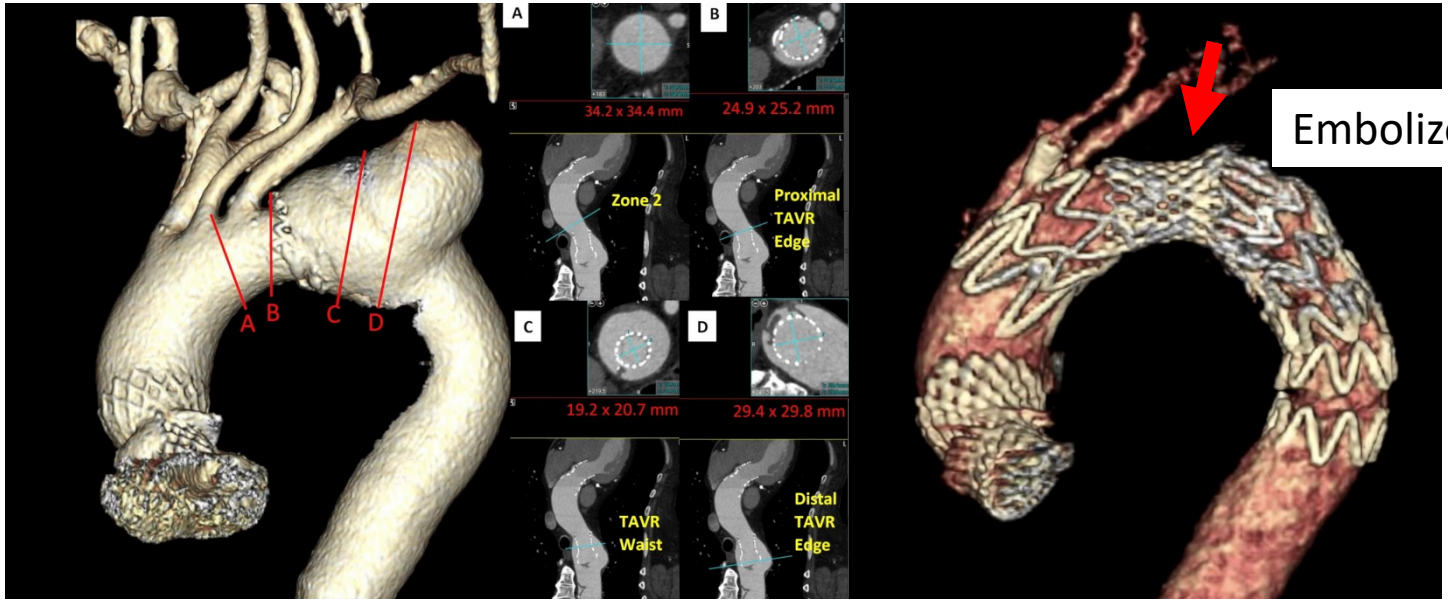
Both TEVAR cases resulted in positive aortic remodeling

Lessons Learned: Type B Group

- Favorable outcomes with TEVAR

- TEVAR and entry coverage at acute stage may be highly warranted
  - Patient#12 with chronic dissection required a complex TEVAR (Figure below)
  - patient#14 without TEVAR developed large aortic aneurysm (Figure right) and eventually died of rupture

"Trans-TAVR" TEVAR (Patient#12)



Fenestration & stent alone without TEVAR (Patient#14)

Summary —Aortic Dissections and TAVR

- Underlying aortic pathology (dilated aorta) **+/-** catheter manipulations associated with implantation difficulty (horizontal aorta) are the main mechanism of aortic dissection.

- Preoperative aorta assessment and avoiding TAVR in patients with such characteristics can make the incidence almost zero (currently 0.6%).

- Open repair is preferred to TEVAR for type A aortic dissection. Immediate TEVAR poses unique challenges (TEVAR-in-TAVR).

- TEVAR for type B aortic dissection may be highly warranted at acute phase.