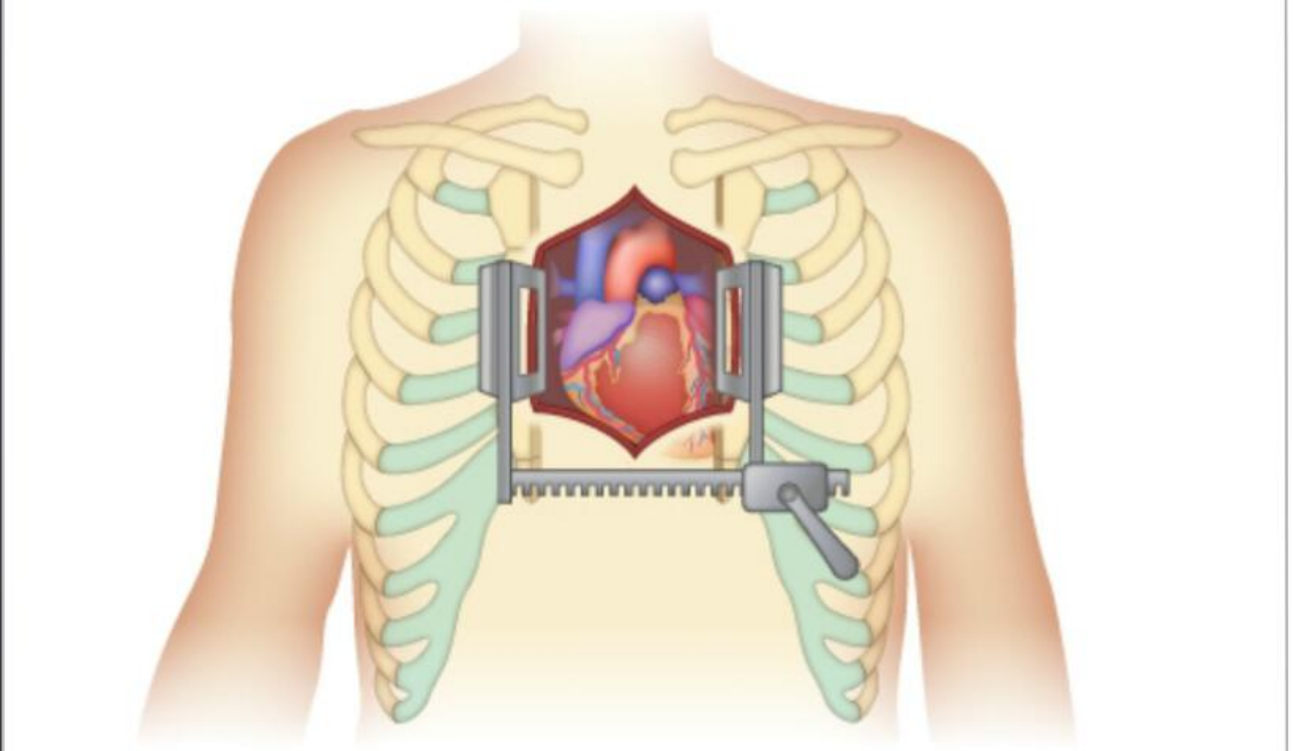
# Patient Introduction

Mr. Colin Hunt is a 74-year-old man diagnosed with aortic stenosis that has been progressively limiting his activity. He is admitted to your unit and is currently being evaluated for aortic valve replacement (AVR). Mr. Hunt lives alone, but is accompanied by his 70-year-old girlfriend. His son lives 4 hours away.

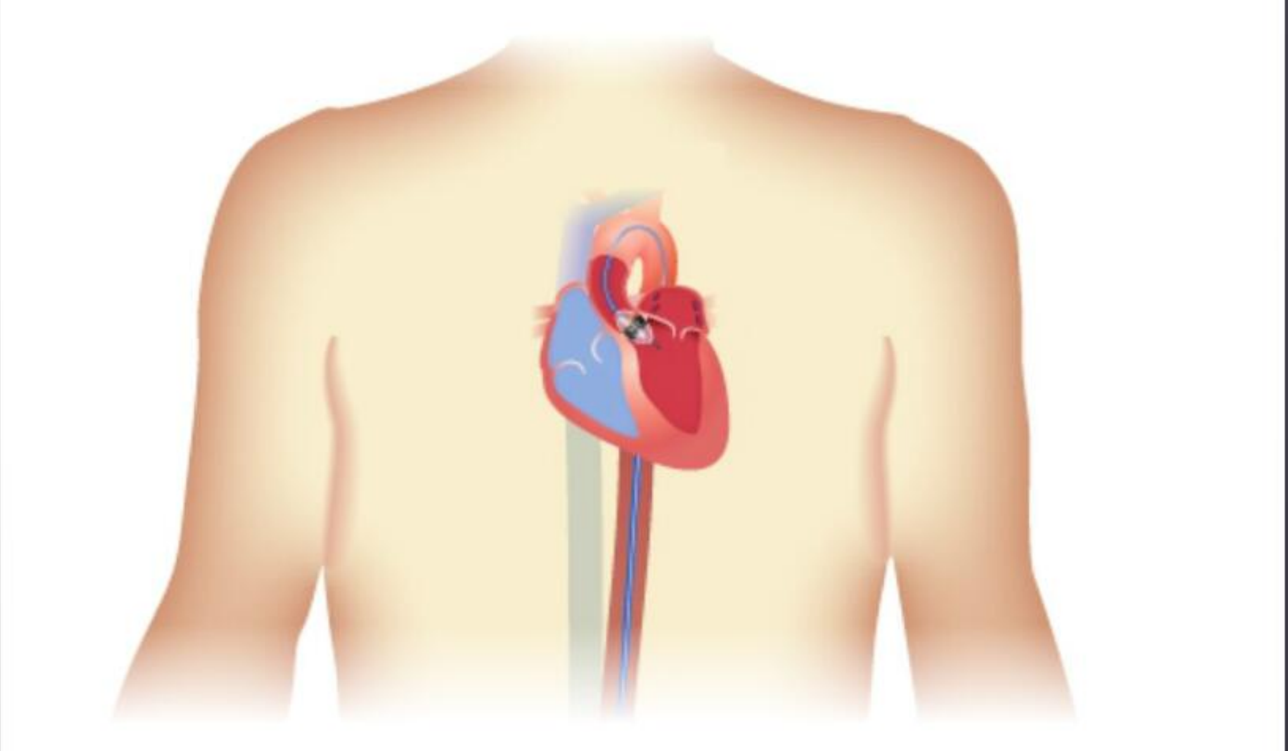
# AVR Procedures



SAVR

## SAVR

Surgical aortic valve replacement (SAVR) is the treatment of choice for patients with severe aortic stenosis, a valvular disease affecting 3.4% of older adults.



TAVR

## TAVR

Transcatheter aortic valve replacement (TAVR) is a minimally invasive prosthetic valve replacement procedure for patients who are not surgical candidates. In this procedure, a catheter is used to deploy a collapsible bioprosthetic valve, which is wedged inside the diseased aortic valve and then expanded to functionally replace the diseased valve.

# Patient Eligibility and Selection Criteria

A comprehensive assessment is performed to assess patient eligibility and select the TAVR access site.

**Patient Eligibility**

Eligibility for TAVR is evolving and includes patients with:

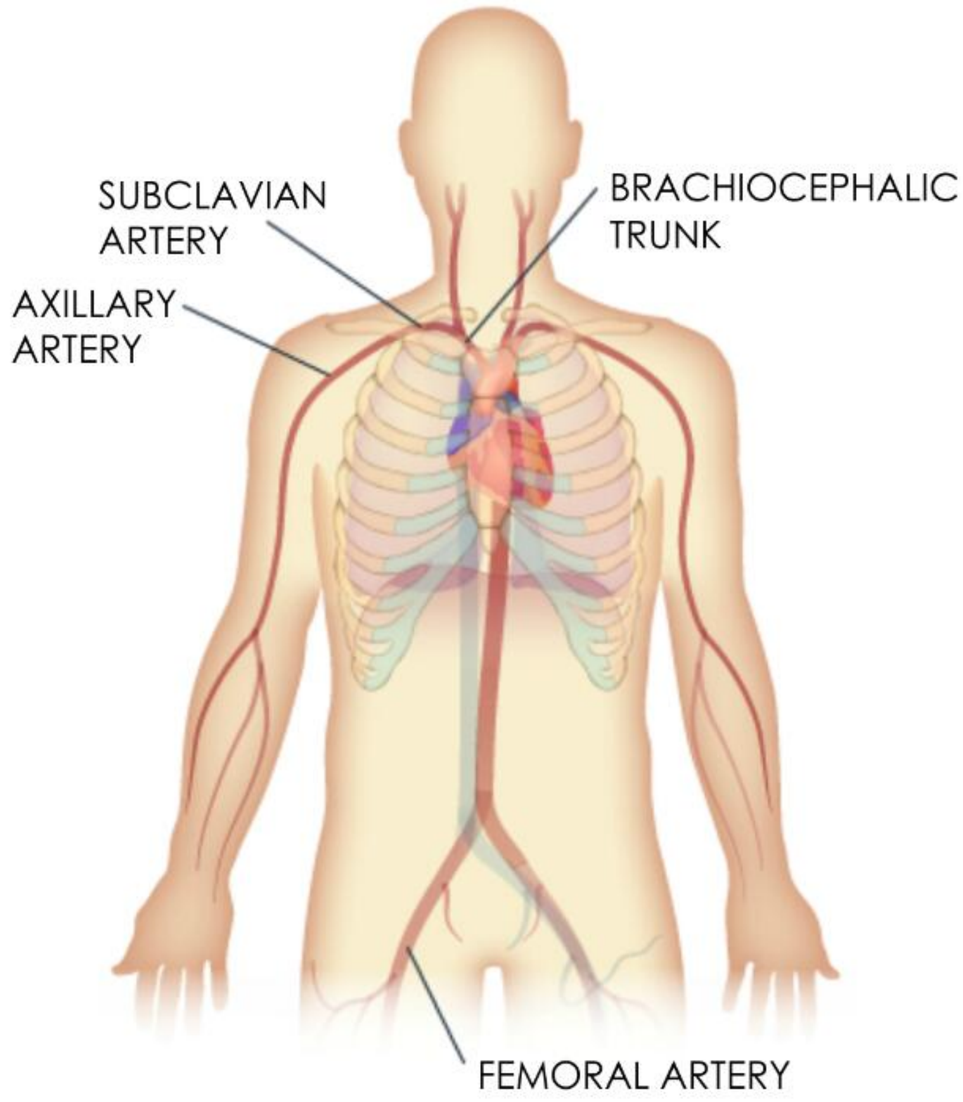
- Severe symptomatic aortic stenosis
- Multiple comorbidities that result in high or intermediate risk of death or serious morbidity if patient were to have SAVR

**Access Site Selection**

The initial patient evaluation consists of angiographic studies and multidimensional CT scanning, which informs the best access site for TAVR. The entire vascular bed is scanned, from the aortic root down to the femoral arteries, including:

- Brachiocephalic trunk
- Left and right subclavian arteries
- Left and right axillary arteries

PAD can limit options for procedural access site selection



# TAVR Procedure

TAVR is performed in a hybrid operating room or cardiac catheterization laboratory. The patient may be under general anesthesia.

1. Catheter Placement:

   Central lines for monitoring are placed by the anesthesiologist, including a pulmonary artery catheter, if needed. Both venous and arterial sheaths for guidewires and temporary pacing catheters are placed by the interventional cardiologist.

2. Insertion Site Access:

   Insertion site access is obtained by the cardiologist, usually at the femoral artery. Heparin is administered, and the guidewire is advanced into the left ventricle (LV) using a transesophageal echocardiogram (TEE) for guidance.

3. Dilation of Aortic Annulus:

   Rapid ventricular pacing is used to reduce ventricular ejection, during which balloon valvuloplasty is used to dilate the aortic annulus and compress the calcified leaflets against the annulus.

4. Circulatory Recovery:

   The patient is allowed a period of circulatory recovery, because the rapid pacing causes a considerable drop in cardiac output and BP.

See More

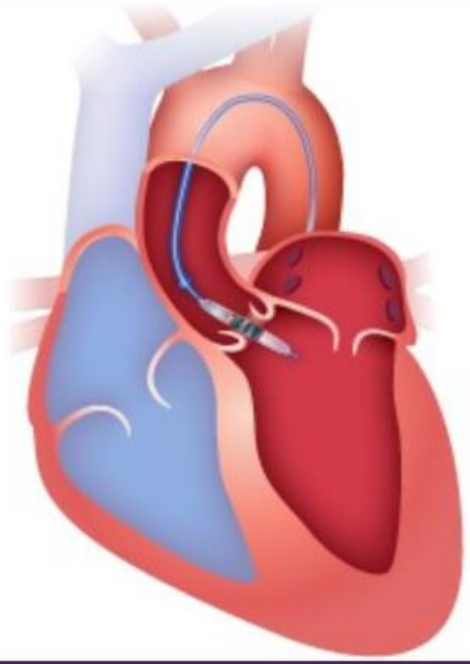
# TAVR Procedure, Continued

Use the slider to view the progression.

The replacement valve is introduced percutaneously on a catheter delivery system and deployed within the native aortic valve.

## Catheter Advancement

The valve delivery system is advanced through the artery to the aortic valve annulus under fluoroscopy.



Catheter Advancement

Valve Deployment

Closure

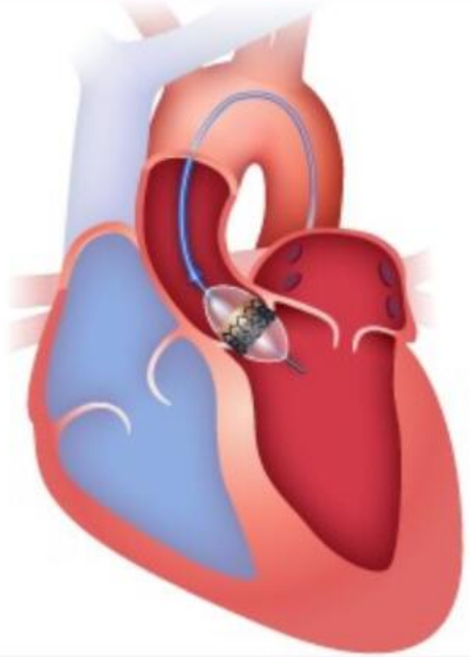
# TAVR Procedure, Continued

Use the slider to view the progression.

The replacement valve is introduced percutaneously on a catheter delivery system and deployed within the native aortic valve.

## Valve Deployment

The valve is deployed during a second period of rapid ventricular pacing. Following valve deployment, both TEE and angiography are used to assess the correct valve placement within the annulus and whether aortic regurgitation or paravalvular leaks are present.



Catheter Advancement | Valve Deployment | Closure

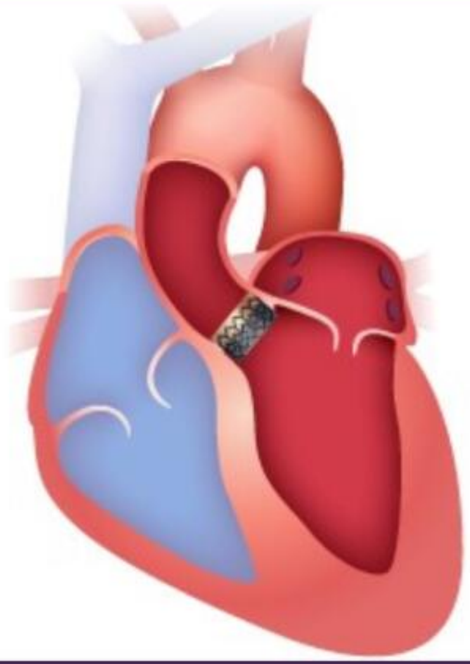
# TAVR Procedure, Continued

Use the slider to view the progression.

The replacement valve is introduced percutaneously on a catheter delivery system and deployed within the native aortic valve.

## Closure

Once the valve is evaluated to be functioning properly, the arterial access is closed by the surgeon with either a closure device or sutures, depending on the approach. The patient is stabilized and transported to the PACU or ICU.



Catheter Advancement

Valve Deployment

Closure

# Patient Update

Mr. Hunt

Mr. Hunt was evaluated for TAVR, and the procedure was performed with a transfemoral approach. The valve was validated to be functioning properly, and his procedure was without complications. Mr. Hunt is admitted to the ICU for recovery.

# Patient Update

Mr. Hunt is recovering from anesthesia. Now, you'll review information about his postoperative care needs.

# Patient Care Priorities

## You answered:

- [x] Assess recovery from anesthesia.
- [x] Monitor vascular access sites.
- [x] Provide hemodynamic support.
- [x] Identify and report signs of hemodynamic deterioration.
- [ ] Administer fluid resuscitation.
- [ ] Start IV anticoagulation.

## The correct answers are:

- [x] **Assess recovery from anesthesia.**

  Patients require recovery from general anesthesia, similar to other cardiac operations.

- [x] **Monitor vascular access sites.**

  Vascular access sites require monitoring for bleeding, hematoma formation, or vascular insufficiency.

- [x] **Provide hemodynamic support.**

  Patients with poor hemodynamic reserve may take longer to recover following the rapid pacing and may need support via inotropes or vasoactive drugs during and after the procedure.

- [x] **Identify and report signs of hemodynamic deterioration.**

  Identify and report any deterioration in hemodynamic status, such as low cardiac output. Most hemodynamic problems are addressed in the OR, and correct TAVR placement is essential for proper functioning.

# Transfemoral Approach to TAVR

Transfemoral access is the most common approach, with the least risk. Other approaches are only used when transfemoral access isn't feasible.

HEALTHY WORK ENVIRONMENT

TRUE COLLABORATION

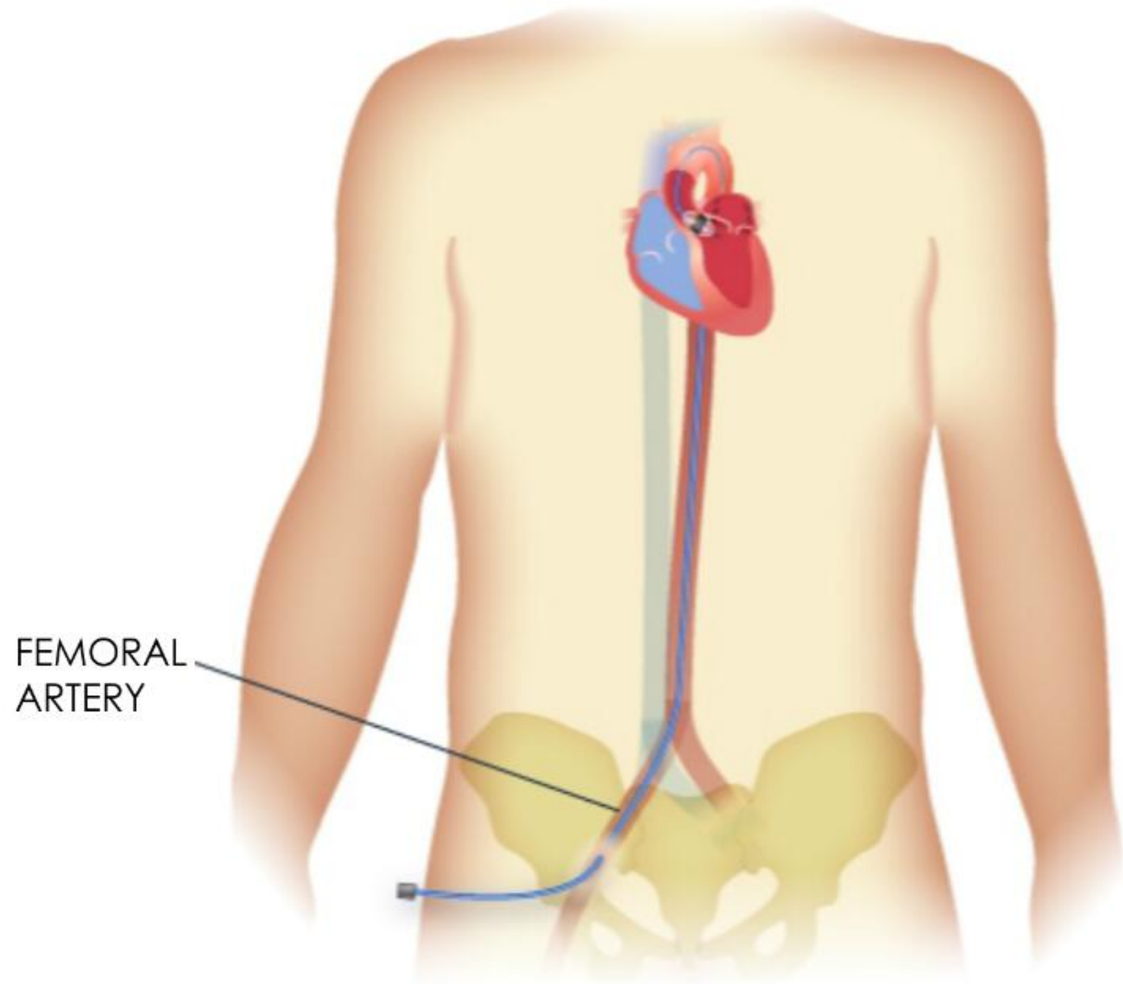
**Potential Complications**

Perform neurovascular checks in the accessed extremity to identify complications, including:

- Vascular insufficiency
- Retroperitoneal bleeding
- Bleeding, hematoma, or pseudoaneurysm formation at insertion site

**Nursing Care**

- Elevate head of bed (HOB) 30 degrees to minimize the work of breathing and increase respiratory capacity.
- Coordinate extubation and femoral sheath removal.
- Keep patient supine with HOB flat for several hours following sheath removal.
- Use acetaminophen (Tylenol) or opioids for breakthrough pain at femoral site when local anesthetics are insufficient.
- Control BP to minimize the risk of bleeding and pseudoaneurysm.




*Transfemoral Approach*

# Transapical Approach to TAVR

Transapical access is a higher risk approach used in patients with severe PAD and a heavily calcified aorta and aortic arch.

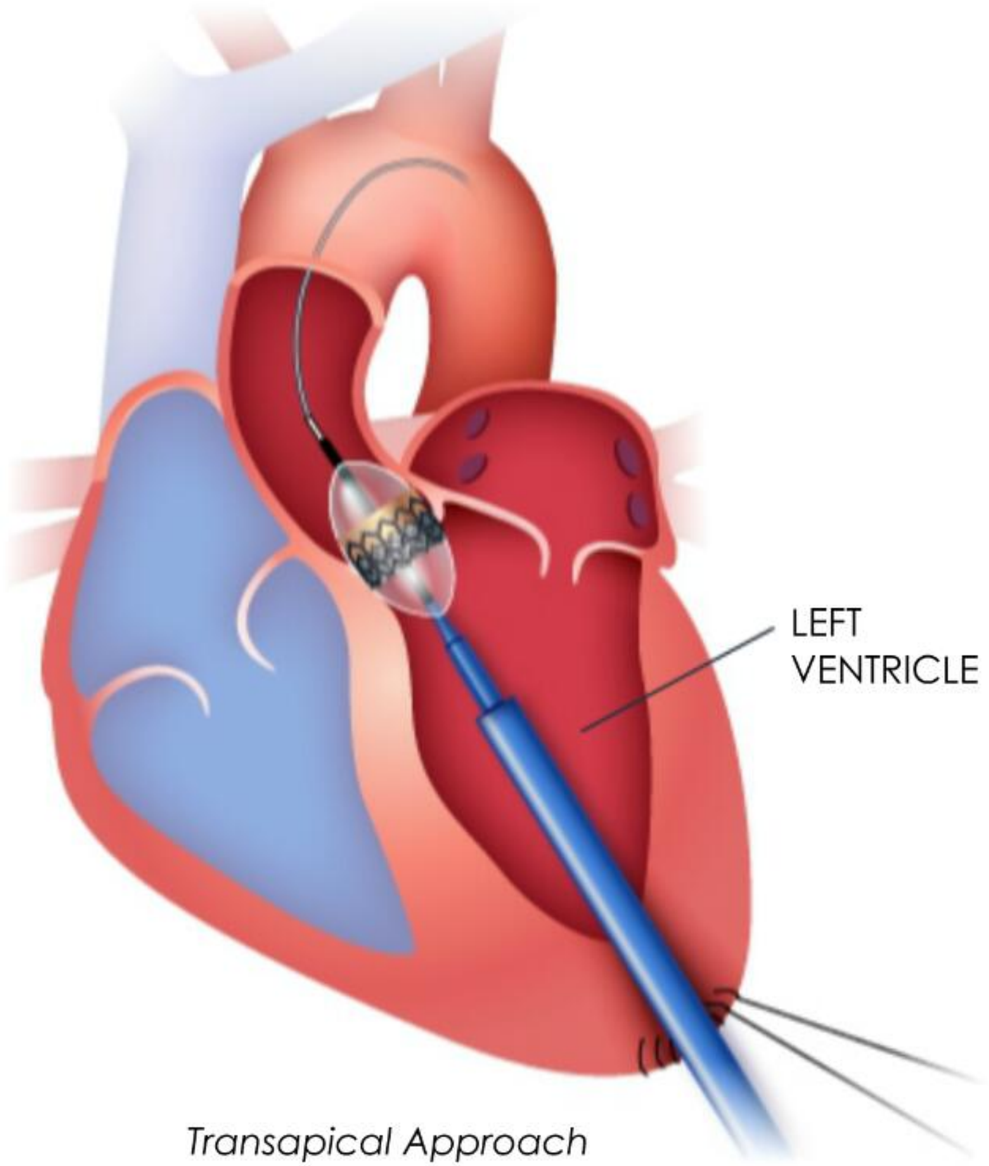
**Potential Complications**

There is an increased risk of tamponade and pericardial bleeding at the ventricular access site, because the left ventricular puncture is more difficult for the surgeon to close. Pleural effusion is also a potential complication.

**Nursing Care**

- Wean and extubate as ordered. Patients are more likely to be mechanically ventilated on admission to the ICU.
- Maintain MAP less than 75 mm Hg to decrease the risk of bleeding or ventricular rupture at the site. Vasodilators may be used for BP control.
- Monitor mediastinal CT for excessive drainage.

Patients may experience more pain and respiratory compromise with this mini-thoracotomy incision. The anesthesia team may place nerve blocks or catheters in the OR.




*Transapical Approach*

# Transaortic Approach to TAVR

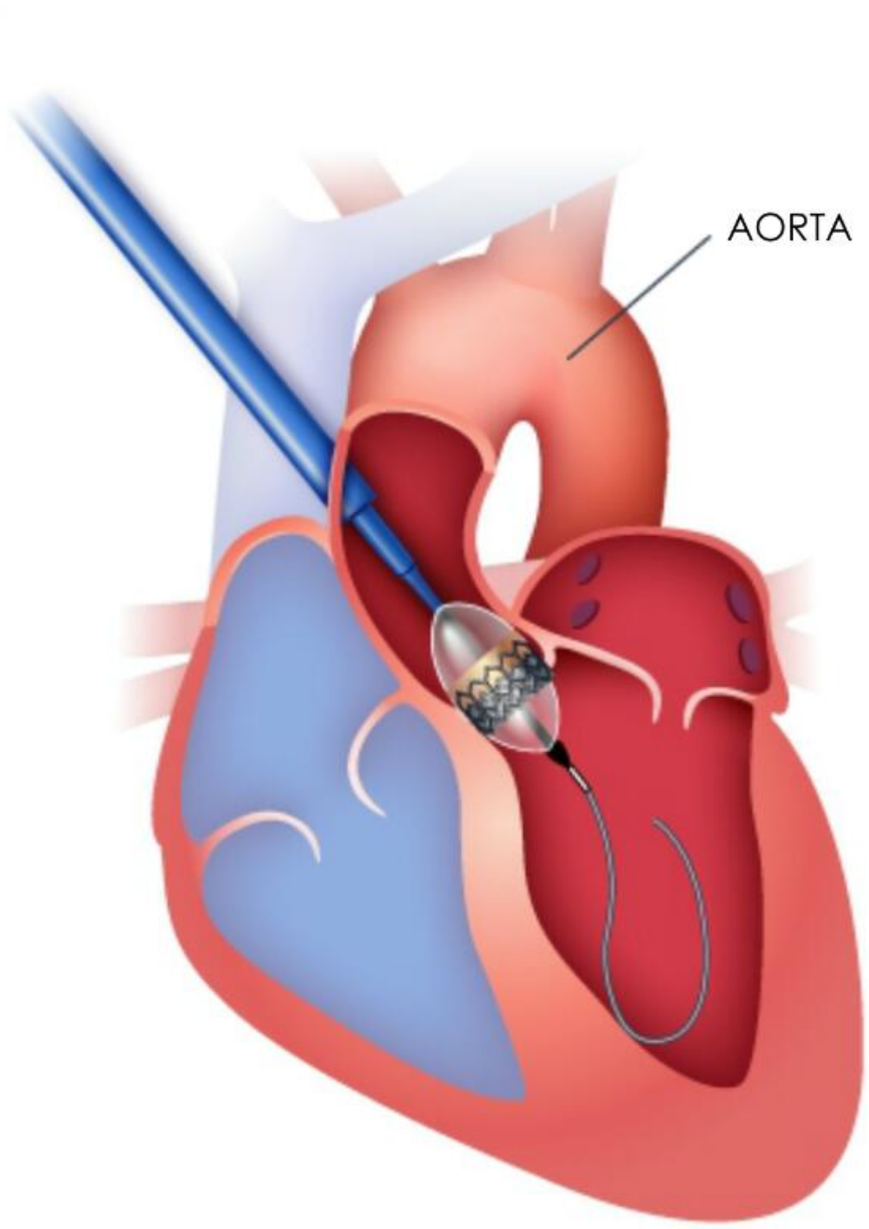
Transaortic access can be through a partial sternotomy or mini-thoracotomy. The deployment sheath is placed directly in the aorta 5-6 cm above the annulus of the aortic valve.

**Nursing Care**

Monitor for bleeding at the aortic site. This is a higher risk for patients with prior CABG and patent grafts close to the midline.

- Observe the incision for partial sternotomy patients.
- Observe CT output in mini-thoracotomy patients.

Mini-thoracotomy incisions are usually more painful than partial sternotomy incisions.




*Transaortic Approach*

# Transaxillary Approach to TAVR

The axillary artery needs to be large enough to accommodate the valve deployment systems.

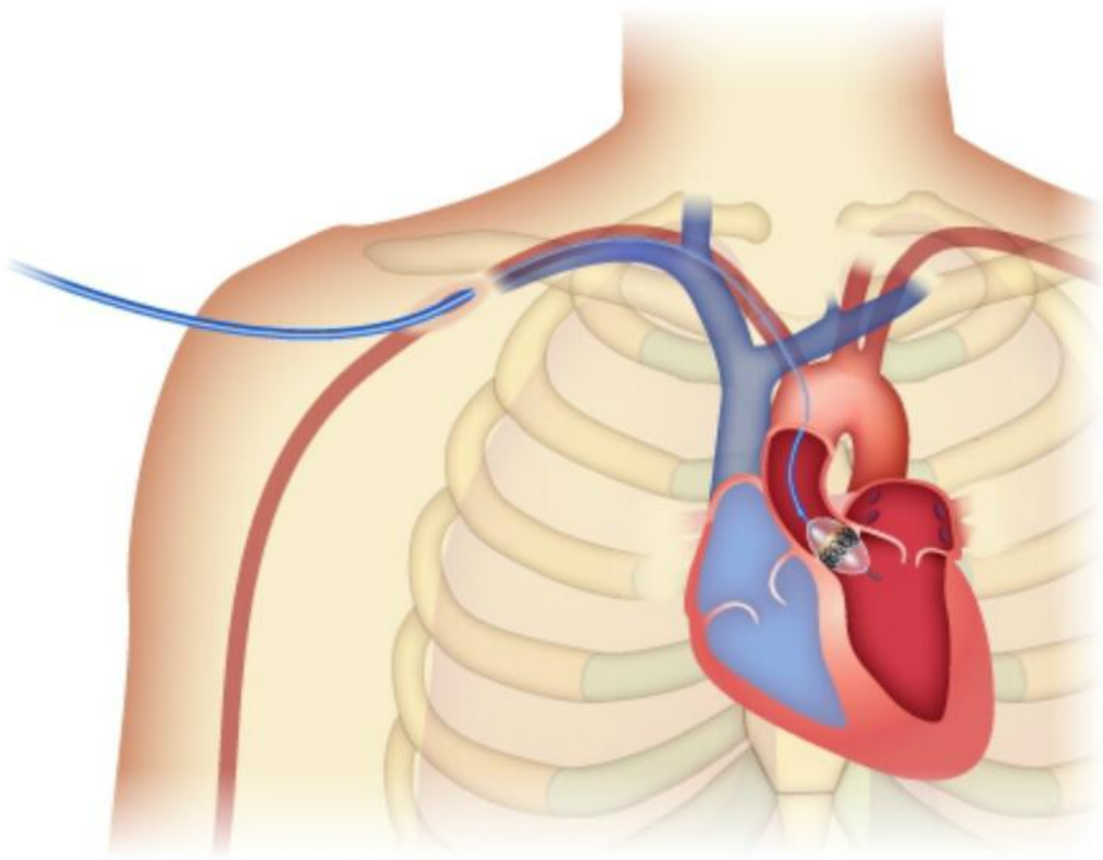
**Potential Complications**

- Major thoracic bleeding
- Vascular insufficiency to arm on access side
- Brachial plexus injury

A patient with a brachial plexus injury may lose function of their fingers or arm on the access side and experience numbness or a tingling sensation.

**Nursing Care**

- Report bleeding or abnormal clotting studies.
- Anticipate return to OR for ongoing bleeding, development of pseudoaneurysm, or vascular insufficiency.



*Transaxillary Approach*

# Check Your Knowledge

Drag each item to the correct location.

Which approach to TAVR is associated with the presented potential complications?

| | | | |
|---|---|---|---|
| • Vascular insufficiency<br>• Retroperitoneal bleeding<br>• Bleeding at insertion site<br>• Pseudoaneurysm formation | • Pericardial bleeding at ventricular access site<br>• Pleural effusion<br>• Cardiac tamponade<br>• Increased pain and respiratory compromise | • Bleeding at insertion site<br>• Bleeding at aortic site<br>• Increased pain and respiratory compromise, if mini-thoracotomy incision used | • Major thoracic bleeding<br>• Brachial plexus injury<br>• Vascular insufficiency to arm on affected side |
| | | | |

Transaxillary

Transapical

Transaortic

Transfemoral

# Check Your Knowledge

Drag each item to the correct location.

Which approach to TAVR is associated with the presented potential complications?

| | | | |
|---|---|---|---|
| • Vascular insufficiency<br>• Retroperitoneal bleeding<br>• Bleeding at insertion site<br>• Pseudoaneurysm formation | • Pericardial bleeding at ventricular access site<br>• Pleural effusion<br>• Cardiac tamponade<br>• Increased pain and respiratory compromise | • Bleeding at insertion site<br>• Bleeding at aortic site<br>• Increased pain and respiratory compromise, if mini-thoracotomy incision used | • Major thoracic bleeding<br>• Brachial plexus injury<br>• Vascular insufficiency to arm on affected side |
| Transfemoral | Transapical | Transaortic | Transaxillary |

# Stroke and TIA

Stroke or transient ischemic attack (TIA) may occur during the TAVR procedure, but as many as half of the cases are reported in the recovery period. Observe and report neurologic changes.

The cause of strokes in TAVR patients is multifactorial and related to:

- Age
- Aortic atherosclerosis
- Calcification of native aortic valve
- Passing stiff guidewires across the aortic arch
- Balloon valvuloplasty and valve deployment

Mortality is higher in patients who experience a stroke. Treat new-onset atrial fibrillation aggressively, as it is associated with a higher stroke rate.

For more information, see ECCO assignment: ECCO: Assessing and Managing Patients with Ischemic Stroke

# Conduction Abnormalities

Conduction abnormalities following TAVR may be due to mechanical impingement on the conduction system by the prosthesis.

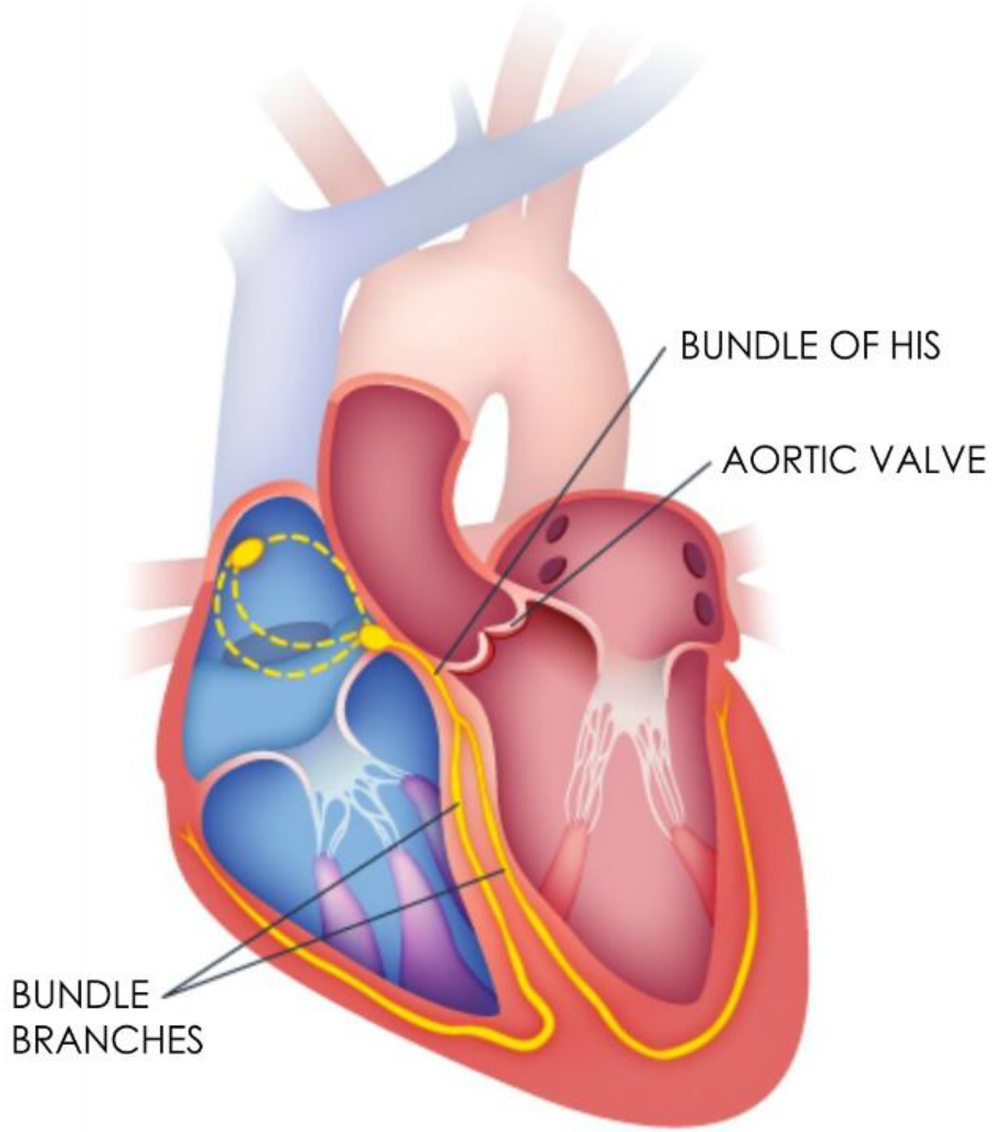
**Risk Factors**

- Pre-existing right or left bundle branch block (RBBB or LBBB)
- Porcelain aorta
- Type of TAVR used (higher risk with longer frame length)
- Increased annulus size

TAVR valves with a longer frame length apply pressure on a longer segment of the septal wall and the conduction system.

**Most Common Conduction Abnormalities**

- New LBBB
- Complete heart block requiring permanent pacemaker




*Conduction System of the Heart*

## Did You Know?

Administer drugs with negative chronotropic action cautiously, because they may precipitate or exacerbate conduction abnormalities. This includes calcium channel blockers and beta blockers.

# Additional Patient Care

Click each tab to learn more.

- Overview
- Vascular Injury
- AKI
- Paravalvular Leak

## Overview

Additional potential adverse outcomes of TAVR include:

- Vascular injury
- AKI
- Paravalvular Leak

# Additional Patient Care

Click each tab to learn more.

Overview

Vascular Injury

AKI

Paravalvular Leak

## Vascular Injury

Vascular injury at the access site is the most frequent adverse outcome of TAVR. It is associated with both early and late mortality, but nursing care can decrease its incidence and severity.

### Risk Factors

- Transfemoral approach, due to large caliber sheaths used to deploy device
- Arterial atherosclerosis and calcification

### Nursing Care

- Assess for signs of bleeding, vessel dissection, vascular insufficiency, groin hematoma, and femoral artery aneurysm.
- Coordinate procedures, such as extubation and sheath pull, to decrease patient stress.
- Control BP at ordered parameters to minimize bleeding and the formation of arterial pseudoaneurysm at access site.
- Notify the provider of signs of bleeding or vascular insufficiency.
- For sudden bleeding or hematoma formation, call for help, apply manual pressure to site, and control hypertension (HTN).
- Notify provider for loss of distal pulses or other signs of compromised perfusion, including color or temperature change.

### Interventions

Interventions for vascular injury and bleeding may include transfusion, urgent endovascular repair or surgery, or both.

# Additional Patient Care

Click each tab to learn more.

Overview

Vascular Injury

AKI

Paravalvular Leak

## Acute Kidney Injury (AKI)

AKI following TAVR is an independent predictor of increased mortality. Even a small increase above baseline creatinine (Cr) is associated with adverse outcomes. Preoperatively, identify patients at high risk for AKI to minimize adverse effects.

### Risk Factors

- CKD
- Kidney injury from the contrast media used in preoperative workup
- History of HTN and peripheral vascular disease
- PAD significant enough to require transapical approach to TAVR
- Peri-procedural blood transfusion
- Life-threatening bleeding
- Elevated leukocyte count following TAVR

### Nursing Care

- Provide hydration before, during, and after procedure with IV isotonic saline.
- Administer renal protective agents, as ordered.
- Prevent hypotension and maintain BP at pre-procedure level.
- Monitor urine output and serum creatinine.

# Additional Patient Care

Click each tab to learn more.

- Overview
- Vascular Injury
- AKI
- Paravalvular Leak

## Paravalvular Leak

Paravalvular leak following TAVR is associated with a significant increase in mortality.

### Risk Factors

Paravalvular leak is likely related to the mechanism of treatment. In TAVR, the calcified leaflets and annulus are left in place to help anchor the device, but also preclude a smooth surface for the valve and may result in leaking.

### Nursing Care

Monitor for signs of hemolysis:

- Increased serum haptoglobin and lactate dehydrogenase levels
- Decreased Hct
- Jaundice

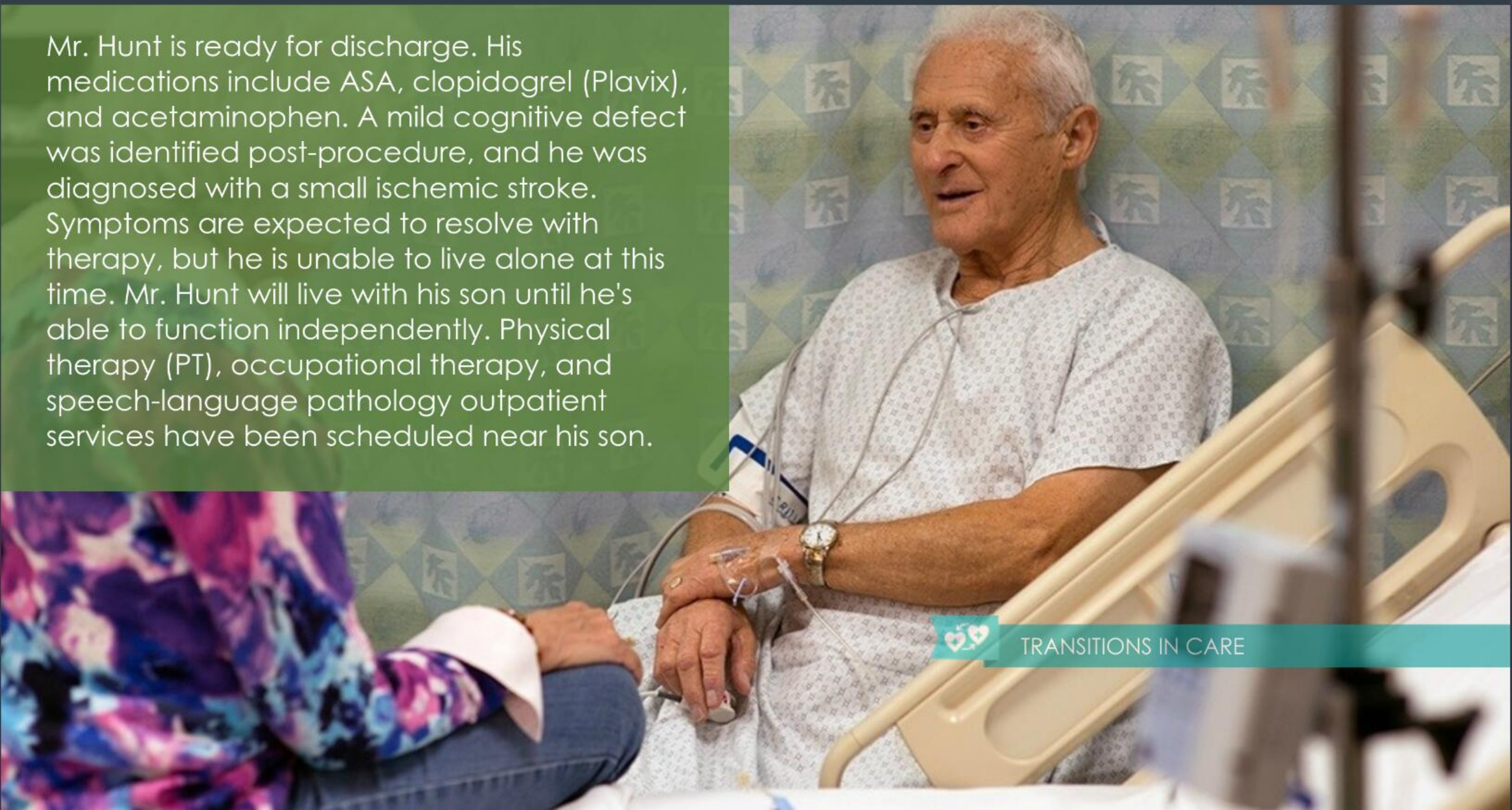
### Interventions

The presence of significant hemolysis or moderate to large aortic insufficiency indicates the need for intervention. Possible treatments include:

- Further dilation of the transcatheter heart valve to improve placement within the aortic annulus
- Implantation of a second TAVR, surgical AVR, or the use of occluder devices

# Patient Conclusion

Mr. Hunt is ready for discharge. His medications include ASA, clopidogrel (Plavix), and acetaminophen. A mild cognitive defect was identified post-procedure, and he was diagnosed with a small ischemic stroke. Symptoms are expected to resolve with therapy, but he is unable to live alone at this time. Mr. Hunt will live with his son until he's able to function independently. Physical therapy (PT), occupational therapy, and speech-language pathology outpatient services have been scheduled near his son.



# Assignment Review

Drag each item to the correct category.

Which complication is more specific to a particular insertion site approach for the TAVR procedure?

| Transfemoral | Transapical | Transaortic | Transaxillary |
| --- | --- | --- | --- |
| Vascular insufficiency | Thoracotomy pain and respiratory compromise | | Vascular insufficiency |
| Pseudoaneurysm formation | Ventricular access site bleeding | | Major thoracic bleeding |

Thoracotomy pain and respiratory compromise

Cardiac Tamponade

Brachial plexus injury

Retroperitoneal bleeding

# Assignment Review

Drag each item to the correct category.

Which complication is more specific to a particular insertion site approach for the TAVR procedure?

| Transfemoral | Transapical | Transaortic | Transaxillary |
| --- | --- | --- | --- |
| Vascular insufficiency | Thoracotomy pain and respiratory compromise | Thoracotomy pain and respiratory compromise | Vascular insufficiency |
| Retroperitoneal bleeding | Ventricular access site bleeding | | Major thoracic bleeding |
| Pseudoaneurysm formation | Cardiac Tamponade | | Brachial plexus injury |

# Assignment Review

The potential complications post-TAVR include:

- Stroke
- Conduction abnormalities
- Vascular injury
- AKI

Each is associated with different risk factors. Review the risk factors here.

## Stroke

- Age
- Aortic atherosclerosis
- Calcification of native aortic valve
- Passing stiff guidewires across aortic arch
- Balloon valvuloplasty
- Valve deployment

## Conduction Abnormalities

- Mechanical impingement by prosthesis
- Pre-existing RBBB or LBBB
- Porcelain aorta
- Use of valve with longer frame length
- Increased annulus size

## Vascular Injury

- Large caliber sheaths used to deploy device in transfemoral approach
- Arterial atherosclerosis
- Calcification

## AKI

- CKD
- Kidney injury from contrast media used in preoperative workup
- History of HTN and peripheral vascular disease
- PAD that necessitates transapical approach to TAVR
- Blood transfusion
- Elevated leukocyte count following TAVR
- Life-threatening bleeding