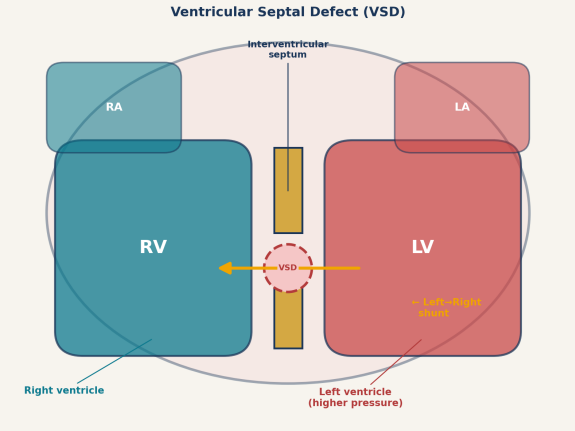
Understanding Ventricular Septal Defect (VSD)

A hole between the heart's two pumping chambers — the most common congenital heart defect

Many small VSDs close on their own. Large ones are very treatable.



Online: https://go.riasalimd.com/vsd-guide

Rias KS Ali, MD FACC

Board Certified in Interventional Cardiology & Cardiovascular Disease

4740 Mile Stretch Drive, Holiday FL 34690 | Office: (727) 943-5200 | Fax: (727) 943-5201 | RiasAliMD.com

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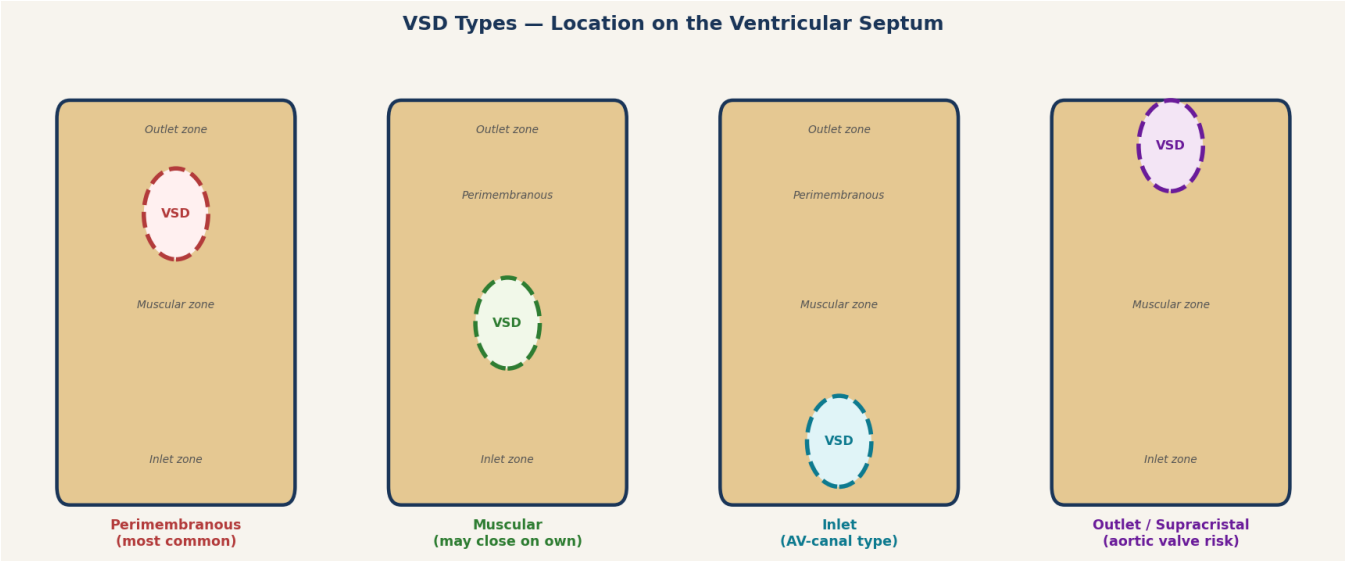
Names & Terms You Will Hear

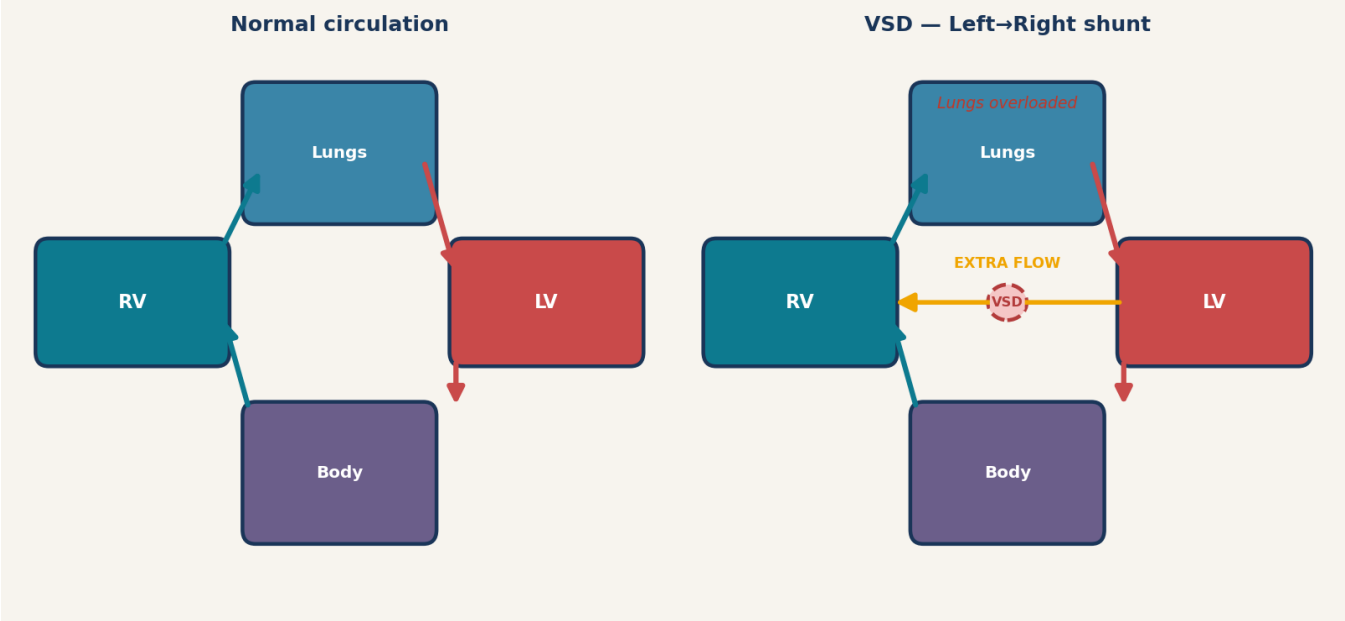
Term	Meaning
Ventricular septal defect (VSD)	A hole in the wall between the heart's two lower pumping chambers (ventricles).
Interventricular septum	The thick wall of muscle that divides the right ventricle from the left ventricle.
Left-to-right shunt	Blood leaks from the left ventricle (higher pressure) through the VSD into the right ventricle. Extra blood is pushed to the lungs.
Restrictive VSD	A small VSD. The narrow hole blocks most blood flow. It often causes a loud murmur but little shunting. Many close on their own.
Non-restrictive (large) VSD	A large VSD. Pressures in both ventricles become equal. A large amount of blood crosses, overloading the lungs.
Eisenmenger syndrome	What happens when a large VSD is left untreated for too long. Lung pressure gets so high that blood reverses direction. The skin turns blue (cyanosis).
Ventricular septal rupture (VSR)	A hole that forms after a heart attack tears the septum. This is an emergency. It is NOT the same as the birth defect VSD.
Qp:Qs ratio	A measure from a heart catheter test. It shows how much extra blood is going to the lungs. A ratio above 2:1 often means closure is needed.



The four VSD types differ by where the hole sits in the ventricular septum. Perimembranous is the most common. Muscular VSDs most often close on their own. Inlet VSDs are near the AV valves. Outlet VSDs are near the aortic valve — they need repair even when small.

What Is Ventricular Septal Defect (VSD)?

- A VSD is a hole in the wall between the heart's **two lower chambers** (ventricles). It is the **most common heart defect at birth** — about 3-4 in every 1,000 babies.
- The left ventricle pumps at higher pressure than the right. Blood leaks **left to right** through the hole. Extra blood floods the right ventricle and the lungs.
- **Small VSDs** often cause a loud murmur but little leaking. The narrow hole blocks most of the flow. Many close on their own by age 2-4.
- **Large VSDs** may have no murmur but cause a lot of leaking. This overloads the lungs. Babies may have trouble feeding, sweat during feeds, and breathe fast.
- There are four types by location: **perimembranous** (most common), **muscular** (most likely to close on their own), **inlet** (near the AV valves), and **outlet/supracristal** (near the aortic valve — even small ones may need repair).
- A **post-heart-attack VSD** (ventricular septal rupture) is a different emergency. A heart attack can tear the septum. This is NOT the same as the birth defect. It needs urgent repair.



Left: normal blood flow — right ventricle sends blood to the lungs, then the left ventricle sends it to the body. Right: with a VSD, the left ventricle also pushes extra blood into the right ventricle. This extra flow overloads the lungs and the right side of the heart.

VSD types compared: location, spontaneous closure likelihood, key risk, and repair approach.

VSD Type	Location	Spontaneous Closure?	Key Risk	Typical Repair
Perimembranous (most common ~70%)	Near aortic valve / membranous septum	Common in small VSDs	Aortic leaflet prolapse if adjacent	Surgical or device
Muscular (~20%)	Thick muscular septum; may be multiple (Swiss cheese)	High — up to 75–80% close by age 2	Multiple holes harder to repair surgically	Usually watchful wait; device if large
Inlet / AV-canal (~5%)	Beneath AV valves (mitral / tricuspid)	Rare spontaneous closure	Associated AV valve abnormalities	Surgical
Outlet / Supracristal (~5–7%)	Beneath pulmonary valve; outflow tract	Does NOT close spontaneously	Aortic valve prolapse and regurgitation	Surgical (even if small)

The murmur paradox: A louder murmur often means a SMALLER hole. Small VSDs force blood through a narrow gap at high speed. This makes a loud, harsh sound. Large VSDs let blood flow freely. The sound may be soft or even absent. A heart echo — not the murmur — tells us how big the VSD really is.

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Why It Matters

- A large VSD forces extra blood into the lungs year after year. Over time, the lung arteries stiffen. This is called **pulmonary hypertension**.
- If lung pressure gets high enough, blood reverses direction. It flows right to left instead. Deoxygenated blood reaches the body — lips and fingers turn blue. This is **Eisenmenger syndrome**. At this stage, the VSD can no longer be safely closed.
- Even a small VSD raises the risk of **endocarditis**. Bacteria in the blood can stick to the turbulent jet inside the hole. Good dental hygiene helps lower this risk.
- The outlet (supracristal) type can damage the aortic valve even when the hole is small. Size alone does not tell you how urgent repair is for this type.
- A VSD caused by a heart attack (septal rupture) can be fatal without urgent surgery. If you have a new harsh murmur and sudden collapse after a heart attack — call 911.

Risk Factors

Some patients are more likely to develop this condition. Knowing your risk helps your care team take extra precautions.

Risk Factor	Why It Increases Risk
Large VSD without repair	Lung artery damage builds over years. Eisenmenger syndrome is the end stage.
Outlet (supracristal) type	Even a small outlet VSD can let the aortic valve leaf slip into the hole. This causes the valve to leak over time.
Prior heart attack	A heart attack that damages the septum can cause it to tear open. This is a medical emergency.
Any unrepaired VSD	The fast jet of blood through the hole can let bacteria stick to the heart wall. This causes a serious infection called endocarditis.
Premature birth or low birth weight	Premature babies have a higher rate of VSD. Most close as the heart grows.
Genetic conditions	Down syndrome and some other genetic conditions increase the chance of VSD at birth.
Certain factors during pregnancy	Maternal diabetes, rubella (German measles) in the first trimester, and alcohol use can raise VSD risk.

Treatment Options

- **Watch and wait** — for small VSDs with no symptoms. Up to 80% of small muscular VSDs close on their own by age 2. Annual heart ultrasound (echo) tracks any changes.
- **Medicines for symptoms** — for babies with a large VSD and heart failure before surgery. Water pills and other heart medicines help while the baby gains weight for surgery.
- **Surgical closure** — open-heart surgery is the gold standard for large VSDs, symptomatic VSDs, and outlet VSDs (even if small). Results are excellent. Mortality is less than 1% at expert centers.
- **Device closure (catheter-based)** — a small plug is placed through a thin tube (catheter) in the groin. No open-heart surgery is needed. This works for many muscular VSDs and some others. Not all VSDs can be closed this way.
- **Outlet VSD** — surgery is advised even for a small outlet VSD. The aortic valve can be damaged over time if left untreated.
- **Post-heart-attack VSD** — urgent surgery or catheter repair is needed. A heart pump (Impella) or ECMO may be used to support the heart before repair.
- **Antibiotic protection after repair** — take antibiotics before dental work for 6 months after any repair. If a small leak remains, talk to your doctor about longer protection.
- **Eisenmenger syndrome** — once the shunt reverses, closing the VSD is no longer safe. Treatment uses medicines to lower lung pressure (sildenafil, bosentan). Expert heart care is needed for life.

Small VSD — Watch and Wait

- Small VSDs narrow the gap and limit how much blood leaks left to right. The narrow hole causes a loud murmur but not much shunting.
- Most small muscular and perimembranous VSDs close on their own by age 2-4 without any procedure.
- A heart echo once a year checks that the VSD is stable or closing. No activity limits are needed.
- Antibiotic protection before dental work is NOT routine for isolated small VSDs. But good dental hygiene always matters.
- Watch for: valve slippage (outlet or perimembranous type), right ventricle getting bigger, or a growing shunt on echo.

Large VSD — Heart Failure and Closure

- A large VSD lets lots of blood cross from left to right. The heart pumps a huge extra load to the lungs.
- Babies with a large VSD breathe fast, tire out during feeds, sweat a lot, and may not gain weight.
- Before surgery: water pills and heart medicines ease symptoms while the baby gains weight.
- Surgery is usually done by age 3-6 months in babies who are not doing well. Earlier if the baby is very ill.
- Adults with a large unrepaired VSD usually have lung hypertension. A heart catheter test checks lung pressure to see if closure is still safe.
- Outcomes after repair are excellent. Most patients live a normal or near-normal life with regular check-ups.

Risks, Benefits, and Alternatives

Every choice has trade-offs. Use this table to start the shared decision conversation.

Option	Risks	Benefits	Alternatives
Watch and wait (small VSD, no symptoms)	Small ongoing infection risk. Outlet VSDs may slowly damage the aortic valve. Rare risk: VSD does not close by adulthood.	No surgery or procedure. Most small muscular and perimembranous VSDs close on their own. Regular heart echo catches any changes early.	Device closure (if the anatomy fits); surgery if symptoms develop.
Surgical closure	Open-heart surgery risks: less than 1% mortality at expert centers; heart block needing a pacemaker (1-2%); wound infection; 4-6 weeks recovery.	Works for all VSD types. Stops the leak fully. Prevents lung damage. Excellent long-term results.	Device closure for muscular or some perimembranous VSDs; watch-and-wait if the VSD is very small with no heart effects.
Device closure (catheter-based)	Not all VSDs can be closed this way. Risks: device slipping out (<1%); small remaining leak (~5%); heart block (1-2%); rare valve damage. Blood thinners for 6 months.	No open-heart surgery needed. Hospital stay is 1-2 days. Works well for most muscular VSDs and some others.	Surgery if the anatomy does not fit the device or if another heart repair is also needed.
Lung pressure medicines (Eisenmenger only)	These medicines do not cure the condition. They cannot undo the lung damage. Side effects: headache, flushing. Regular specialist visits are needed.	Improve symptoms, activity level, and quality of life. May slow the disease. Heart-lung transplant is the only cure at the end stage.	No other option once Eisenmenger sets in. The best prevention is closing the VSD before lung damage becomes permanent.

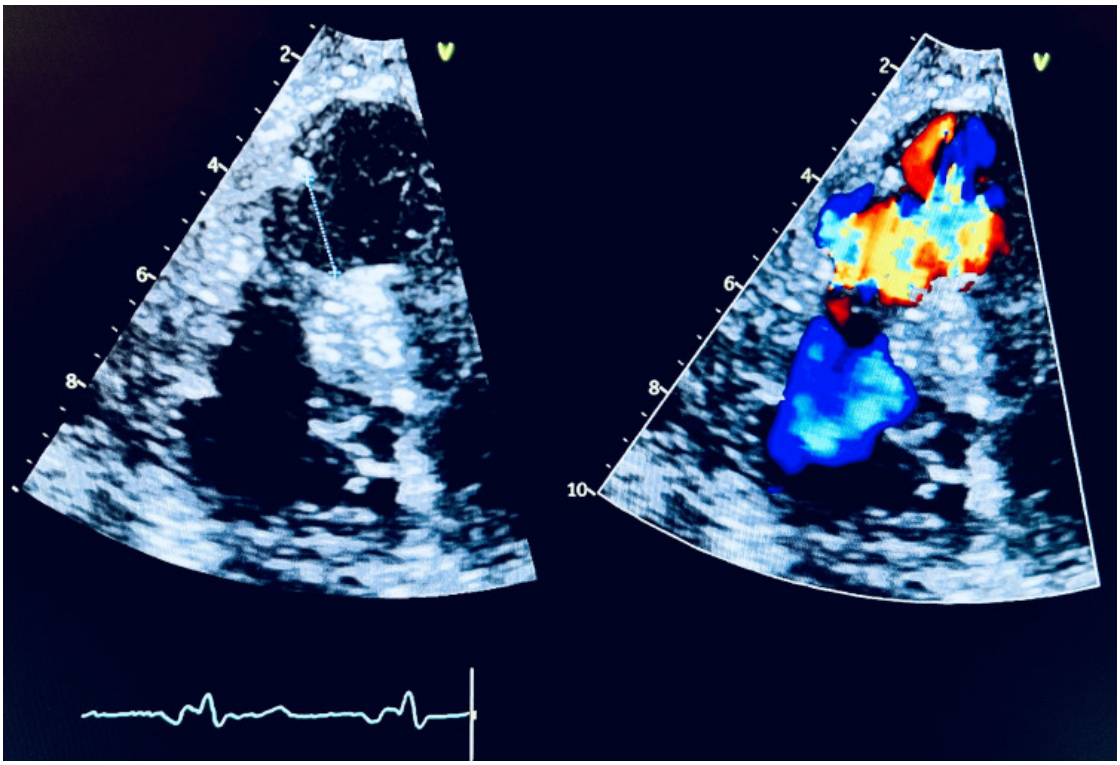
Common Misconceptions

Myth	Reality
"A loud murmur means a big, dangerous VSD."	Often the opposite is true. Small VSDs make the loudest murmurs. The narrow hole forces blood through at high speed, making a loud sound. Large VSDs may have no murmur at all. Murmur loudness does NOT tell you how big the hole is. An echo is needed.
"All VSDs need surgery right away."	Many small VSDs close on their own by age 2-4. Regular echo follow-up is all that is needed for small, quiet VSDs. Surgery is only for VSDs that are large, causing symptoms, or of the outlet type.
"My child had a VSD repaired, so they are completely cured."	Outcomes are excellent after repair. But lifelong follow-up is still advised. A small leak may remain. There is a small risk of heart rhythm problems or heart block years later. Once-a-year or every-other-year heart checks are standard.
"A post-heart-attack VSD is the same as a birth defect VSD."	They are completely different. A birth defect VSD is present from birth. A post-heart-attack VSD forms when a heart attack tears the septum open. This is a sudden emergency. It usually happens within 2-7 days of a heart attack.
"Once the VSD is closed, I am safe from infection."	Take antibiotics before dental work for 6 months after any closure. If a small leak stays near the device or patch, talk to your doctor about longer protection. Good dental hygiene matters for life.
"Eisenmenger syndrome means nothing can be done."	Medicines (sildenafil, bosentan) can ease symptoms and slow the disease. They improve activity levels and quality of life. Expert care from a specialist heart center is needed. Heart-lung transplant is an option at the end stage.

Possible Complications

Knowing what can go wrong helps you spot problems early. Most complications are uncommon, especially with treatment.

Where / What	What Can Happen
Pulmonary hypertension	Extra blood flow to the lungs raises lung artery pressure over time. If not treated, this can become permanent and lead to Eisenmenger syndrome.
Eisenmenger syndrome	Blood flow reverses direction. Blue skin (cyanosis) and low oxygen follow. The VSD can no longer be safely closed. Medicines help but cannot cure it.
Endocarditis	Bacteria in the blood can stick to the turbulent jet inside the VSD. This causes a serious heart infection. It needs IV antibiotics and sometimes surgery.
Aortic valve damage	This happens mainly with outlet VSDs. The aortic valve can slip into the hole over time. This causes the valve to leak. It can happen even with a small hole.
Heart failure in infancy	A large VSD forces the heart to pump extra blood. Babies tire out easily, feed poorly, sweat a lot, and breathe fast. They may not gain weight normally.
Irregular heartbeat (arrhythmia)	Both untreated and repaired VSDs carry a small risk of abnormal heart rhythms. Heart block (slow heart rate) can happen after surgery near the conduction system.
Septal rupture after heart attack	A heart attack can tear the septum open. This causes sudden shock and a new harsh murmur. It is an emergency that requires urgent repair.



A real echocardiogram of a post-heart-attack VSD. Left: standard grayscale view. Right: color Doppler shows turbulent, mixed-color flow (the mosaic pattern) where blood jets through the torn septum, plus a separate blue jet from normal flow nearby. Image: Habeb et al., Cureus 2025 (CC BY 4.0).

Eisenmenger Syndrome — The Point of No Return

- Eisenmenger happens when a large VSD is left open too long. Year after year of high-pressure blood flow into the lungs scars the lung arteries.
- Lung pressure rises until it is higher than heart pressure. Blood then flows the wrong way — right to left.
- Signs: blue lips and fingers (cyanosis), swollen finger tips, low oxygen, and poor stamina.
- At this stage, closing the VSD is no longer safe. The right ventricle has learned to pump against high pressure. Sudden closure would cause it to fail.
- Treatment: medicines to lower lung pressure (sildenafil, bosentan). Care at an expert adult congenital heart center is essential.
- Prevention is the cure. Close the VSD before lung damage becomes permanent — ideally in infancy or early childhood.

Post-Heart-Attack VSD — A Cardiac Emergency

- This is NOT the birth defect VSD. After a large heart attack, the dead heart muscle in the septum can tear open.
- It happens in about 1-2 of every 1,000 heart attacks. It usually occurs 2-7 days after the attack.
- Warning signs: a sudden new harsh murmur plus shock (low blood pressure, rapid breathing) after a heart attack.
- A bedside echo confirms the tear. Blood is now leaking left to right through the torn septum.
- Urgent surgery is needed. A catheter-based plug can sometimes be placed first to stabilize the patient.
- Without repair, 40-90% of patients die within 30 days. Early recognition and fast transfer to a heart surgery center saves lives.

Points to Know

If you remember nothing else, remember these key points.

- VSD is the most common congenital heart defect — 3-4 per 1,000 live births.
- Many small VSDs close on their own in childhood — especially muscular VSDs.
- A loud murmur often means a SMALL VSD; a quiet murmur can mean a LARGE VSD.
- Large untreated VSDs cause pulmonary hypertension and, eventually, Eisenmenger syndrome (shunt reversal).
- Outlet/supracristal VSDs need surgical repair even when small, because of aortic valve risk.
- Post-MI ventricular septal rupture is an emergency — recognize it by a new harsh murmur + shock after a heart attack.
- After repair (surgical or device), antibiotic prophylaxis is needed for 6 months, and lifelong ACHD follow-up is recommended.
- Good dental hygiene reduces endocarditis risk in all VSD patients — repaired and unrepaired.

When to Call Us - and When to Call 911

If you are not sure, call. We would rather hear from you twice than miss a real problem.

- **Call 911** if a child with a known VSD has severe difficulty breathing, turns blue (cyanosis), or collapses.
- **Call 911** if an adult patient who has had a recent heart attack develops a sudden new harsh murmur with shortness of breath and low blood pressure — this may be ventricular septal rupture.
- **Call our office today** if your infant is feeding very slowly, sweating during feeds, or not gaining weight.
- **Call our office today** if you develop new palpitations, chest pain, or greater-than-usual shortness of breath.
- **Call our office** before any dental procedure or dental surgery — discuss endocarditis prophylaxis.
- **Call our office** if you are planning a pregnancy and have a known VSD or prior VSD repair — we need to assess risk and coordinate with obstetrics.
- **Call our office** if you notice your lips or fingernails turning blue — this suggests oxygen levels are falling and needs prompt evaluation.

Office: (727) 943-5200

Trusted Resources

The links below are the trusted resources Dr. Ali used to write this guide and that he recommends you visit for more information. Each is a clickable link in the digital version and a Short.io tracked URL on the printed version.

- American Heart Association — VSD - AHA patient overview — VSD types, symptoms, treatment, and living with VSD.
- Mayo Clinic — Ventricular Septal Defect - Plain-language overview of causes, diagnosis, and treatment options.
- Cleveland Clinic — VSD - Comprehensive patient overview including closure criteria.
- Adult Congenital Heart Association (ACHA) - Support and resources for adults living with congenital heart disease, including VSD.
- ACC/AHA 2024 ACHD Guideline - 2024 guidelines on management of adults with congenital heart disease — the primary professional reference.
- NIH MedlinePlus — VSD - Government patient reference — epidemiology, spontaneous closure rates, and follow-up.
- Go.RiasAliMD.com — ASD Guide - Related: Atrial Septal Defect (ASD) — septal defects between the upper chambers.
- Go.RiasAliMD.com — PFO Closure Guide - Related: PFO closure guide — catheter-based closure of septal defects.

Sources Used to Build This Guide

Every recommendation in this guide is grounded in one or more of the studies, guidelines, or trusted resources below. Short links are tracked so Dr. Ali can see which references patients are reading; nothing personally identifying is captured.

- AHA — Ventricular Septal Defect (Congenital) *[Professional Society]*
  AHA patient page on VSD — types, symptoms, closure criteria.
- Mayo Clinic — Ventricular Septal Defect *[Academic Center]*
  Plain-language overview of VSD diagnosis, treatment, and follow-up.
- Cleveland Clinic — VSD *[Academic Center]*
  Comprehensive patient page covering types, shunt physiology, and repair options.
- ACC/AHA 2024 Congenital Heart Disease Guideline *[Guideline]*
  2024 ACC/AHA adult congenital heart disease guideline — primary reference for VSD classification, closure indications, and endocarditis recommendations.
- ACHD Association — VSD Patient Resources *[Patient Advocacy]*
  Adult Congenital Heart Association — patient perspective, long-term follow-up guidance.
- NIH/MedlinePlus — Ventricular Septal Defect *[Government]*
  NIH patient-facing summary — epidemiology, spontaneous closure in small VSDs.
- Soto B et al. — VSD Classification (AJC 1980) *[Primary Literature]*
  Classic four-type anatomic classification of VSD (perimembranous, muscular, inlet, outlet/supracristal).
- Eisenmenger Syndrome — Overview (PubMed) *[Primary Literature]*
  Eisenmenger physiology — shunt reversal, cyanosis, and irreversibility of pulmonary vascular disease.
- Post-MI VSD — Contemporary Management *[Primary Literature]*
  Ventricular septal rupture after myocardial infarction — incidence, timing, surgical/percutaneous options.

About This Guide

Rias KS Ali, MD FACC | Board Certified in Interventional Cardiology & Cardiovascular Disease

4740 Mile Stretch Drive, Holiday FL 34690 | Office: (727) 943-5200 | Fax: (727) 943-5201 | RiasAliMD.com

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Reviewer note: Reviewed against Mayo Clinic, Cleveland Clinic, AHA, and the ACC/AHA 2024 ACHD Guideline. This guide adds: all four VSD types by name and location; the murmur paradox (louder = smaller hole); post-heart-attack VSR as a distinct emergency; and Eisenmenger syndrome in plain language.

Disclaimer

This guide is for educational purposes only and does not replace medical advice from your physician. Recommendations may not apply to every patient. Always follow the specific instructions of Dr. Ali and your care team. In an emergency call 911 or go to the nearest emergency department.

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