THE MUELLER MANEUVER AND PATHOLOGICAL DIASTOLIC SOUNDS

Prepared by **Dr. Sidhartha Mullapudi**, DrNB (Cardiology), MD (General Medicine)
Last reviewed: October 2026

I THE MUELLER MANEUVER: TECHNIQUE AND PHYSIOLOGY

- **Definition:** The Mueller Maneuver is essentially the **reverse of the Valsalva maneuver**. It consists of a forced inspiratory effort against a closed glottis (or a closed mouth and nose) after a full expiration.
- **Physiological Effect:** It creates a significant **negative intrathoracic pressure**.
- **Cardiac Hemodynamics:**
  - **Right Side:** The negative pressure increases venous return to the Right Atrium and Right Ventricle, augmenting right-sided murmurs and sounds.
  - **Left Side:** The negative pressure increases the transmural pressure of the Left Ventricle (LV), effectively **increasing LV afterload**. This causes an increase in the severity of **Mitral Regurgitation (MR)** and **Aortic Regurgitation (AR)**.

II PATHOLOGICAL ADDITIONAL SOUNDS IN DIASTOLE

- **Principle:** Diastole is normally silent between the Second Heart Sound (S2) and the First Heart Sound (S1). Pathological sounds are categorized by their timing in early, mid, or late diastole.

A The Third Heart Sound (S3) / Ventricular Gallop

- **Timing:** Early diastole, during the phase of rapid ventricular filling.
- **Mechanism:** Occurs when blood from the atrium rushes into a **dilated, compliant ventricle**. It is caused by the sudden deceleration of blood flow against the ventricular wall.
- **Clinical Significance:** A hallmark of **Congestive Heart Failure (HFrEF)** in adults.
  - *Note:* It can be physiological in children and pregnant women.

B The Fourth Heart Sound (S4) / Atrial Gallop

- **Timing:** Late diastole, coinciding with atrial contraction (“Atrial Kick”).
- **Mechanism:** Occurs when the atrium contracts against a **stiff, non-compliant ventricle**.
- **Clinical Significance:** Indicates **Ventricular Hypertrophy** (Hypertension, Aortic Stenosis) or **Acute Myocardial Infarction**.
  - *Crucial Distinction:* S4 cannot occur in Atrial Fibrillation because there is no organized atrial contraction.

C The Opening Snap (OS)

- **Timing:** Early diastole, shortly after S2 (specifically the A2-OS interval).
- **Mechanism:** Caused by the sudden “tensing” of the Mitral Valve leaflets as they open.
- **Clinical Significance:** Diagnostic of **Mitral Stenosis (MS)**.
  - **Distinction Rule:** The shorter the A2-OS interval, the more severe the Mitral Stenosis (as higher LA pressure forces the valve open earlier).

D The Pericardial Knock

- **Timing:** Early diastole (slightly earlier and louder than an S3).
- **Mechanism:** Occurs in **Constrictive Pericarditis** when rapid early diastolic filling is abruptly halted by a rigid, calcified pericardium.

E The Tumor Plop

- **Timing:** Early-to-mid diastole (later than an opening snap).
- **Mechanism:** Caused by an **Atrial Myxoma** (usually Left Atrial) as the tumor mass “plops” into the mitral orifice during diastole, mimicking Mitral Stenosis.

III SUMMARY OF DIASTOLIC SOUNDS BY TIMING

Sound	Timing	Most Common Cause
Opening Snap	Early Diastole	Mitral Stenosis
Pericardial Knock	Early Diastole	Constrictive Pericarditis
S3 (Ventricular)	Early Diastole	LV Failure (Dilated CM)
Tumor Plop	Early-to-Mid Diastole	Atrial Myxoma
S4 (Atrial)	Late Diastole	LV Hypertrophy / Stiffness

IV THE INDIAN CLINICAL CONTEXT

- **The "MS" Dominance:** The **Opening Snap** remains the most frequently encountered pathological diastolic sound in Indian clinical practice due to Rheumatic Heart Disease.
- **The S3 Warning:** In the Indian diabetic population, a new-onset S3 gallop warrants prompt evaluation for heart failure, even if the patient is relatively asymptomatic.
- **Mueller Maneuver Utility:** While echo has reduced reliance on bedside maneuvers, the Mueller maneuver reproduces the large negative intrathoracic pressure swings of **obstructive sleep apnea**, a relevant mechanism in the Indian obese/metabolic syndrome cohort.