Systolic Anterior Motion

SAM is defined as the anterior translation of 1 or both mitral valve (MV) leaflets into the LVOT during systole.

The extent of this translation is variable and leads to differing degrees of SAM, ranging from no hindrance to blood flow to profound LVOT obstruction (LVOTO) and cardiovascular collapse.

Systolic Anterior Motion (SAM) Mechanism:

- **Venturi Effect (Old Theory)**: High-velocity flow lifts the slack AMVL into the LVOT.
- **Drag Force (Current Theory)**: High-velocity LVOT flow drags the slack MV leaflet toward the septum, influenced by septal hypertrophy and structural abnormalities.

Pathophysiology of SAM in HCM

Basal Septal Wall Hypertrophy: Leads to narrowing of the LV outflow tract (LVOT), whose borders include the septum and anterior mitral valve leaflet (AMVL).

Papillary Muscle Displacement: Hypertrophied, anteriorly displaced papillary muscles and elongated MV leaflets shift the mitral apparatus toward the enlarged septum, causing abnormal mitral valve coaptation

Systolic septal thickening occurring during LV contraction further diminishes the outflow tract dimension, resulting in elevated LVOT blood flow velocities.

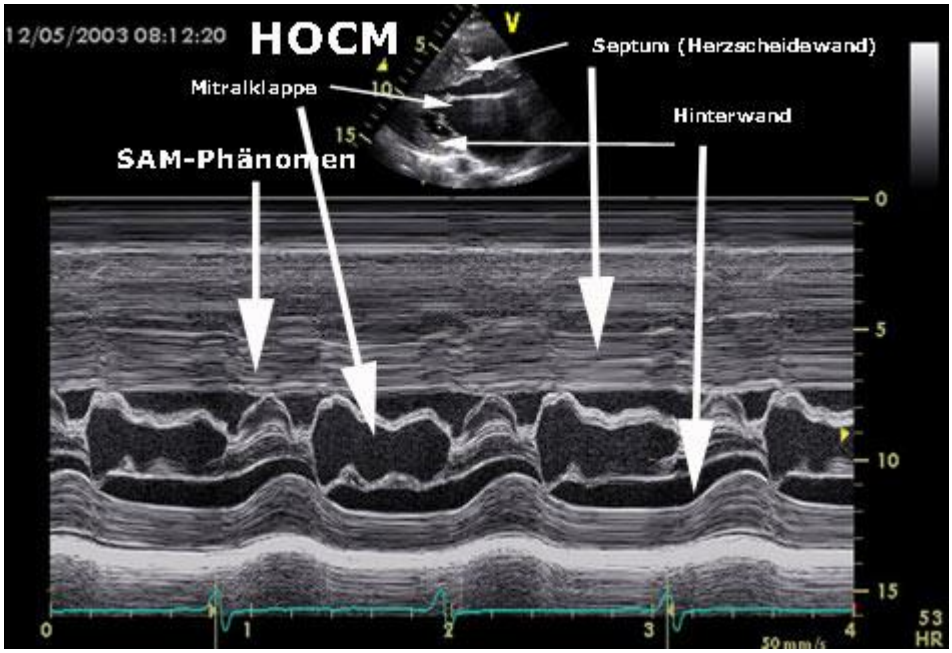
High-velocity flow can then lift the anteriorly displaced, slack (becomes excessively loose or redundant) MV leaflet into the LVOT in a phenomenon known as the **Venturi effect**, the initial proposed SAM mechanism.

Mitral Regurgitation (MR):

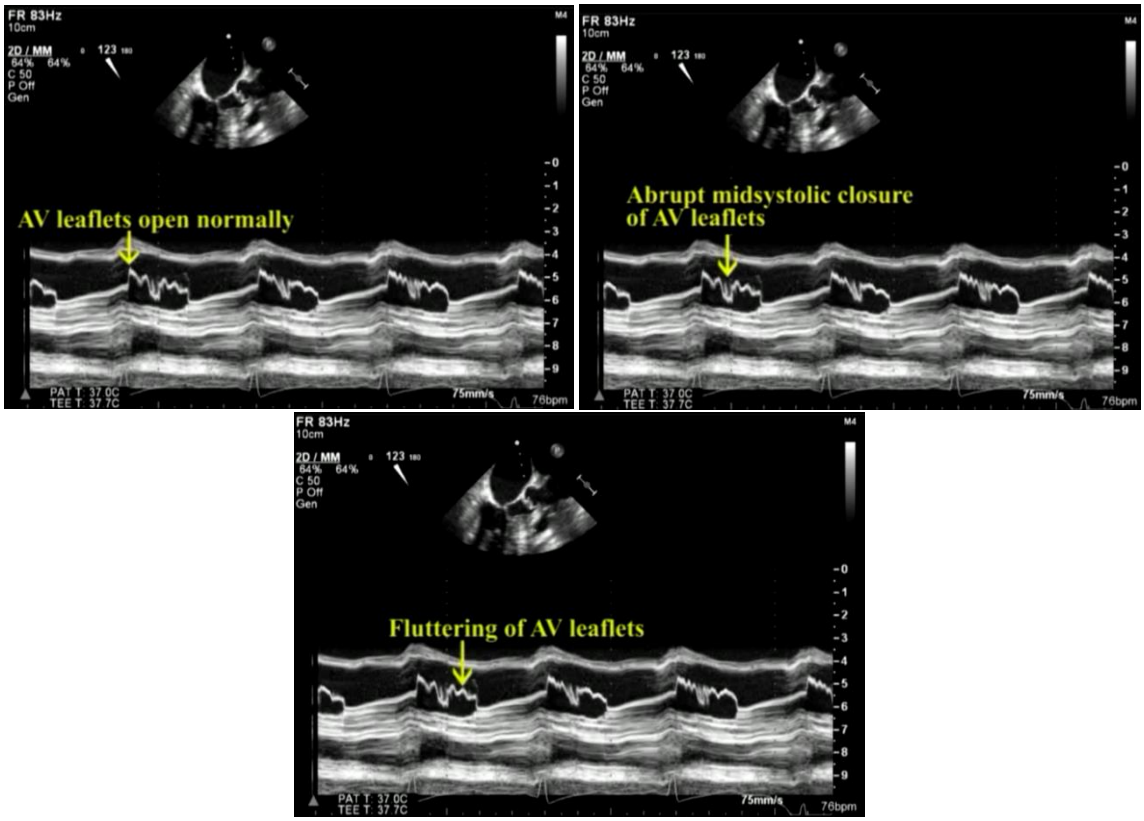
- **SAM-Induced MR**: Distal AMVL remains in the LVOT, preventing proper mitral coaptation, resulting in a posteriorly directed jet of MR.
- **Timing**: MR occurs in mid-to-late systole after the onset of SAM and LVOT obstruction (LVOTO).

Echo Features

- SAM of the anterior mitral leaflet towards the septum. Best seen in PLAX 2D or M-Mode. May see mid-systolic contact of anterior leaflet with the septum in severe obstruction.

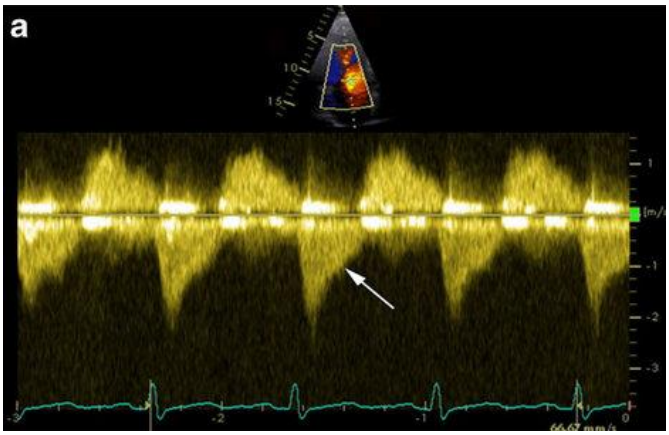


- When SAM results in LVOTO, stroke volume is reduced, leading to abrupt mid-systolic closure of the AV leaflets. This can be seen as fluttering of the AV leaflets.



- M-mode directed perpendicularly to the AV also demonstrates early closure of the AV leaflets
- With dynamic LVOTO, the spectral display shows high-velocity envelope in the shape of a dagger. The delayed peak of this “dagger-shaped” profile

occurs in mid-to-late systole, as opposed to the more homogenous, parabolic profile seen with fixed obstruction (i.e., aortic stenosis).



- Eccentric, posteriorly directed MR jet secondary to SAM (causing incomplete leaflet apposition), as the AML is pulled away from the PML the MR is increases. It also appears mid-to-late peaking (may confused with dynamic LVOT gradient). Mid-to-late peaking appearance of MR