ATRIAL ABNORMALITIES, FASCICULAR BLOCKS

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I ATRIAL ABNORMALITIES (ENLARGEMENT VS. CONDUCTION DELAY)

- **Core Concept:** The term Atrial Abnormality is preferred over "Enlargement" because surface ECG changes reflect combined intra-atrial conduction delay, elevated intracavitary pressure, and chamber dilatation rather than pure anatomical size.

A Right Atrial Abnormality (RAA) / P-Pulmonale

- **Criteria in Lead II (Frontal Plane):** P-wave amplitude greater than 2.5 mm (0.25 mV) in the inferior leads (II, III, aVF) with normal P-wave duration (less than 120 ms).
- **Criteria in V1/V2 (Horizontal Plane):** Initial positive deflection of the P-wave greater than 1.5 mm (0.15 mV).
- **Morphology and Axis:** Tall, peaked, symmetrical P-waves with rightward shift of the frontal plane P-wave axis (greater than +75 degrees).
- **Clinical Significance:** Classically seen in chronic obstructive pulmonary disease (COPD), Pulmonary Hypertension, congenital heart disease (e.g., Ebstein anomaly, pulmonary stenosis), and Tricuspid Stenosis or regurgitation.

B Left Atrial Abnormality (LAA) / P-Mitrale

- **Criteria in Lead II:** Prolonged P-wave duration of 120 ms or greater (0.12 s), classically displaying a wide, notched "M" shape with an inter-peak distance greater than 40 ms (0.04 s).
- **Criteria in Lead V1 (Morris Index / P-Terminal Force in V1):** Biphasic P-wave with a prominent terminal negative deflection having a depth of 1 mm or greater (0.1 mV) and a duration of 40 ms or greater (0.04 s), yielding a P-terminal force (PTFV1) of 40 mm·ms or greater (0.04 mm·s or greater).
- **Clinical Significance:** Reflects Left Ventricular Hypertrophy (LVH), Mitral Stenosis or Regurgitation, Systemic Hypertension, or interatrial conduction block (Bayés syndrome when P duration is 120 ms or greater with biphasic plus/minus P-waves in leads II, III, and aVF).

C Bi-Atrial Abnormality

- **Diagnostic Criteria:** Simultaneous presence of both RAA and LAA criteria on the same 12-lead ECG—such as a tall peaked P-wave greater than 2.5 mm in lead II combined with a deep, wide terminal negative deflection in lead V1 (depth 1 mm or greater and duration 40 ms or greater), or a large biphasic P-wave in V1 with an initial positive component greater than 1.5 mm and a terminal negative component meeting Morris criteria.

II FASCICULAR BLOCKS (HEMIBLOCKS)

- **Core Principle:** Fascicular blocks result from conduction delay or interruption in one of the divisions of the Left Bundle Branch. They are diagnosed primarily by shifts in the frontal plane mean QRS axis and specific initial/terminal QRS vectors in the absence of other causes of axis deviation.

A Left Anterior Fascicular Block (LAFB)

- **Frontal Plane QRS Axis:** Marked Left Axis Deviation between -45 degrees and -90 degrees.
- **QRS Morphology:** qR pattern in high lateral leads (I and aVL) and rS pattern in inferior leads (II, III, and aVF), where S in lead III is deeper than S in lead II.
- **R-Wave Peak Time:** Delayed intrinsicoid deflection (R-wave peak time) in lead aVL of 45 ms or greater.
- **QRS Duration:** Less than 120 ms in isolated LAFB (unless accompanied by Right Bundle Branch Block).

B Left Posterior Fascicular Block (LPFB)

- **Frontal Plane QRS Axis:** Marked Right Axis Deviation between +90 degrees and +180 degrees (AHA/ACCF/HRS 2009 criteria).
- **QRS Morphology:** rS pattern in leads I and aVL and qR pattern in leads III and aVF, with QRS duration less than 120 ms.
- **Mandatory Rule of Exclusion:** LPFB is strictly a diagnosis of exclusion; Right Ventricular Hypertrophy (RVH), chronic cor pulmonale, acute pulmonary embolism, extensive lateral myocardial infarction, and vertical heart in a slender/asthenic body habitus must be ruled out clinically and echocardiographically.
- **Anatomical and Clinical Significance:** Isolated LPFB is rare and carries a worse prognosis than LAFB because the left posterior fascicle is shorter, broader, travels in a less turbulent inflow tract, and possesses a dual blood supply from both the LAD (septal perforators) and RCA (posterior descending artery); thus, LPFB typically signifies extensive multivessel coronary artery disease or diffuse conduction system disease.

ECG Feature	Left Anterior Fascicular Block (LAFB)	Left Posterior Fascicular Block (LPFB)
Frontal Plane QRS Axis	-45 degrees to -90 degrees (Left Axis Deviation)	+90 degrees to +180 degrees (Right Axis Deviation)
Leads I and aVL	qR complex (R-wave peak time in aVL 45 ms or greater)	rS complex
Leads II, III, and aVF	rS complex (S3 deeper than S2)	qR complex (R3 taller than R2)
QRS Duration	Less than 120 ms (isolated)	Less than 120 ms (isolated)
Blood Supply & Anatomy	Long, thin; single supply (LAD septal branches)	Short, thick; dual supply (LAD and RCA/PDA)

III BIFASCICULAR AND TRIFASCICULAR PATTERNS

- **Bifascicular Block:** Conduction block involving two of the three main infra-Hisian fascicles—most commonly Right Bundle Branch Block (RBBB) + LAFB, less commonly RBBB + LPFB (which carries a higher risk of progression to complete heart block), or complete Left Bundle Branch Block (LBBB) alone.
- **So-Called "Trifascicular" Block (Incomplete):** Defined electrocardiographically as Bifascicular Block + First-Degree AV Block (prolonged PR interval greater than 200 ms). In approximately 50 percent of cases, the PR prolongation reflects AV nodal delay rather than true disease in the remaining third fascicle, whereas true alternating bundle branch block (alternating LBBB and RBBB, or RBBB with alternating LAFB and LPFB) represents definitive trifascicular disease and is a Class I indication for permanent pacing regardless of symptoms.

IV LANDMARK EVIDENCE AND PACING GUIDELINES (ESC 2021 / ACC/AHA/HRS 2018)

- **Asymptomatic Bifascicular Block (Class III — Harm):** In asymptomatic patients with isolated bifascicular block (with or without first-degree AV block), routine permanent pacemaker (PPM) implantation is not indicated because the annual rate of progression to complete AV block is low (1 to 2 percent per year).
- **Bifascicular Block with Unexplained Syncope (PRESS Trial / ESC 2021):** Patients with bifascicular block and unexplained syncope require a stepped diagnostic workup (electrophysiology study followed by an implantable loop recorder if the EP study is negative), though empirical dual-chamber pacing may be considered (Class IIb) in frail elderly patients.
- **Electrophysiology Study (EPS) Pacing Thresholds (Class I, Level B):** During invasive EPS in patients with bifascicular block and syncope, permanent pacemaker implantation is Class I recommended if the baseline HV interval is 70 ms or greater, or if second- or third-degree His-Purkinje (infra-Hisian) block is provoked by incremental atrial pacing or pharmacological stress (ajmaline, procainamide, or flecainide).

V PRACTICAL CONSIDERATIONS IN THE INDIAN CLINICAL CONTEXT

- **Ischemic vs. Degenerative Etiology:** While primary degenerative Idiopathic Fibrosis of the conduction system (Lenègre disease in younger/middle-aged patients and Lev disease from calcific extension of the fibrous cardiac skeleton in the elderly) is common globally, acquired fascicular and bifascicular blocks in India frequently occur secondary to anterior STEMI (proximal LAD occlusion before the first septal perforator causing RBBB + LAFB) due to delayed reperfusion.
- **Pre-TAVI Conduction Risk:** Pre-existing RBBB (especially when combined with LAFB or first-degree AV block) is the strongest independent baseline predictor of high-grade AV block and permanent pacemaker requirement following Transcatheter Aortic Valve Implantation (TAVI), particularly with self-expanding prostheses or deep implantation in small calcified aortic roots.

KEY REFERENCES

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