University of Constantine 3
Faculty of Medicine
Department of Medicine
Laboratory of Normal Anatomy
Course Handout for Second-Year Medical Students

CARDIAC INNERVATION

I – INTRODUCTION:

Cardiac innervation relies on **two complementary systems**:

- **The cardiac conduction system**, or **intrinsic innervation**, which is responsible for the **generation and conduction of electrical impulses** and underlies **cardiac automaticity**.
- **Extrinsic innervation**, represented by the **sympathetic and parasympathetic (vagal) systems**, which **regulate cardiac activity**, particularly the heart rate and force of contraction.

Sympathetic and parasympathetic fibers give rise to the **cardiac nerves**. These contribute to the formation of the **cardiac plexuses**, located around the great vessels and at the base of the heart.

Voici une traduction en **anglais académique et anatomique**, adaptée à un cours universitaire :

II – EXTRINSIC INNERVATION

The regulation of **cardiac automaticity** is mediated by two systems:

1-Parasympathetic system

The parasympathetic supply is provided by **branches of the vagus nerve**, which are schematically divided on each side into three cardiac nerves:

- **Superior cardiac nerve**: arises from the **trunk of the vagus nerve**, distal to the **inferior ganglion of the vagus nerve**.
- **Middle cardiac nerve**: arises from the **loop of the recurrent laryngeal nerve**.
- **Inferior cardiac nerve**: arises **below the loop of the recurrent laryngeal nerve**.

1- Le système sympathique:

It is formed by branches arising from the ganglia of the cervical sympathetic chain, which are arranged on each side into three groups:

- **Superior cardiac nerve**

Arises from the superior cervical sympathetic ganglion.

- **Middle cardiac nerv**

The largest cardiac branch, arising from the middle cervical sympathetic ganglion.

- **Inferior cardiac nerve**

A very short nerve, arising from the inferior cervical sympathetic ganglion (cervicothoracic ganglion) or from the subclavian loop (ansa subclavia

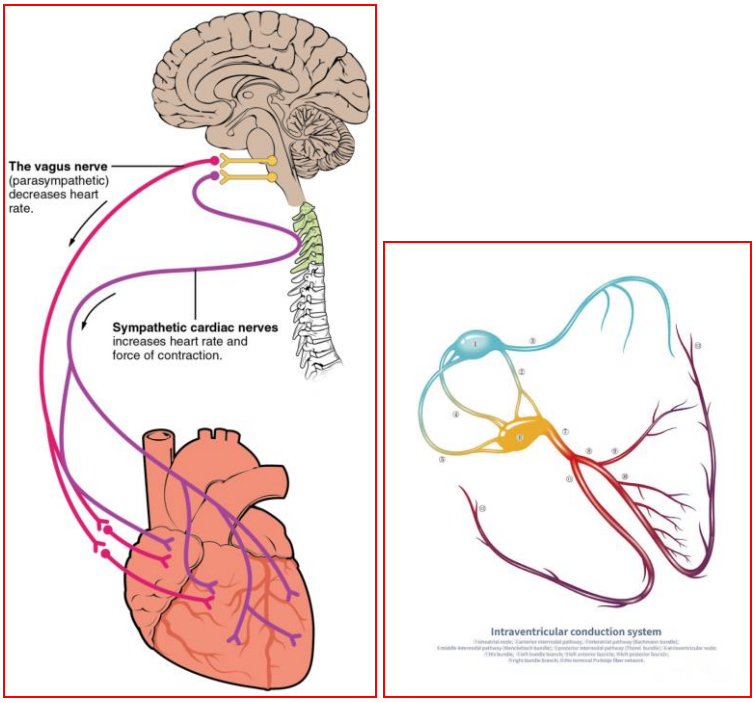


Fig 1 SYSTEME INTRINSEQUE ET EXTRINSEQUE DU CŒUR

3- Cardiac Plexuses:

All cardiac nerves contribute to the formation of **two cardiac plexuses**:

A- Anterior Arterial Plexus (or Superior Cardiac Plexus)

It surrounds the **ascending aorta** and the **pulmonary trunk**.
It receives nerve fibers from:

- the **cardiac nerves of both sympathetic trunks**;
- the **left vagus nerve** and the **superior cardiac branch of the right vagus nerve**.

After crossing the **anterior and posterior surfaces of the aorta**, the plexus becomes condensed into the **ganglion of Wrisberg**.
It can be subdivided into three plexuses:

- **pre-aortic plexus**;
- **retro-aortic plexus**;
- **subaortic plexus**.

It gives rise to the **right and left coronary plexuses**, which accompany the **coronary arteries** and form, more deeply, the **intracardiac plexuses**, including the **subepicardial** and **subendocardial plexuses**.

B- Posterior Venous Plexus (or Inferior Cardiac Plexus)

It surrounds the **pulmonary veins** and the **superior vena cava**.
It receives nerve fibers from:

- the **right sympathetic cardiac nerves**;
- the **middle and inferior cardiac branches of the right vagus nerve**.

Posterior to the **pulmonary bifurcation**, it gives rise to two groups of nerve branches:

- **Right-sided branches**, descending posterior to the **right atrium**;

- **Left-sided branches**, descending along the **posterior surface of the ventricles**.

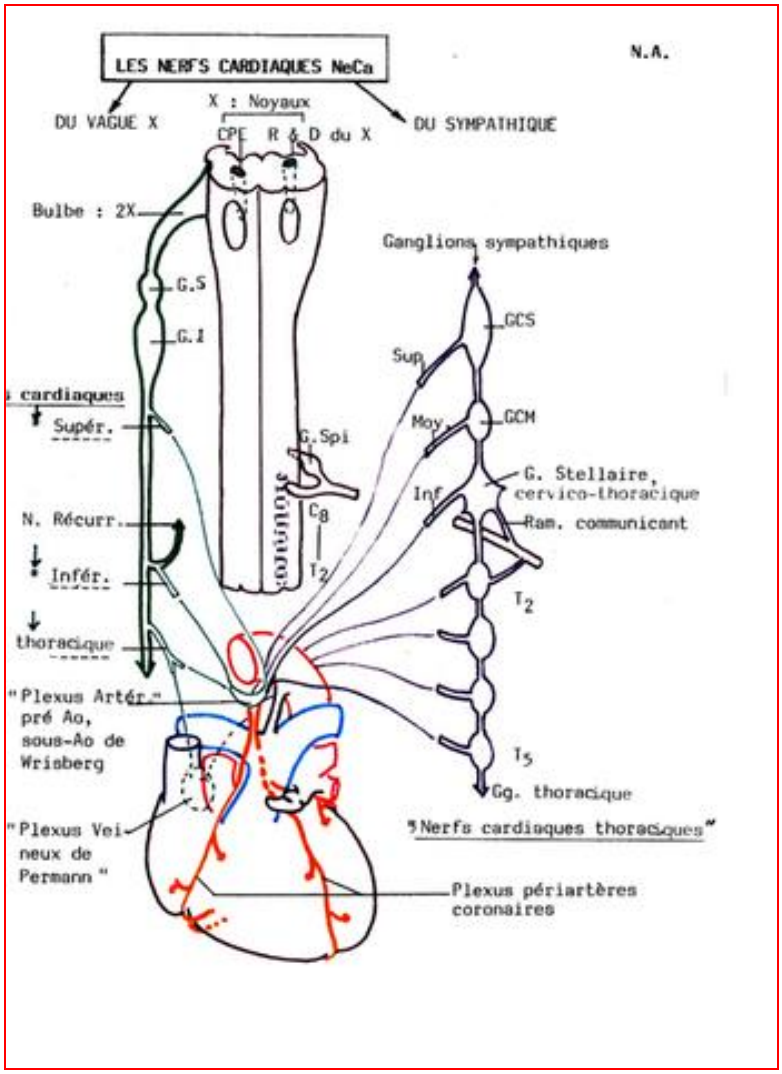


Fig2- PLEXUS CARDIAQUE

4 – Systematization

- The **sympathetic motor centers** are located in the **lateral horn of the spinal cord**, extending from **C4 to T4**.
- The **parasympathetic motor centers** are located in the **parasympathetic nucleus of the vagus nerve**, also known as the **cardiopneumoenteric nucleus**.
- The **cardiac plexuses** convey both **efferent (centrifugal)** and **afferent (centripetal)** nerve fibers, allowing a degree of **intrinsic cardiac regulation**.

III – INTRINSIC INNERVATION: CARDIAC CONDUCTION SYSTEM

The cardiac conduction system is responsible for coordinating the contractions of the different cardiac chambers. It consists of:

- **Nodal structures**, namely the **sinoatrial node** and the **atrioventricular node**;
- **Bundles of specialized cardiac fibers**, including the **atrioventricular bundle (bundle of His)** and its branches.

NB:

In the event of dysfunction of the cardiac conduction system, cardiac rhythm can be maintained by an **electronic cardiac pacemaker**.

1-Sinoatrial Node (Keith–Flack Node)

The **sinoatrial node** is located **subepicardially** in the **right atrium**, near the **junction of the superior vena cava with the right atrium**.

It is most commonly supplied by a branch of the **right coronary artery (approximately 60%)**, and less frequently by a branch of the **left coronary artery**.

NB:

Its precise anatomical location is of particular importance to the **cardiac surgeon**, who must take care to preserve it during surgical procedures.

Pathology of the sinoatrial node is closely related to its **immediate anatomical relationship with the epicardium** and to disease affecting its **arterial blood supply**.

2– Atrioventricular Node (Aschoff–Tawara Node)

The **atrioventricular node** is located **subendocardially** in the inferior part of the **interatrial septum**. It lies **anteromedial to the ostium of the coronary sinus**.

It is supplied by **branches of the right coronary artery**.

NB:

The most common pathological lesions affecting the atrioventricular node are **ischemic injury (infarction)** and **fibrosis**, resulting from damage to the **coronary artery supplying the node**.

3– Internodal Pathways

These are conduction pathways connecting the sinoatrial node to the atrioventricular node.

Three pathways are distinguished:

- **Anterior internodal pathway:** passes along the superior border of the interatrial septum.
- **Middle internodal pathway:** courses around the superior border of the fossa ovalis.
- **Posterior internodal pathway:** courses along the crista terminalis and passes either anterior or posterior to the ostium of the coronary sinus.

4– Atrioventricular Bundle (Bundle of His)

The atrioventricular bundle continues from the atrioventricular node. It courses through the atrioventricular septum and the interventricular septum.

It consists of a main trunk that divides into two branches, a right and a left branch, each supplying the corresponding ventricle.

- **Right bundle branch:** courses along the interventricular septum, then passes through the septomarginal trabecula and terminates beneath the endocardium as a Purkinje fiber network.
- **Left bundle branch:** courses along the interventricular septum to reach the left ventricle. It terminates beneath the endocardium as a Purkinje fiber network.

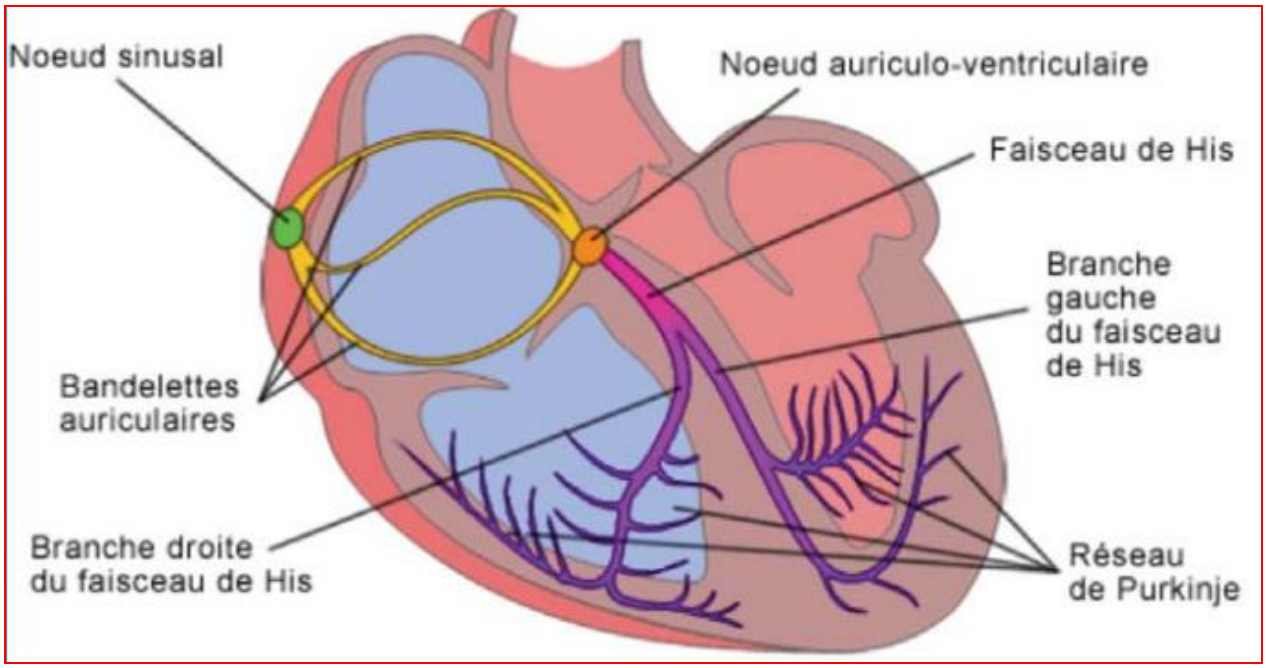


FIG 3- SYSTEME CARDIONECTEUR

VI – FUNCTIONAL ANATOMY

The **nodal tissue** is responsible for **cardiac automaticity**.

- The **sinoatrial (SA) node** is the **physiological pacemaker**: it generates the electrical impulse and determines the heart rate (**70–80 beats per minute**).
- The impulse spreads through the **atria** to the **atrioventricular (AV) node** via the **internodal pathways**.
- At the level of the **AV node**, the impulse **slows down**, allowing the atria to contract before the ventricles.
- The impulse then rapidly travels through the **bundle of His**, its branches, and the **Purkinje fiber network**, resulting in **ventricular contraction**.

The electrical activity of the heart is recorded by **electrocardiography (ECG)**, which allows the assessment of **cardiac rhythm and conduction disorders**.

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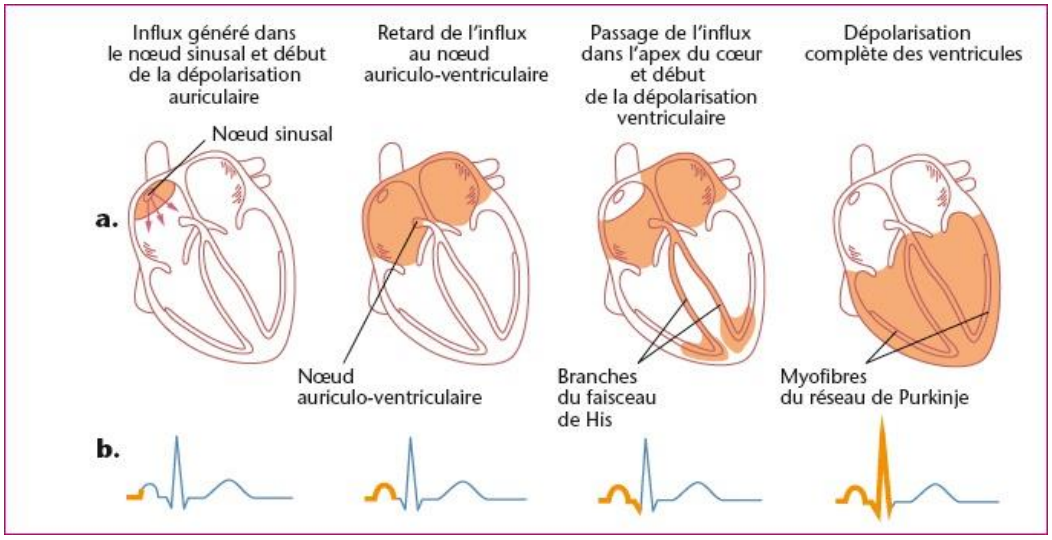


FIG 4- ANATOMIE FONCTIONNELLE