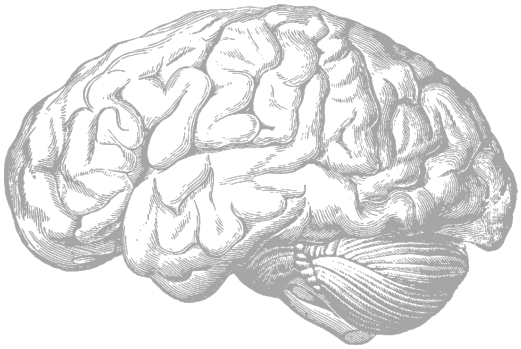
# Organization of the Nervous System

## CNS Block



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The Editing File

# Objectives

- List the **parts** of the nervous system.
- List the **function** of the nervous system.
- Describe the **Structural & Functional Organizations.**
- Define the terms:
  - Nervous tissue.
  - Grey matter
  - White matter.
  - Nucleus.
  - Ganglion.
  - Tract.
  - Nerve.
- List the **parts of the brain.**
- List the **structures protecting** the central nervous system.

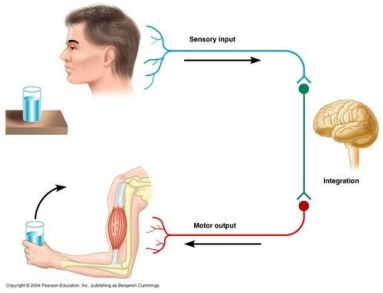
You can find Atlas by Clicking HERE!

# Introduction to the nervous system

| The Nervous System | It is the major controlling, regulatory & communicating system in the body. |
|---|---|

| It is the center of all mental activity including | | | |
|---|---|---|---|
| Thought 💭 | Learning 📚 | Behavior 😜 | Memory 🤔 |
| responsible for **regulating** and **maintaining** homeostasis (Together with the endocrine system) | | | |

## How the nervous system works
## The nervous system has three functions:




1. **Collection of sensory input**
   Identifies changes occurring inside or outside the body by using sensory receptors. These **changes** are called ***stimuli***.

2. **Integration**
   Processing, analyzing and interprets the changes (what changes ? the one in the first point) and makes decisions.

3. **Motor output**
   response by activating muscles or glands (effectors).
   In other words initiate action potential 🚦 .

# Classification of the nervous system

The nervous system has two main classification, one being ***Anatomical( Structural)*** and the other being ***Physiological (Functional)***

## Anatomical( Structural) Classification

### Central Nervous System

- Consists of Brain and Spinal cord
- Occupied by the dorsal body cavity (CLICK)
- Acts as the integrating and command centers.

### Peripheral Nervous system

- Consists of **receptors, nerves & ganglia.**
- It's the part of the nervous system outside the CNS. (outside the dorsal cavity).

## physiological (Functional) Classification/Organization

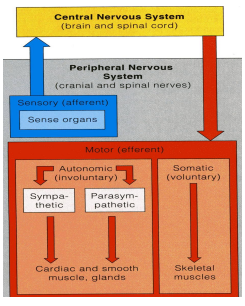
**Motor division (Efferent)**
Consists of nerve fibers that convey impulses from the CNS to the effector muscles, organs, and glands:
"CNS———————> Organ"

**Sensory division (Afferent)**
Consists of nerve fibers that convey impulses from receptors located in various parts of the body, to the CNS.
"Organ ———————>CNS"

## The Sensory and Motor division are subdivided into:

### Somatic Division:

Concern with:
1- Skin.
2- Skeletal muscles.
3- Joints.




### Autonomic Division:

Concern with:
1- Visceral organs.

# Nervous Tissue

Nervous system is **composed of nervous tissue**, which <u>contains two **types of cells:**</u>

**1- Nerve cells or neurons**

They are the **basic structural (anatomical), functional and embryological unit** of the nervous system.

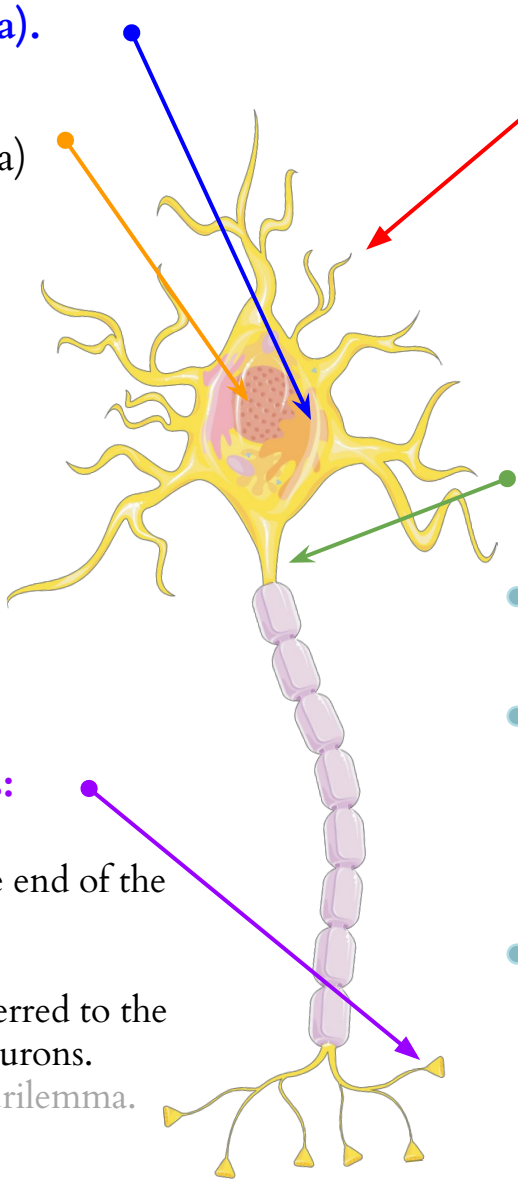
**2- Neuroglia (Glial cells)**

They are supporting cells ( non-neuronal cells, they don't actually produce electric impulses).

The human nervous system is estimated to contain about $10^{10}$ neurons that vary in shape,size, number of processes. Neurons contain:

**1- Cell Body (Soma).**

**Nucleus.**
(Inside the soma)



**2- Dendrites:**

Short processes of the cell body with variable numbers and are receptive in function, detects stimulus like environmental changes and carries impulses toward the cell body.

**3- Axon (or Nerve Fiber) :**

- one of the processes leaving the cell body.
- It is a **single process** highly variable in length and may divide into several branches or Collaterals through which information can be distributed to a number of different destinations.
- Carries information **away** from the cell body.

**4- Terminal Buttons:**

- specializations occur at the end of the axon.
- Here information is transferred to the Dendrites of other neurons.

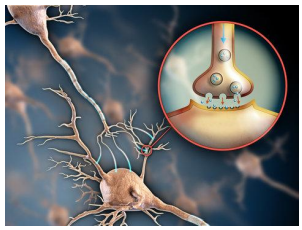
Coverings: Myelin, Neurilemma.

EXTRA: when action potential reaches synaptic knobs it causes release of neurotransmitters. It send signals to other neurons.

# Nervous tissue Cont.

## Synapse/Relay

It's the junction site of two Neurons, in the synapses the membranes of adjacent cells are in close apposition.
(contiguity=contact, not continuity) متقاربين وليسوا متصلين ببعض



## Neuroglia or glia or glial cells:

Female slide

1 ***Neuroglia***, or ***glial cell*** constitute the other major cellular component of the nervous tissue.

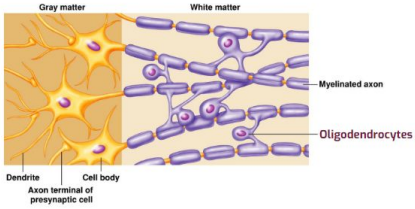
2 It is a **specialized connective tissue supporting framework** for the nervous system.

3 Unlike ***Neurons***, ***Neuroglia*** do not have a direct role in information processing but they are essential for the normal functioning of the *Neurons*, they act as supporting and nutrition for ***Neurons.***

### Nervous Tissue is Organized as:

#### Grey Matter

**Which contains :**
1- Cell bodies
2- Processes of the neurons
3- Neuroglia and
4- Blood vessels.




#### White Matter

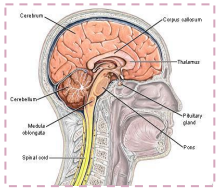
**Which contains :**
1- Processes of the neurons
2- Neuroglia and
3- Blood vessels.
NO cell bodies in the white matter.

| Term | Nucleus | Tract | Ganglion | Nerve |
|---|---|---|---|---|
| Definition | A group of neurons within the CNS | A group of nerve fibers (axons) within the CNS | A group of neurons outside the CNS | A group of nerve fibers (axons) outside the CNS |

# Spinal Cord

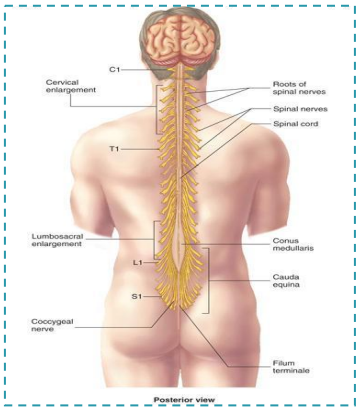
Male Slides

## Introduction

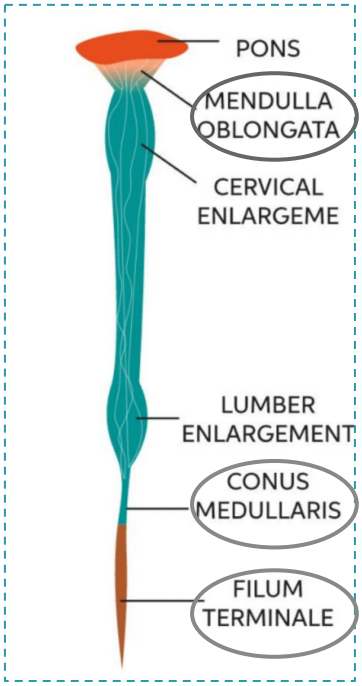


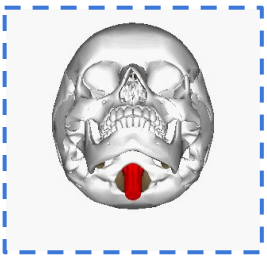
- The spinal cord is the main pathway for information connecting the brain and peripheral nervous system.
- Elongated almost cylindrical suspended in the vertebral canal, surrounded by the meninges and cerebrospinal fluid.
- The primary function of spinal cord is a transmission of neural signals between the brain and the rest of the body.
  - Sensory
  - Motor
  - Local reflexes
- Approximately 45 cm long in adult males and is about the thickness of the little finger.

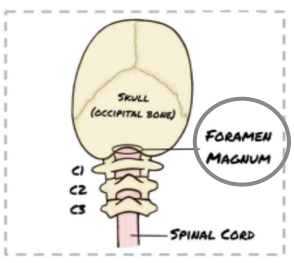
## Structures




- Extends from foramen magnum to **2nd lumbar vertebra.**
- Continuous above with the **medulla oblongata.**
- The tapered inferior end forms conus medullaris, which is **connected to the coccyx** by a **non-neuronal** cord called Filum Terminale.





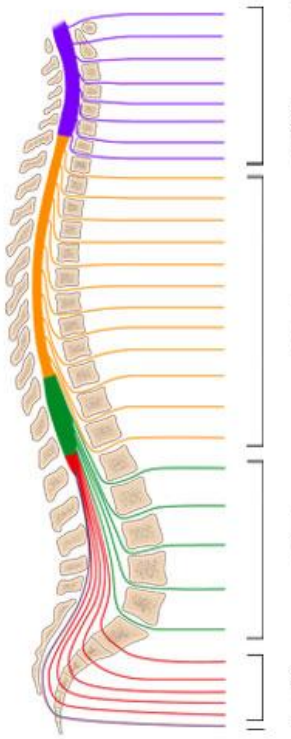
# Spinal Cord

Male Slides

## Features

Segmented structure, gives rise to 31 pairs of spinal nerves. Spinal nerves are part of the PNS, however the spinal cord is part of the CNS.

- **First pair** exit vertebral column **between skull and atlas.**
- Others exit through intervertebral foramina.
- **Last four pairs** exit via the **sacral foramina.**



8 Cervical Pair

12 Thoracic Pair

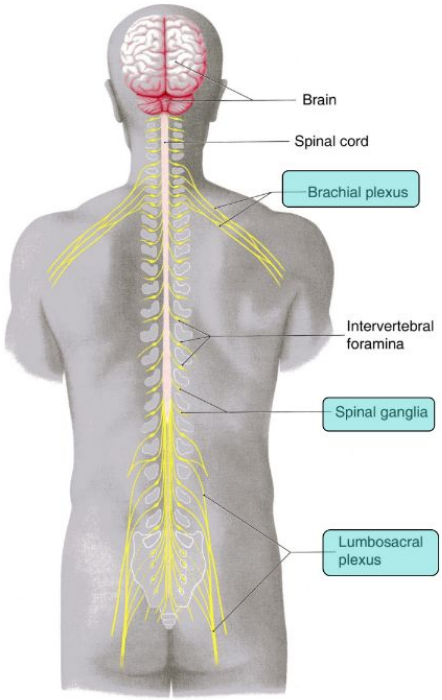
5 Lumbar Pair

5 Sacral Pair

1 coccygeal Pair

Spinal nerves **supplying** the upper or lower **limbs** form plexuses e.g. brachial or lumbar plexus.

Nerve **cell bodies** that are aggregated **outside the CNS** are called GANGLIA.



# Autonomic Nervous System (A.N.S)

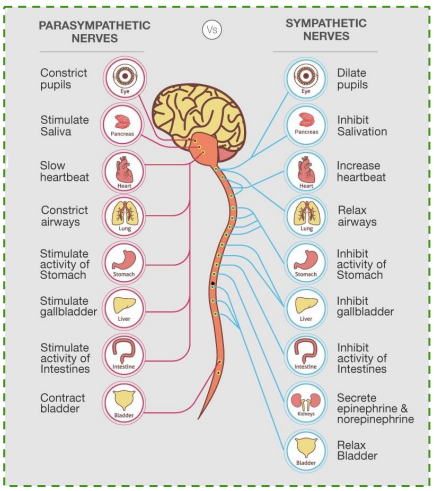
## Definition

Neurons that detect changes and control the activity of the viscera(Organs that placed inside a body cavity) are collectively referred to as the autonomic nervous system.

Its components are present in both the central and peripheral nervous systems.

**Autonomic Nervous System**
is divided into two anatomically and functionally distinct parts:

- **Sympathetic Nervous System (Thoracolumbar outflow)**
- **Parasympathetic Nervous System (Craniosacral outflow)**




## Effects of the sympathetic & Parasympathetic systems:

Sympathetic and parasympathetic , divisions are generally have **antagonistic** effects(Ach, Epinephrine…etc) on the structures that they innervate, E.g. Sympathetic increases the heart rate, while the parasympathetic decreases the heart rate.

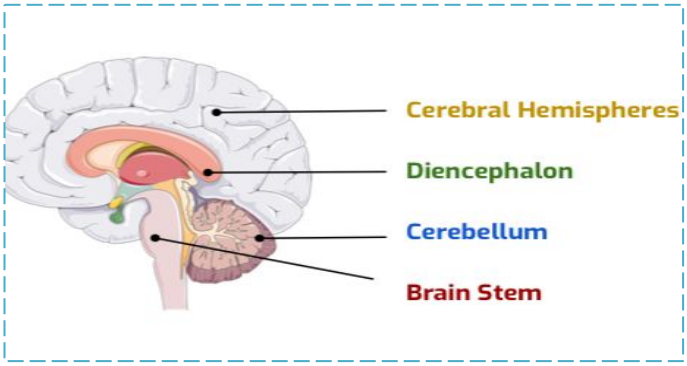
## The Autonomic nervous system innervates:

- Smooth muscles.
- Secretary glands
- Cardiac muscle.
- It is an important part of the homeostatic mechanisms that control the internal environment of the body with the endocrine system.

# The brain

## The Brain is composed of 4 parts:

- Cerebral Hemispheres
- Diencephalon
- Cerebellum
- Brain Stem




## Cerebral Hemispheres:

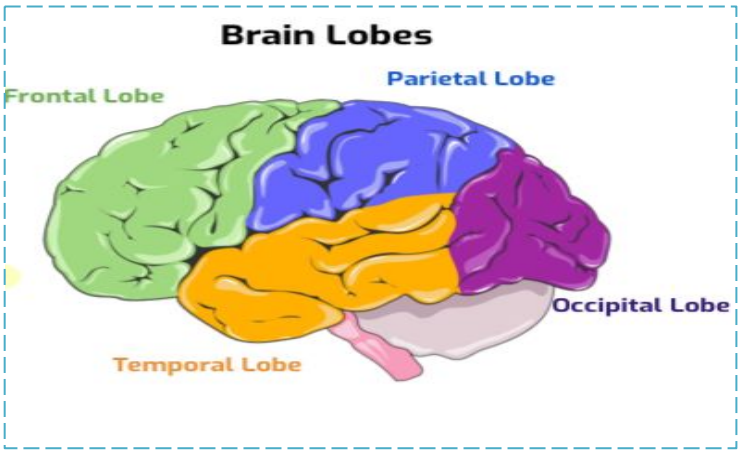
The **largest** part of the brain.

They have elevations مرتفعات, called **gyri**.

Gyri are separated by depressions منخفضات called **sulci**.

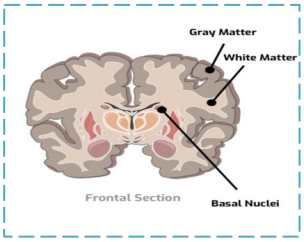
Each hemisphere is divided into **4 lobes** named **according to the bone above.**

Lobes are separated by deeper grooves called **fissures or sulci**.



# The brain

## Tissue of Cerebral Hemispheres:




The outer layer is the **Gray Matter** or **Cortex.**

**Deeper** is located the **White Matter** or medulla, composed of **bundles of nerves fibers** carrying impulses to and from the cortex.

**Basal Nuclei** are **gray matter** that are located deep within the white matter.

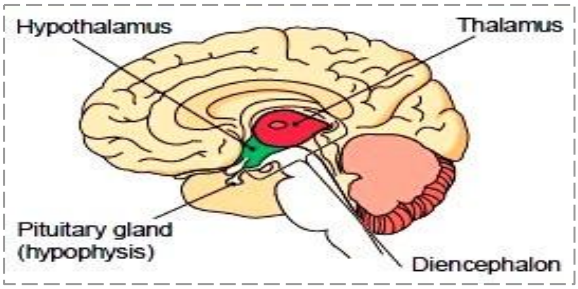
they help the motor cortex in regulation of **voluntary motor activities.**

## Diencephalon:

The diencephalon is located between the 2 cerebral hemispheres and is linked to them and to the brainstem.

### The major structures of the Diencephalon are:

- Thalamus
- Hypothalamus
- Subthalamus
- Epithalamus

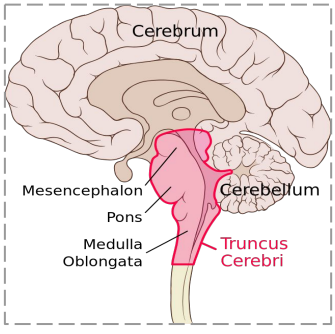



## Brainstem

It is connected to the cerebellum with **3 paired peduncles superior, middle and inferior.**

### The brainstem has three parts:

1. **Midbrain**
2. **Pons**
3. **Medulla oblongata**



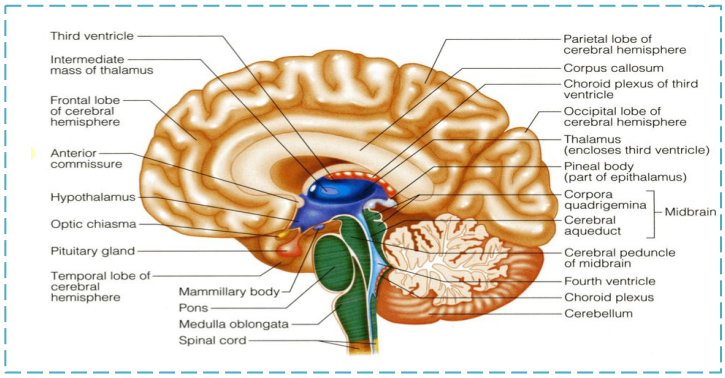
# The brain

## Cerebellum:

Cerebellum has 2 cerebellar hemispheres with convoluted surface.

It has an **outer cortex of gray matter** and an **inner region of white matter.**

It provides precise **coordination for body movements and helps maintain equilibrium.**

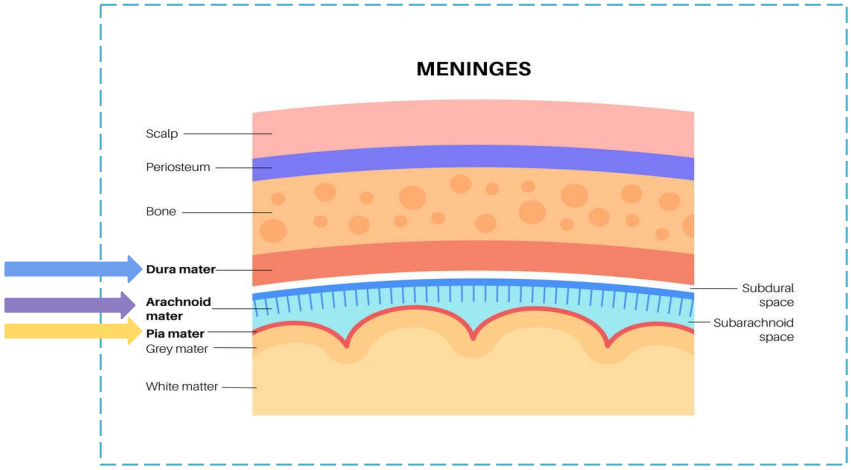



# Meninges

## Definition

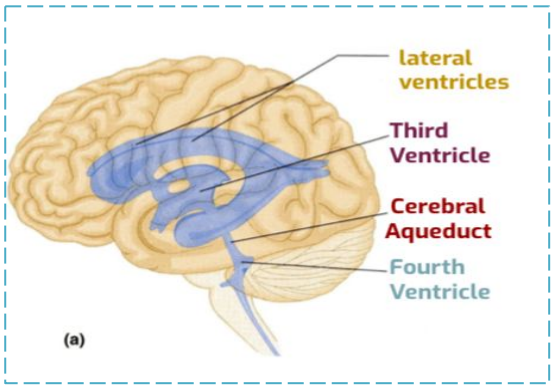
There are **three** connective tissue membranes invest the **brain** and the **spinal cord**, these are **from outward to inward** are:

1. Dura Mater
2. Arachnoid Mater
3. Pia Mater



# Brain Ventricles

1. Brain is bathed by the cerebrospinal fluid (**CSF**).
2. Inside the brain, there are **4 ventricles** filled with CSF.
3. **N.B.** Cerebral Aqueduct: in the midbrain connects the 3rd to the 4th ventricle.

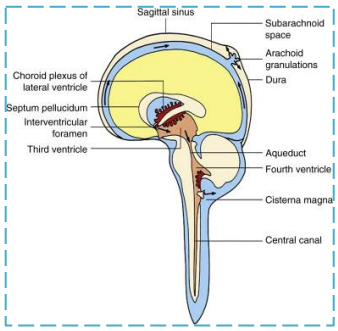



- 2 lateral ventricles: One in each hemispheres.
- 3rd ventricle: In the Diencephalon.
- 4th ventricle: between Pons, Medulla oblongata & Cerebellum.

# Cerebrospinal Fluid

**Cerebrospinal Fluid**

CSF is constantly **produced by** the **choroid plexuses** inside the:
1- third ventricle
2- fourth ventricle
3- lateral ventricle




- Inside the brain, CSF flows from the lateral ventricles to the 3rd and 4th ventricles.
- From the 4th ventricle, part of the CSF flows down in the central canal of the spinal cord.
- Most of the CSF drains from the 4th ventricle through 3 apertures to distribute in the subarachnoid space around the brain and returns to the dural sinuses through the arachnoid villi.
- Arachnoid villi are small protrusions of the arachnoid (the second layer covering the brain) through the dura.
- Villi absorb cerebrospinal fluid and return it to the dural venous circulation.

# Team Leaders

Remaz Almahmoud

Areej Alquraini

Sarah Alshahrani

Moath Alhudaif

Faris Alzahrani

# Team Members

Aleen Alkulyah

Khawla Alfaqih

Haya Alajmi

Sarah Alajaji

Almas Almutairi

Bayan Alenazi

Sadeem Alyahya

Zahra Alhazmi

Salma Alsaadoun

Norah Almohaimeed

Waad Alanazi

Aseel Alshehri

Lama Alsuliman

Aljoharah Alkhalifah

Aishah Boureggah

Maryam Alghannam

Lama Alotaibi

Wafa Alakeel

Ghaida Aldossary

Retal alshohail

Norah Almania

Deena Almahawas

Omar Almogren

Nazmi M Alqutub

Abdulaziz Alqarni

Mansour Alotaibi

Khalid Alsobe

Khalid Alanezi

Almuthana Alageel

Aban Basfar

Zeyad Alotaibi

Mohammed Alqutub

Abdalmalik Alshammakhi

Hamad Alyahya

Mohammed Alsalamah

Khalid Alsobei

Mohammed Alarfaj

Ziyad Alsalamah

Faisal Alshowier

Faisal Alhejji

Abdullah Aldhuwaihy

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**Anatomy.med443@gmail.com**