Medical Neuroscience | Tutorial Notes

Ventral Surface of the Brain

Map to Neuroscience Core Concepts[1]

NCC1. The brain is the body's most complex organ.

Learning Objectives

After study of the assigned learning materials, the student will:

1. Describe the major features of the cerebral lobes, as seen from the ventral view, discussing major gyri and sulci that characterize each lobe.
2. Recognize the major embryological subdivisions of the brain that are visible from the ventral view.

Narrative

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Overview

When you view the lateral aspect of a human brain specimen (see **Figures A3A** and **A11**[2]), three structures are usually visible: the **cerebral hemispheres**, the **cerebellum**, and part of the **brainstem** (although the brainstem is not visible in the specimen photographed in lateral view for **Fig. 1** below). The spinal cord has usually been severed (but we'll consider the spinal cord later), and the rest of the subdivisions are hidden from lateral view by the hemispheres. The diencephalon and the rest of the brainstem are visible on the medial surface of a brain that has been cut in the midsagittal plane. Parts of all of the subdivisions are also visible from the ventral surface of the whole brain. In this set of tutorials, you will find video demonstrations (from the brain anatomy lab) and photographs (in the tutorial notes) of these brain surfaces, and sufficient detail in the narrative to appreciate the overall organization of the parts of the brain that are visible from each perspective. As you work through this text and if you have access to an interactive digital atlas of the human brain, such as ***Sylvius4 Online***, find the structures and regions that are described here[3].

The **cerebral hemispheres** are especially large in humans. They are entirely covered by a 2–3-mm thick

[1] Visit **BrainFacts.org** for *Neuroscience Core Concepts* (©2012 Society for Neuroscience) that offer fundamental principles about the brain and nervous system, the most complex living structure known in the universe.

[2] Figure references to Purves et al., *Neuroscience, 5th Ed.*, Sinauer Assoc., Inc., 2012. [click here]

[3] To do so, launch ***Sylvius4 Online*** and go to **Photographic Atlas**, then select one of the atlas filters, such as **Gyri**, **Lobes**, or **Sulci and Fissures**.

layer of cells and cellular processes called the **cerebral cortex**. The surface of each hemisphere is highly infolded; the ridges thus formed are known as **gyri** (singular: gyrus) and the valleys are called **sulci** (singular: sulcus) or **fissures** (if they are especially deep). The appearance of the sulci and gyri varies somewhat from brain to brain. (As you might guess, each one has its own name, but it is necessary to become familiar with only a few of them.) The hemispheres are conventionally divided into lobes named for the bones of the skull that overlie them, namely the **frontal**, **parietal**, **occipital** and **temporal lobes** (see **Figure A3**).

If it were possible to unfold the cerebral cortex from one hemisphere (which can be done in digital representations of the cerebral hemisphere), the surface area of the resulting, flattened cerebral cortex would be roughly approximated by the crust of a 13-inch pizza (thin crust, *New York* style, of course, given the thinness of the cortex).

Ventral aspect of the brain

Fig. 1 below provides another look at the surface of the whole brain (see also **Figure A11**). Most of the subdivisions of the brain can be seen when it is viewed from its ventral aspect. The inferior surfaces of the frontal and temporal lobes of the cerebral hemispheres are prominent in this view. Running along the inferior surface of the frontal lobe near the midline are the olfactory tracts, which arise in little swellings at their anterior ends, the **olfactory bulbs**. The olfactory bulbs receive the axons of sensory cells in the olfactory mucosa (these axons are the first cranial nerve), and neurons in the bulbs give rise to fibers in the olfactory tracts (therefore, the tracts are part of the forebrain). Just superior to the bulbs, of course, is the ventral aspect of the frontal lobe, often referred to as the "orbital cortex" since this is the portion of the frontal lobe the overlies the orbits. The olfactory bulbs and tracts lie in the olfactory sulci (one in each hemisphere). This sulcus divides the **gyrus rectus** at the medial margin of the ventral frontal lobe from the more complex gyral structures that occupy much of the remaining ventral aspect; we will refer to these gyri simply as **orbital gyri**. Most of the ventral aspect of the frontal lobe is visible in **Fig. 1**, except for that posterior portion hidden by the underlying anterior temporal lobes.

On the ventral surface of the temporal lobe, the inferior temporal gyrus occupies most of the visible surface of the lobe (with brainstem and cerebellum intact). However, it is possible to appreciate additional gyral structures on the medial side of the ventral temporal lobe. The medial boundary of the inferior temporal gyrus is formed by two sulci, the rhinal sulcus more anteriorly and the collateral sulcus more posteriorly. Just on the medial side of these sulci are gyral structures that are associated with the *hippocampal formation* (a primitive cortical structure that we will see when we dissect the brain); first, is the **parahippocampal gyrus** and then a medial protuberance of this gyrus called the **uncus**. Just posterior to the parahippocampal gyrus is another prominent structure called the **occipito-temporal gyrus** (also called—especially by functional brain imagers—the **fusiform gyrus**), but this gyrus is mostly hidden from view in **Fig. 1** by the cerebellum.

A small part of the diencephalon is visible in this view of the brain. The part that you see is the hypothalamus, bounded rostrally by the **optic chiasm** (formed by the crossing of some of the axons in cranial nerve II) and caudally by the mammillary bodies, which are considered part of the hypothalamus. The midbrain is mostly hidden from view by the temporal lobes; however, the prominent paired **cerebral peduncles** are visible (these structures define a space between them called the interpeduncular fossa).

The pons is obvious in this view, as are the **middle cerebellar peduncles**, which attach the pons to the cerebellum. Cranial nerve V (the trigeminal nerve), the largest of the cranial nerves, arises at the level of

the pons. Caudal to the pons is the medulla. The columnar swellings on its ventral surface on either side of the midline are known as the **medullary pyramids**. They contain axons that arise in the precentral (the motor cortex) and the postcentral gyri (the somatic sensory cortex) and terminate in the spinal cord (i.e., the corticospinal tract) and medulla (a portion of the corticobulbar tract). Lateral to the pyramids are the **inferior olives**. Caudal to the medulla, a portion of the cervical spinal cord is seen. Cranial nerves VI-XII arise from the medulla or at the junction of the pons and medulla. We will consider them in detail later, when we discuss more comprehensively the brainstem and its relation to the cranial nerves (see the tutorial, ***Surface Anatomy of the Brainstem***).

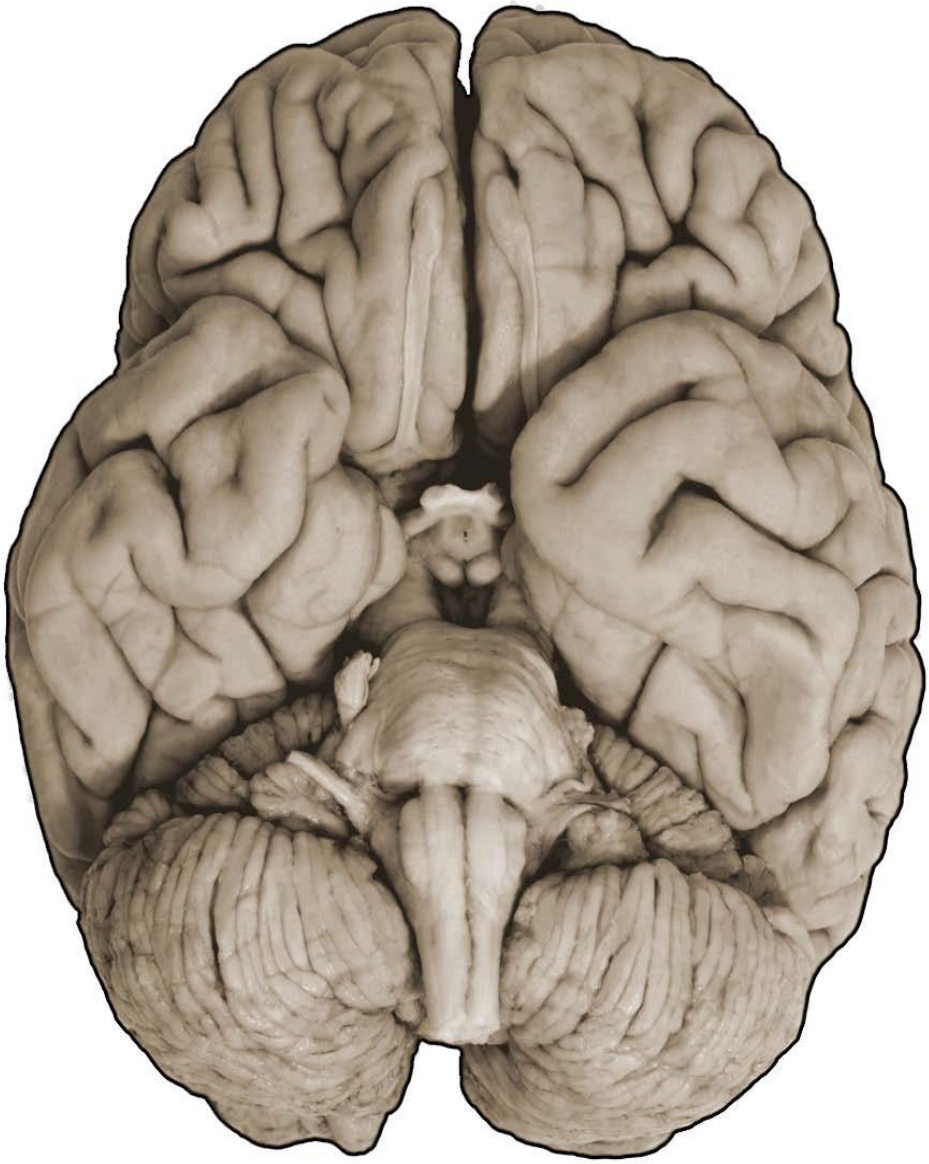

Fig. 1. The ventral surface of the brain. (Image from ***Sylvius4 Online***)

STUDY QUESTION

Which of the following structures is hidden from view when the brain is seen from its **ventral surface**?

A. midbrain
B. hypothalamus
C. corpus callosum
D. medullary pyramids
E. cerebral peduncles