

Auditory Pathway

■ INTRODUCTION

Fibers of auditory pathway pass through **cochlear division** of **vestibulocochlear nerve** (VIII cranial nerve). It is also known as **auditory nerve**. Major part of the auditory pathway lies in medulla oblongata, midbrain and thalamic region.

Higher center for hearing is in temporal lobe of cerebral cortex, where the fibers of auditory pathway finally terminate. Fibers are both crossed and uncrossed, so that each cochlea is represented in the cortex on both sides.

■ RECEPTORS

Hair cells in organ of Corti are the receptors of the auditory sensation. Hair cells are of two types, outer hair cell and inner hair cell. All the hair cells are innervated by afferent and efferent nerve fibers. Afferent nerve fibers from the hair cells form auditory nerve (see below).

■ FIRST ORDER NEURONS

First order neurons of auditory pathway are the **bipolar cells of spiral ganglion**, situated in modiolus of cochlea (Fig. 173.1).

Peripheral short processes (dendrites) of the bipolar cells are distributed around hair cells of organ of Corti as afferent nerve fibers. Their long processes

(axons) leave the ear as cochlear nerve fibers and enter medulla oblongata. In medulla oblongata, these fibers divide into two groups, which end on ventral cochlear nucleus and dorsal cochlear nucleus of the same side in medulla oblongata.

Efferent Nerve Fibers to Hair Cells

Efferent nerve fibers of hair cells arise from **superior olivary nucleus**. Fibers from this nucleus reach the hair cells by passing through the ventral and dorsal cochlear nuclei and cochlear nerve of the same side.

Efferent nerve fiber to outer hair cell terminates directly on the cell body and controls the motility of this cell (Chapter 174). Efferent nerve fiber to inner hair cell terminates on the auditory (afferent) nerve fiber, where it leaves the inner hair cell. It controls the impulse output from this hair cell.

■ SECOND ORDER NEURONS

Neurons of **dorsal** and **ventral cochlear nuclei** in the medulla oblongata form the second order neurons of auditory pathway. Axons of the second order neurons run in four different groups:

1. First group of fibers cross the midline and run to the opposite side, to form **trapezoid body**. Fibers from trapezoid body go to the **superior olivary nucleus**.

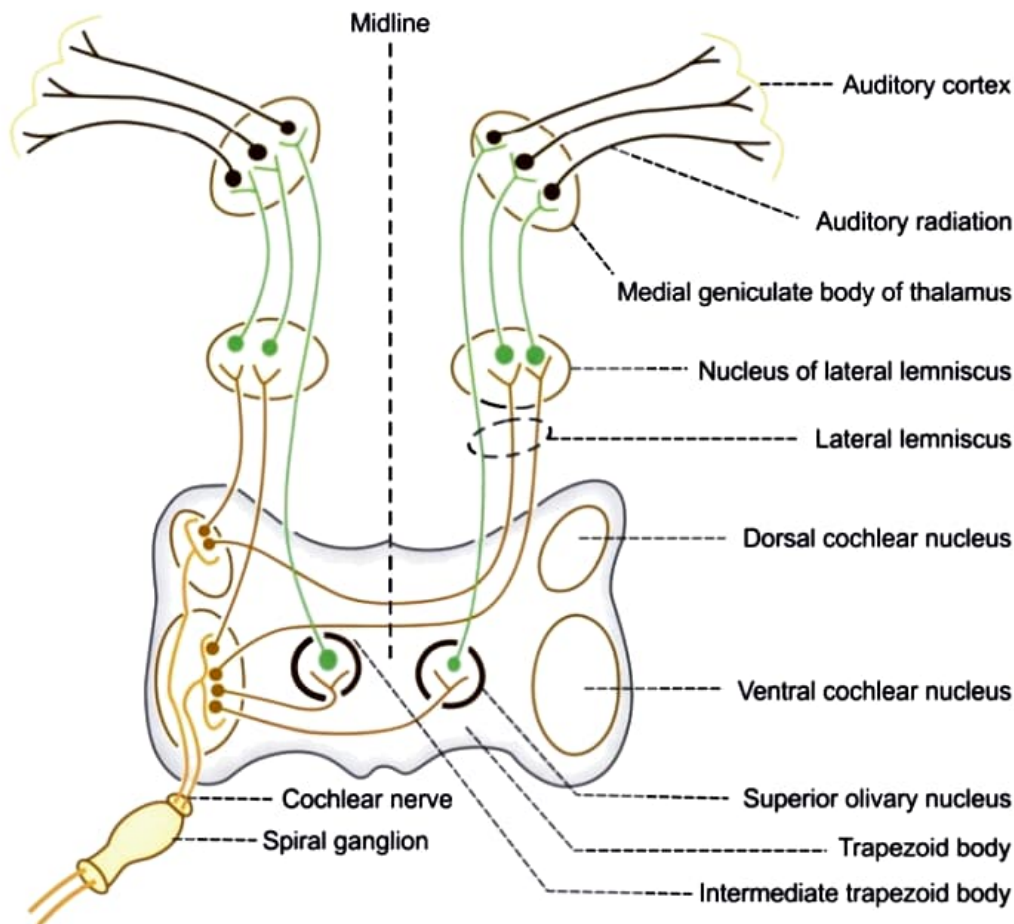


FIGURE 173.1: Auditory pathway. Blue = First order neuron, Red = Second order neuron, Green =Third order neuron, Black = Auditory radiation.

2. Second group of fibers terminate at superior olivary nucleus of same side via trapezoid body of the same side
3. Third group of fibers run in lateral lemniscus of the same side and terminate in **nucleus of lateral lemniscus** of same side
4. Fourth group of fibers run into reticular formation, cross the midline as **intermediate trapezoid fibers** and finally join the nucleus of lateral lemniscus of opposite side.

■ THIRD ORDER NEURONS

Third order neurons are in the **superior olivary nuclei** and **nucleus of lateral lemniscus**. Fibers of the third order neurons end in medial **geniculate body**, which forms the **subcortical auditory center**.

Fibers from medial geniculate body go to the temporal cortex, via internal capsule as **auditory**

radiation. Some fibers from medial geniculate body go to **inferior colliculus** of tectum in midbrain. The fibers of auditory radiation are involved in reflex movement of head, in response to auditory stimuli.

■ CORTICAL AUDITORY CENTERS

Cortical auditory centers are in the temporal lobe of cerebral cortex (Chapter 152).

Auditory areas are:

1. Primary auditory area, which includes area 41, area 42 and Wernicke area
2. Secondary auditory area or audiotpsychic area, which includes area 22.

Areas 41 and 42 are the primary auditory areas situated in the anterior transverse gyrus and lateral surface of superior temporal gyrus. Wernicke area is in upper part of superior temporal gyrus, posterior to areas 41 and 42. Area 22 occupies the superior temporal gyrus.

■ FUNCTIONS OF CORTICAL AUDITORY CENTERS

Cortical auditory centers are concerned with the perception of auditory impulses, analysis of pitch and intensity of sound and determination of source of sound.

Areas 41 and 42 are concerned with the perception of auditory impulses only. However, analysis and interpretation of sound are carried out by Wernicke area, with the help of area 22.

■ APPLIED PHYSIOLOGY – EFFECT OF LESION

1. Lesion of cochlear nerve causes **deafness** of the ear
2. Unilateral lesion of auditory pathway, above the level of cochlear nuclei causes **diminished hearing**
3. Degeneration of hair cells in the organ of Corti leads to **presbycusis**. Presbycusis is the gradual loss of hearing. It is common in old age.
4. Lesion in superior olivary nucleus results in **poor localization of sound**.