PINEAL GLAND

Introduction

The pineal gland is a small, pea-shaped gland in the brain. Pineal gland, organ, or pineal called conarium, epiphysis cerebri, pineal also body, endocrine gland found in vertebrates the that is source of melatonin, a hormone derived from tryptophan that plays a central role in the regulation of circadian rhythm (the roughly 24-hour cycle of biological activities associated with natural periods of light and darkness). The pineal gland has long been an enigmatic structure. Even in the early 21st century, when sophisticated molecular techniques were available for biological study, fundamental features of the glandincluding the extent of the effects of its principal hormone, melatoninremained incompletely understood.

Anatomy Of The Pineal Gland

The pineal gland develops from the roof of the diencephalon, a section of the brain, and is located behind the third cerebral ventricle in the brain midline (between the two cerebral hemispheres). Its name is derived from its shape, which is similar to that of a pinecone (Latin *pinea*). In adult humans it is about 0.8 cm (0.3 inch) long and weighs approximately 0.1 gram (0.004 ounce).

The pineal gland has a rich supply of adrenergic nerves (neurons sensitive to the adrenal hormone epinephrine) that greatly influence its function. Microscopically, the gland is composed of pinealocytes (rather typical endocrine cells except for extensions that mingle with those of adjacent cells) and supporting cells that are similar to the astrocytes of the brain. In adults, small deposits of calcium often make the pineal body visible on X-rays. (The pineal gland eventually becomes more or less calcified in most people.)

Pineal Hormones

its precursor, serotonin, which derived Both melatonin and are chemically from the alkaloid substance tryptamine, are synthesized in the pineal gland. Along with other brain sites, the pineal gland may also produce neurosteroids. Dimethyltryptamine (DMT). а hallucinogenic compound present in the Amazonian botanical drink ayahuasca, is chemically similar to melatonin and serotonin and is considered to be a trace substance in human blood and urine. Although alleged to be produced by the pineal gland, DMT has not been consistently detected in human pineal microdialysates (purified pineal extracts), and proof of its regulated biosynthesis in the mammalian pineal gland is lacking. In addition to the pineal gland, melatonin is also synthesized in the vertebrate retina, where it transduces information about environmental light through local receptors designated MT1 and MT2, and in certain other tissues, such as the gastrointestinal tract and the skin. In the generally rate-limiting step of melatonin biosynthesis, an enzyme called serotonin N-acetyltransferase (AANAT) catalyzes the serotonin to N-acetylserotonin. Subsequently that conversion of acetylserotonin Omelatonin compound catalyzed is to by circulating melatonin methyltransferase (ASMT). The rise in concentrations that occurs and is maintained after sundown and with darkness coincides with the activation of AANAT during dark periods. Melatonin concentrations also are higher in the cerebrospinal fluid (CSF) of the third ventricle of the brain than in the CSF of the fourth ventricle or in the blood. That suggests that melatonin is also secreted directly into the CSF, where it may have direct and perhaps more-sustained effects on target areas of the central nervous system.

In some species pineal cells are photosensitive. In humans and higher mammals a "photoendocrine system"—made up of the retina, the suprachiasmatic nucleus of the hypothalamus, and noradrenergic sympathetic fibres (neurons responsive to the neurotransmitter norepinephrine) terminating in the pineal—provides light and circadian information that regulates pineal melatonin secretion. In contrast to many other endocrine hormones, human melatonin concentrations are highly variable, and serum melatonin levels decline markedly during childhood, as there is little or no growth of the pineal gland after about one year of age.

Pineal Physiology And Pathophysiology

Circulating melatonin levels in vertebrates are derived from pineal melatonin secretion, and their magnitude informs brain regions about environmental light-dark cycles and seasonality, as inferred by changes in the duration of the nocturnal melatonin plateau. Those cues, in turn, help to entrain sleep activity (enhanced by darkness) and reproductive cycle events (increased with more seasonal lighting). In birds, rodents, and seasonally breeding mammals, pinealectomy (pineal gland removal) impairs reproduction. In those species there are indications that melatonin stimulates the release of gonadotropin-inhibitory hormone, in turn leading to the suppression of gonadotropins (hormones that act on the ovaries or testes), which may explain the disruptive effects on reproduction.

In humans both precocious puberty and delayed puberty have been associated with pineal tumours and cysts. However, the pathogenesis leading to those conditions is unclear, and both mechanical and hormonal factors may be involved. Positive relationships between melatonin secretion and some other hormones have been reported, though pure melatonin-secreting tumours have not been observed. Indeed, contrast other endocrine to glands, such in as the pituitary, adrenal, and thyroid, there are no well-defined pineal hormone-deficiency or hormone-excess syndromes.

The lack of pineal disorders that involve hormone deficiency or hormone excess has been an obstacle to the investigation of putative roles for the gland. Such roles include the possibility that melatonin secretion is an important factor in the induction and maintenance of nocturnal sleep, as suggested by classical studies in night-shift workers. Relatively little is known about genetic variants that influence melatonin levels and the relationship of those variants to sleep disorders and other circadian pathologies. Nonetheless, melatonin administration has been associated with numerous and diverse effects, including immune responses, cellular changes, and protection against oxidative stress. Those observations stimulated research on the therapeutic potential of melatonin and its analogues, such that certain melatonin receptor agonists (e.g., tasimelteon) have been approved for the treatment of certain sleep-related disorderS.

