Pineal Gland Histology 
& lesser known facts

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Medical Science

» Pineal body
» Epiphysis cerebri
» Glandula superior
» Glandula pinealis Lt)
» Conarium (Gr)
» Konarion (Gr)

(Galen c 130 – c 210 AD)
Religious texts

Western philosophy

• Seat of the soul
  \((Rene~Descartes, 1596-1650)\)
• God organ
• Pineal eye
• Third eye

Eastern philosophy

• Eye of Shiva
• तीसरा तिल्ल
• तीसरी आँख
• दिव्य चक्षु
• Eye of Dangma (Tibet)
• चश्म-ए-बातिन (Persian)
Dissected specimen
Gross Anatomy

- Piriform in shape
- Apex
- Body
- Stalk
- Roots- 2
- **Maximum** size by **2 years** (*Masayuki et al., 1996*).
- **No decrease** thereafter (*Tapp and Huxley, 1971*)
Histology

Very sketchy information in text books.
Enormous literature in Journals & Reference books.

Points of interest in HISTOLOGY.
- Capsule
- Trabeculae
- Parenchyma. having
  - Pinealocytes - Lamellate calcareous bodies.
  - Peptidergic neuron-like cells - Calcite micro crystals.
  - Phagocytes - Blood vessels.
  - Nerve endings
Histology
Histology

- Capsule.
- Trabeculae.
- Parenchyma.
  - Pinealocytes or chief cells.
  - Peptidergic neuron like cells.
  - Neuroglia – astrocytes.
Histology

- **Parenchyma** (contd.)
  - perivascular phagocytes.
  - interstitial cells.
  - **Blood vessels, blood sinuses.**
    (vascularity next only to kidney)
  - **Nerve endings:** 3 types
    sympathetic, parasympathetic & sensory.
Pinealocyte

• 95% of cell population.
• Highly modified neurons.
• Arranged as cords & clusters.
• Body – polyhedral.
• Processes: 4 – 6.
Pinealocyte

- Nucleus.
- Golgi apparatus.
- RER & SER.
- Mitochondria.
- Microtubules.
- Lipofuscin pigment.
Pinealocyte

- **Terminal buds** end on blood capillaries and wall of ventricle of brain for transfer of molecules in blood and CSF.

- Membranous bags resembling CONES of Retina.

- Hormones –
  - Imdolamines
  - DMT
Types of Pinealocyte

Light type
- Out number dark type.
- Round of oval cell body.
- Round nucleus.
- Rich in vesicles and ribbons.

Dark Type
- Variable shape.
- Numerous nuclear in-folding forming nuclear pellets.
- Pigment in cytoplasm.

Third type
- Very small cell type.
- Extremely thin.
- Elongated cell bodies.
- Elongated nucleus.


Histology

Peptidergic Neuron-like Cells

- These cells have been histochemically identified in the pineal parenchyma.

- Their classification based on the hormones synthesized and secreted is yet to come.

Nerve supply

Nerve endings: 3 types

- Sympathetic: for secretion.
- parasympathetic & sensory: for feed back.
Phototransduction cascade of light signals

5 to 7 neuron pathway

- Retina......................... 1\textsuperscript{st}
- SCN............................. 2\textsuperscript{nd}
- Mid brain..................... 3\textsuperscript{rd}
- Spinal cord (T1)......... 4\textsuperscript{th}
- Sup Cer Sym Gang.... 5\textsuperscript{th}
- Plexus around ICA
- Nervous conarii
- **Pineal gland**

\(^{(Singh IB, 2006)}\)
\(^{(Standering et al. 2008)}\)
\(^{(Gunasegaran JP, 2010)}\)
\(^{(Pal GP, 2012)}\)
Flow chart of light stimuli reaching Pineal Gland
(Photoreceptor cascade)

1. Retina
   - Optic nerve
   - Optic chiasma
     - Supra chiasmatic nucleus of Hypothalamus
       - Reticular formation of Mid Brain
         - Reticulo spinal tract
           - Superior cervical sympathetic ganglion
             - Sympathetic plexus around internal carotid artery
               - Nervous conarii
                 - Pineal Gland
                   - T1 spinal nerve
                     - Lateral column of upper thoracic segments of spinal cord
A new nerve tract of Pineal gland

- **D. Larry Sparks** (1998) reported the presence of both myelinated and non-myelinated fibers connecting the pineal gland and the pre-tectal area.
- A previously unreported paired fiber tract was observed associated with the anterior inferio- ventro-lateral pineal gland. This paired tract appears to be physically separate and distinct from the posterior commissure.
- These tracts form a structural component of the wall of the pineal recess. The fibers coursing in this paired tract are myelinated, and are of two different sizes (1–3 mm diameter and 5–8 mm diameter) as determined by electron microscopy. Fibers from these tracts invade the pineal gland and can be traced a short distance into the lateral pre-tectal area.
- The precise point of origin and termination for this paired tract is unknown.
Pineal Gland - Minerals

Medical Scientists / Physicists, Electrical / Electronic engineers have been differently interested since early ‘60s.

H & E Stain showing minerals
Minerals in Pineal Gland
Lamellate calcareous bodies

- Both intra pineal and extra pineal.

- May result in to distortion of shape of the gland.

- At many places found attached to the cytoplasmic membrane of pinealocytes.
Fluoride in Pineal Gland

• Pineal is the **prime target** of fluoride accumulation.

• **Magnetic forces** attract fluoride to the pineal gland.

• Fluoride is **strikingly high** in the Pineal gland (Luke 2001).
  
  - soft part (Non-calcified)
    approx. **300 ppm**

  - hard part   approx. **21,000 ppm**

Fluoride in Pineal Gland

- **Drinking Water:** ~ 4 mg / Lit or 4 ppm
- **Plasma:** 0.017 ± 0.011 ppm
- **Breast milk:** 0.006 ± 0.002 ppm
- **Tooth paste:** 1000 to 1500 ppm
- **Pineal gland:** 300 to 21000 ppm

- **99%** of body fluoride is found in *calcified tissue*.

Why this **high concentration** in the pineal?
Calcification in Pineal Gland

• For long the calcareous bodies have been regarded as signs of aging and degeneration.

• can occur at any age, even as early as 2 years of age (Scharemberg & Liss 1965).
Calcification in Pineal Gland

- **Salts** of calcium, magnesium, phosphorus, ammonium, aluminum & fluoride arranged as:
  - Concentric lamellate calcareous deposits: Corpora arenacea, acervulus (Lt), psammona (Gr) bodies.
  - Scattered: Brain sand, Calcite micro crystals.
Calcification in Pineal Gland

- calcite micro crystals.
- hexagonal in shape.
- found floating in pineal parenchyma (Lang et al. 1996).
- Non-uniform distribution and variable size.
Calcification in Pineal Gland

- Chemically - **hydroxyapatite crystals** which are also found in the bone minerals (Mabie & Wallace 1975).

- Difference ....In bone they form a **hard matrix**, in Pineal gland they are embedded in **soft matrix**.

- **Bacconnier 2002** first reported **100 to 300 micro-crystals / cu mm** in 20 human pineals.

- The crystals **expand and contract** due to the presence of normally occurring electromagnetic field around us.
Calcification in Pineal Gland

- ↓ number of functioning pinealocytes (Kunz et al. 1999)
- ↓ melatonin production (Kunz et al. 1999)
- Impairment of sleep wake cycle (Mahlberg et al. 2009).
Functions of Pineal gland

• For long the pineal gland has been regarded as a vestigial structure with no functional importance and that it degenerated with age.

• The Pineal gland evolved to improve the vision about 500 million years from now (David Klein, 2004), Chief of Neuroendocrinology of NICHD, USA
Functions

• Till 1917 except for
  1. gross anatomy.
  2. intimate association with various spiritual phenomena.
  3. extract of cow pineal lightened the colour of frog skin, etc. nothing else was known.

• Scientists consciously avoided any work /experiment on pineal gland because of its association with various spiritual phenomena.
Functions of Pineal Gland

• In 1958 Aron B. Learner et al. from Uni. Of Yale (USA) in a milestone research discovered *Melatonin* in the Pineal extract.

• Secretions require *sympathetic stimulus*.

• Functions are regulated by light and dark

  ↑ in dark

  ↓ in light
Functions of Pineal Gland

• Secretions are discharged both in blood capillaries and in CSF.
Functions of Pineal Gland

- **Indolamines** – synthesis and secretions, e.g.,
  - MELATONIN
  - Norepinephrine
  - Serotonin
  - Tryptophan
  - 5-HT

- **Melatonin** is also known as ‘chronobiotic molecule’ and regulates **circadian rhythm** together with SCN.

- **Peptide group of hormones** – synthesis and secretion. They inhibit pituitary .... thyroid .... parathyroid ..... adrenal cortex .... adrenal medulla .... ovary.... Testis .... pancreas (endocrine).
Functions of Pineal Gland

- **Secretions**— peptides
  - Arginine vasolocin - ↓ gonadotropin hormone.
  - Pineal antigonadotropin.
  - Gonadotropin releasing hormones..
  - Prolactin releasing & inhibiting hormone.
  - Thyrotropin releasing & inhibiting hormone.
  - Neurophysin – prohormone.
- **More hormones are to be discovered.**
Functions of Pineal Gland

- Thermoregulation...↑regulated by pineal. ↓regulated by SCN

- DMT – (Di-methyl tryptamine) There is massive release of DMT from pineal gland close to death, which is responsible for near death experience (NDE).

- (Strassman (2001) proposed the theory that DMT could be the “Spirit molecule”.)
Di-methyl-tryptamine

- NDE are both auditory and visual.
- Strassman 2001 demonstrated that DMT production is stimulated at the time of
  - medication,
  - Child birth,
  - Sexual ecstasy,
  - extreme physical stress,
  - near death &
  - death.
Circadian rhythm and Pineal Gland

• The pineal gland is a control tower for the Biological Clock is the classical concept.
• However, It is doubtful in the human beings as this function has been by and large taken over by Supra Chiasmatic Nucleus.
• Light sensing capabilities in retina, iris, skin & pineal gland.
• In cell culture each of them have independent rhythm.
• Retina, in human beings might have its own Clock which could also be set and reset like Biological Clock after jet lag.
• Location of the clock in retina is not yet known.
Infrared energy and Pineal gland

- Infrared energy waves have lower frequency with longer wave length in the light spectrum.
- They correspond with lower emotional energies and moods.
- Strong pulses of infrared energy affect brain and especially calcite micro crystals. Resulting into:
  - sleepiness
  - crying
  - agitation
  - depression
  - anxiety
  - Apathy
  - aggression
  - fear
  - terror
  - hopelessness
  - grief
  - death
Other unique functions

• **EM fields:** 60 Hz suppress the activity of Pineal gland in our homes, work place and out side (Burch James et al. 1999). and reduce melatonin production.

• They interact with Global System for Mobile (GSM) waves which could constitute a new mechanism for electro-mechano-transduction for pinealocyte membrane.

• **Pineal Gland in Birds:** Calcite micro crystals (magnetite) works as magnetorecepter to align the body in space and therefore works as Instrument of navigation.
Other unique functions

• **Blind men:** It is postulated that the pineal might be performing a similar function.

• **Gottfried de Purucker 2011** that
  “The pineal gland vibrates gently when ever we have a hunch. It vibrates more strongly when we have intuition or a sudden flash of intuitive understanding.”
Other unique functions

• Calcite micro crystals emit cold light in the range of blue & green (Atari 1982). Piezoluminescence.

• Pineal calcifications are also piezoelectric (Cady 1964).

• Electricity produced is in the frequency range of mobile communication.

• These crystals are capable of tuning into radio stations without the use of electricity.
Piezoelectricity in pineal gland

• Pineal calcifications are piezoelectric (Cady 1964).

• Piezoelectricity means electricity resulting from pressure or in response to the applied mechanical stress (Reiter 1993).

• This is in the frequency range of mobile communication.

• These crystals are capable of tuning into radio stations without the use of electricity.
Piezoelectricity in pineal gland

• These crystals turn sound vibrations into electrical current and thus used in the microphones.

• Cell phones and microwave emitting devices have an adverse effect on the pineal gland by changing the way these crystals function in the gland.

• These crystals also interrupt the synthesis of melatonin.
Piezoluminescence in Pineal gland

- Emission of light due to pressure upon solids.

- Calcite micro crystals emit cold light in the range of blue & green (Atari 1982).

- This phenomenon also occurs in certain marine fishes.
Solar flare and Pineal Gland

Solar flare--Pineal glans is **stimulated**.

Infrared energy --
Evening sun  ↑

Ultra violet --
Morning sun  ↑
Solar flare and Pineal Gland

• On 1st September 1859 Richard Carrington for the first observed Solar Flare (storm) with the help of an optical telescope.

• They keep happening in varying quantum and frequency.

• Published in New Scientist 1998 - there is a direct connection between solar flares and human biological phenomena.

• Due to sudden spurt in EM activity Pineal gland is stimulated during solar flare producing excessive melatonin.
Summary of factors influencing Pineal functions

Stimulated
- Darkness
- Sympathetic stimulus
- Pineal tumors
- Solar flare
- UV light - morning sun
- Infrared – evening sun

Depressed
- Light
- EM Field
- Infrared energy- strong pulse
- Mobile phones
- Microwave emitting devices.
- Strong magnetic field
- Fluoride accumulation
- Calcium deposits
- Alzheimer’s disease
- Stress
- High altitude
- Nutritional imbalance
References

5. Carrington RC. Description of a singular appearance seen in the sun on September 1, 1859
References


References


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