

Miloš Grim, Rastislav Druga, Ondřej Naňka et al.

# ZÁKLADY ANATOMIE

Grim, Druga, Naňka et al.

- Třetí díl **Základů anatomie** je věnován popisu orgánů trávicího, dýchacího a močopohlavního systému a žláz s vnitřní sekrecí. Pro snadnější manipulaci je rozdělen na část **3a. Trávicí a dýchací systém**, a část **3b. Močopohlavní a endokrinní systém**.
- U jednotlivých orgánů je uvedena jejich funkce a jejich popis je členěn na makroskopickou a mikroskopickou anatomii. Navazuje popis jejich syntopie, polohy a projekce a popis cévního zásobení, inervace a lymfatické drenáže. Poznámky ke klinickým souvislostem jsou vyznačeny šedým podkladem.
- Ke každému systému je připojena kapitola o jeho vývoji, růstu a významných vrozených vadách. Detailní poznámky, zejména k vývojovým mechanismům, jsou tištěny petitem.
- Anatomické struktury jsou pojmenovány podle *Terminologia Anatomica* (1998) a jsou uváděny také běžně používané české termíny. Text v části 3b doprovází 98 obrázků včetně snímků pořízených různými zobrazovacími metodami. Většina ilustrací je barevná a jejich popis je uveden přímo v obrázcích.
- Do rejstříku byly zařazeny všechny základní pojmy obsažené v textu.

[www.galen.cz](http://www.galen.cz)

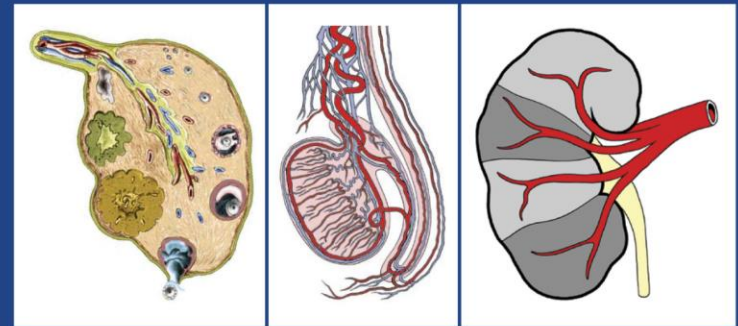


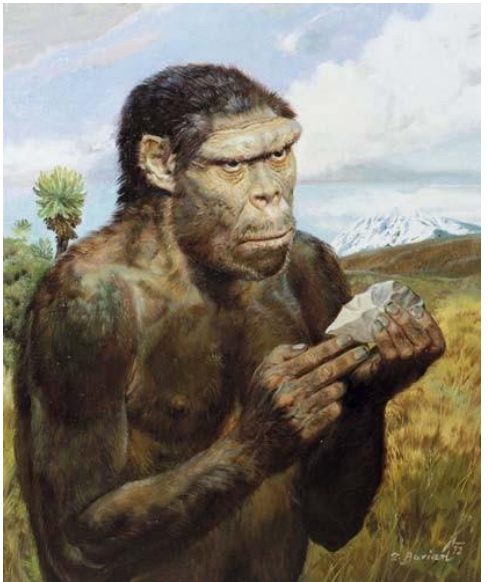
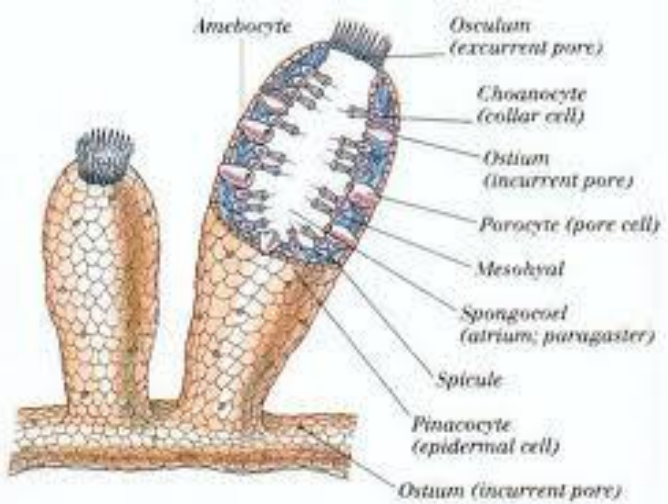
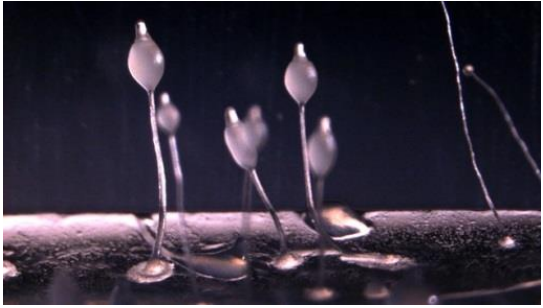
ZÁKLADY ANATOMIE – 3b. MOČOPOHLAVNÍ A ENDOKRINNÍ SYSTÉM

# ZÁKLADY ANATOMIE

## 3b. MOČOPOHLAVNÍ A ENDOKRINNÍ SYSTÉM

Druhé, přepracované a rozšířené vydání





# Regulace v rámci organismu

Nervový systém

Endokrinní systém

Imunitní systém

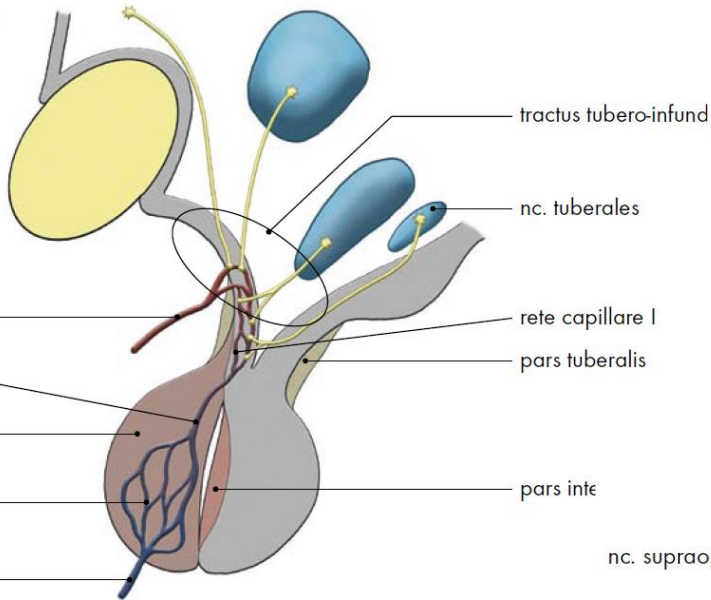
V rámci makroorganismu se navzájem doplňují. **V těle prakticky není orgán a tkáň, které by neprodukovaly nějaký hormon.**

**Autokrinní vs parakrinní vs endokrinní signalizace**

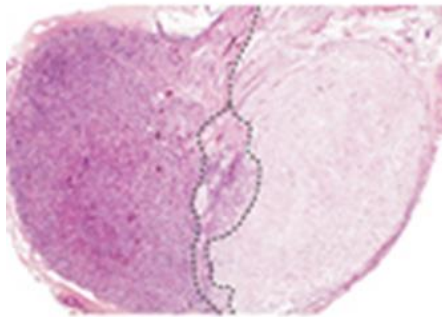
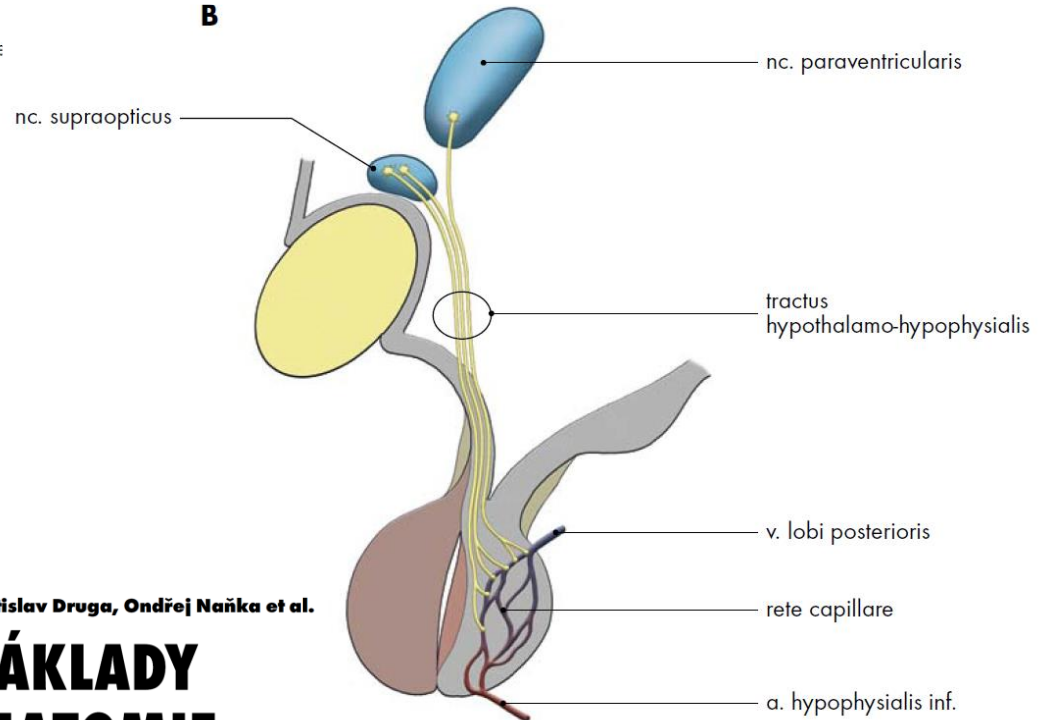


# Hypofýza

**A**



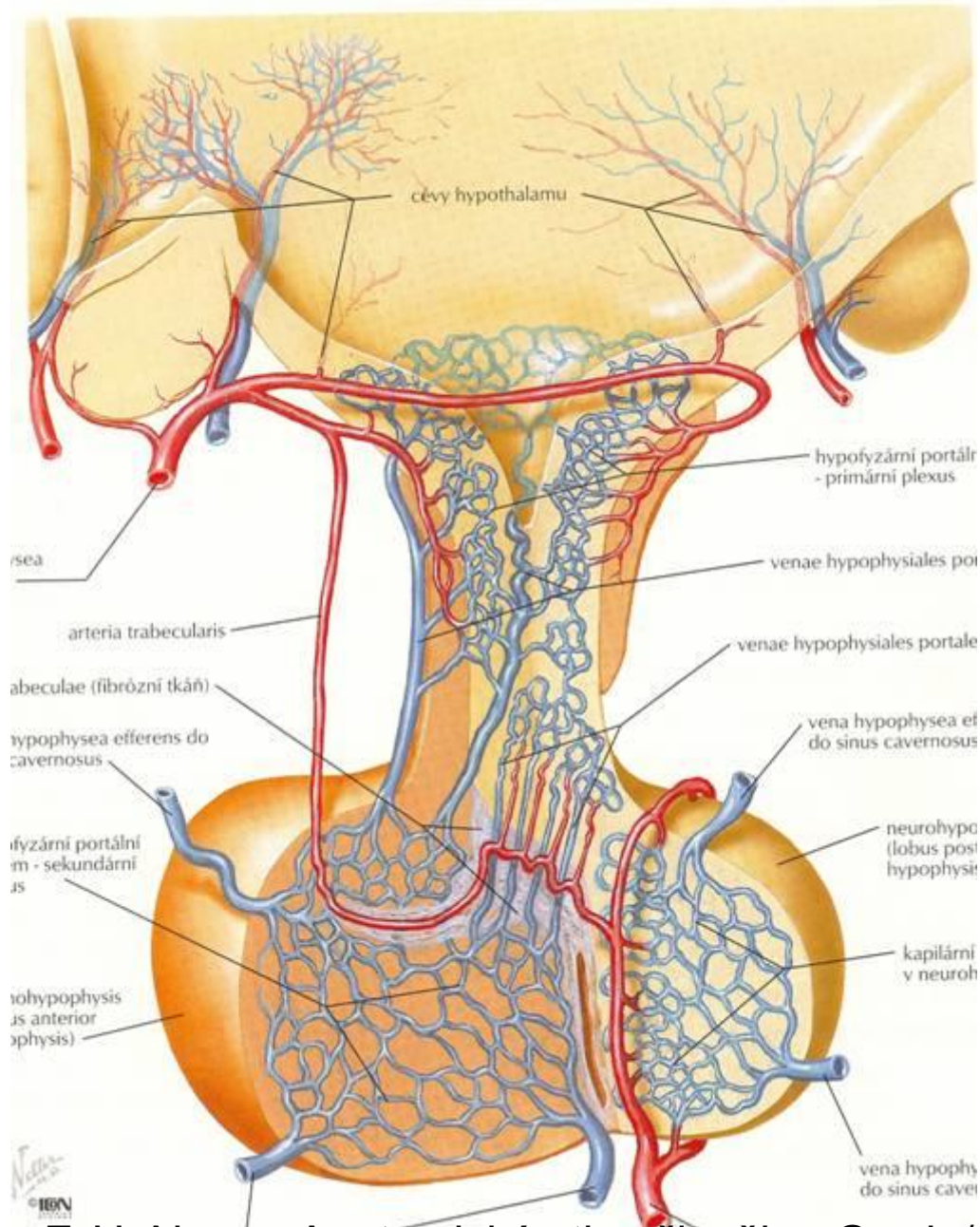
**B**



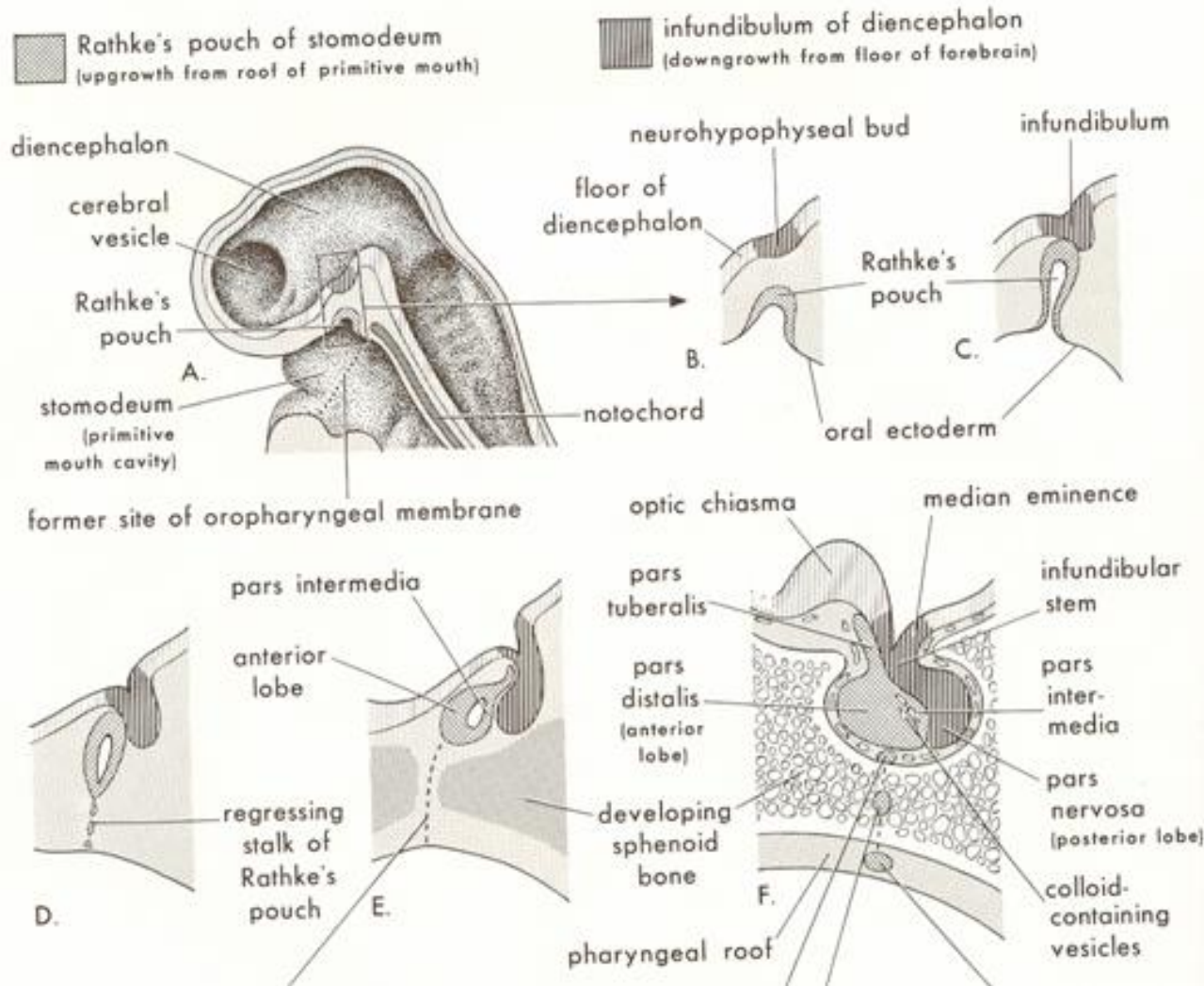
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# Hypofýza - cévní zásobení



# Hypofýza - vývoj



K.L. Moore: The Developing Human,  
W.B. Saunders, Philadelphia, 1982

## Přední lalok:

PRL

ACTH

FSH

LH

STH (GH)

TSH

## Zadní lalok:

Oxytocin

ADH

# Hypofýza-hormony



# Hypofýza-adenom

Tlak na zkřížená  
vlákna zrakového  
nervu ze zevních částí  
sítnice způsobuje  
trubicové vidění



Trubicové vidění



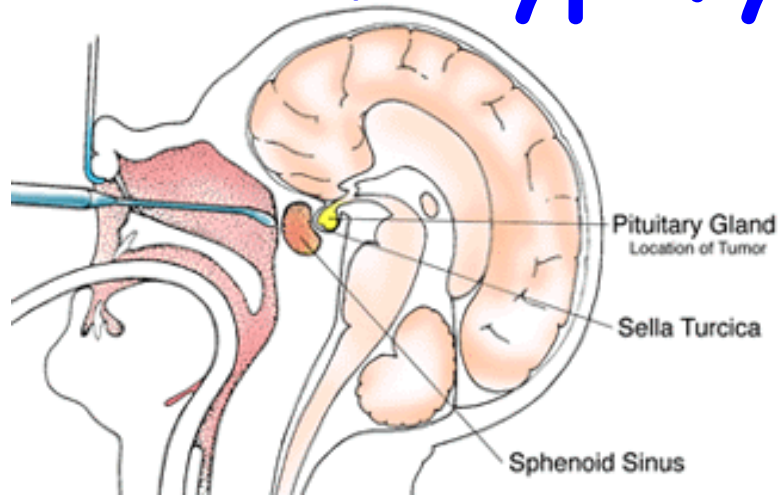


# Adenom hypofýzy: akromegálie a gigantismus



<http://skarlet.hubpages.com/hub/Acromegaly-Gigantism#>

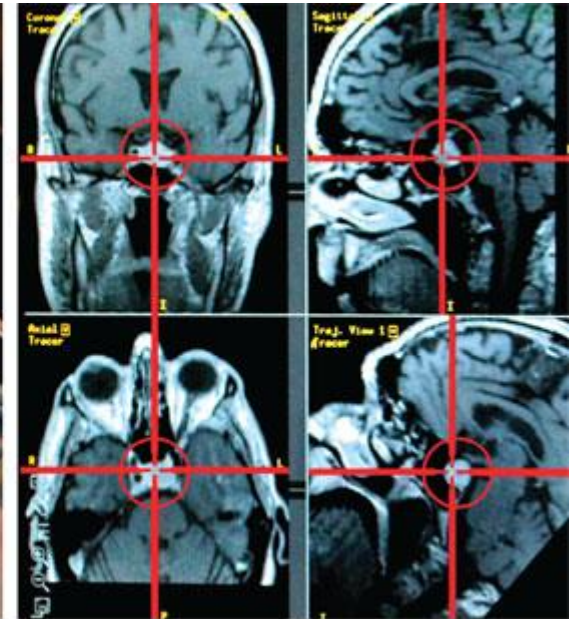
# Adenom hypofýzy: terapie



<http://neurosurgery.ufl.edu/patient-care/diseases-conditions/pituitary-tumors/>



Endoscopic resection of pituitary tumor through the nose



Computer image guidance system

<http://neurosurgery.stanford.edu/pituitary/review.html>

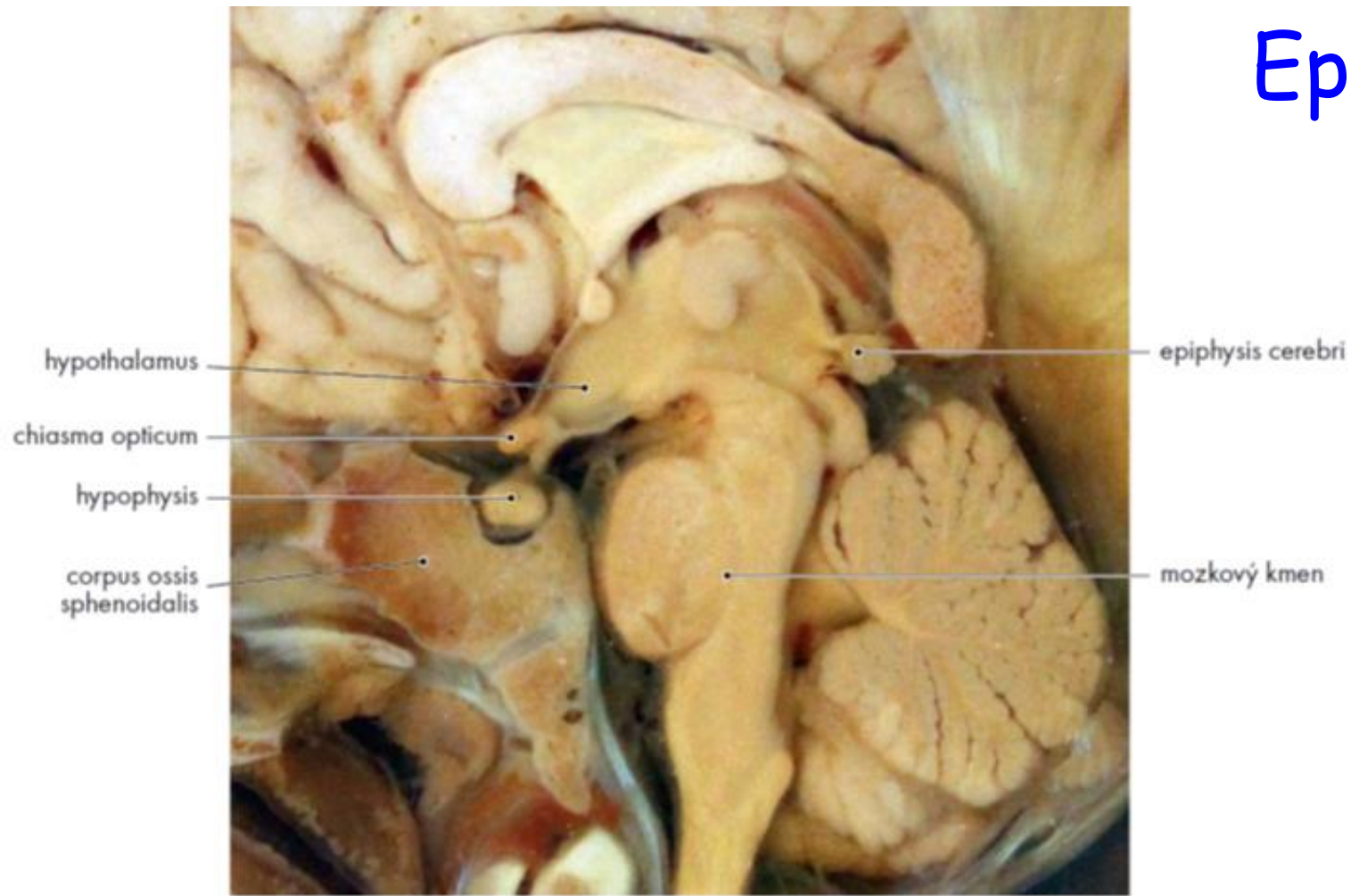


# Úspěšně léčená pacientka





# Epifýza



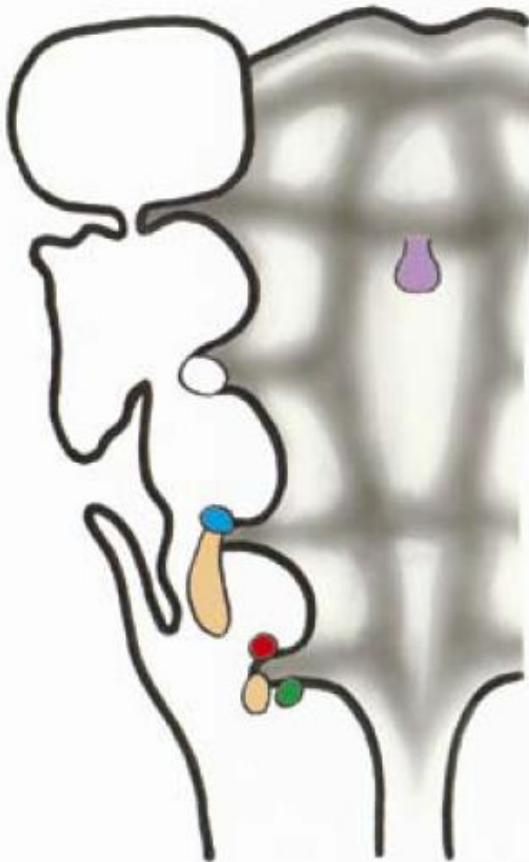
Epifýza produkuje **melatonin**. Tento hormon se podílí na regulaci biorytmů – jeho podáním lze navodit spánek. Sekrece melatoninu se mění s mírou osvitů, za světla je nízká, v temnu vysoká.

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# Štítná žláza a branchiogenní orgány

žaberní výchlipky I-IV



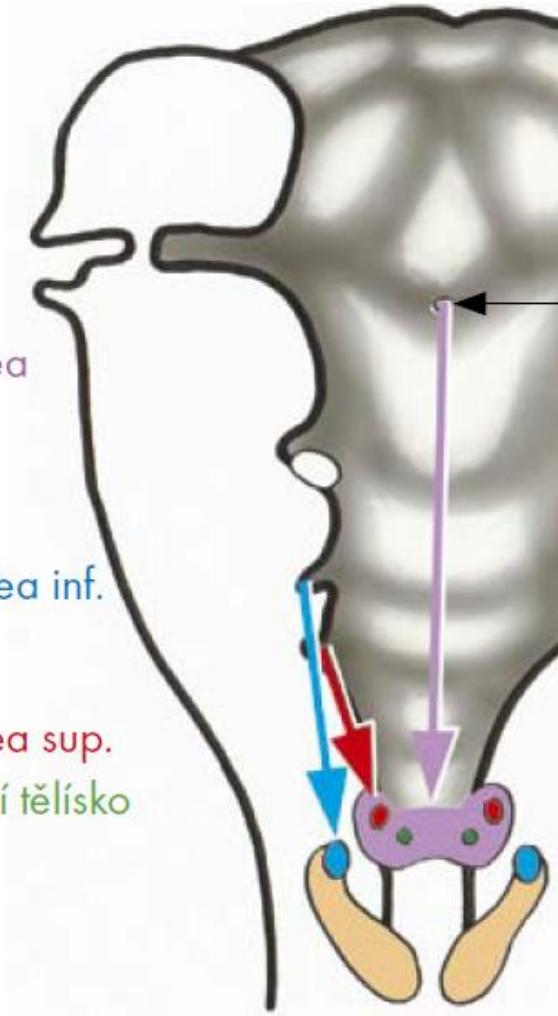
gl. thyroidea

gl. parathyroidea inf.

thymus

gl. parathyroidea sup.

ultimobranchiální tělísko

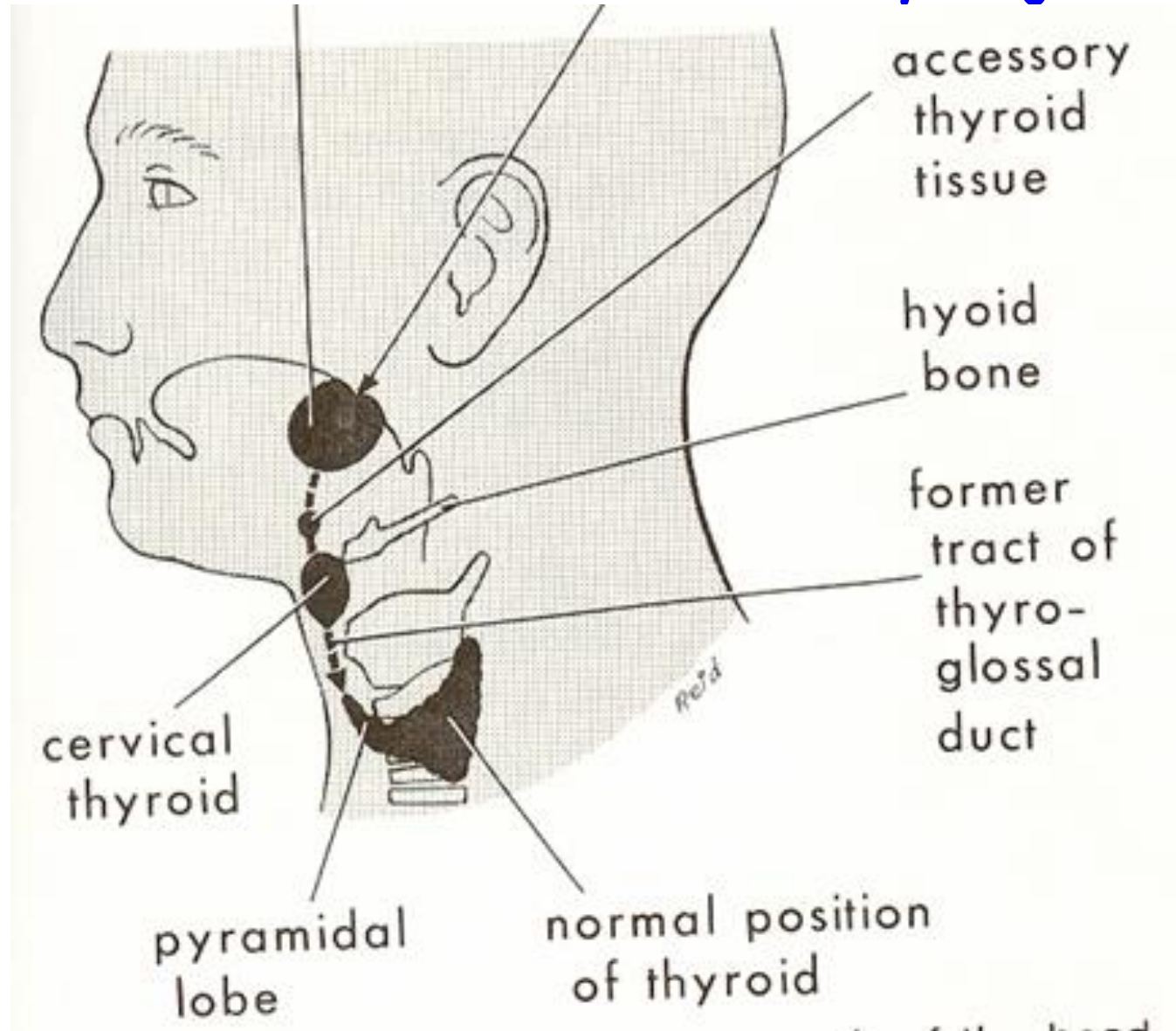


foramen caecum

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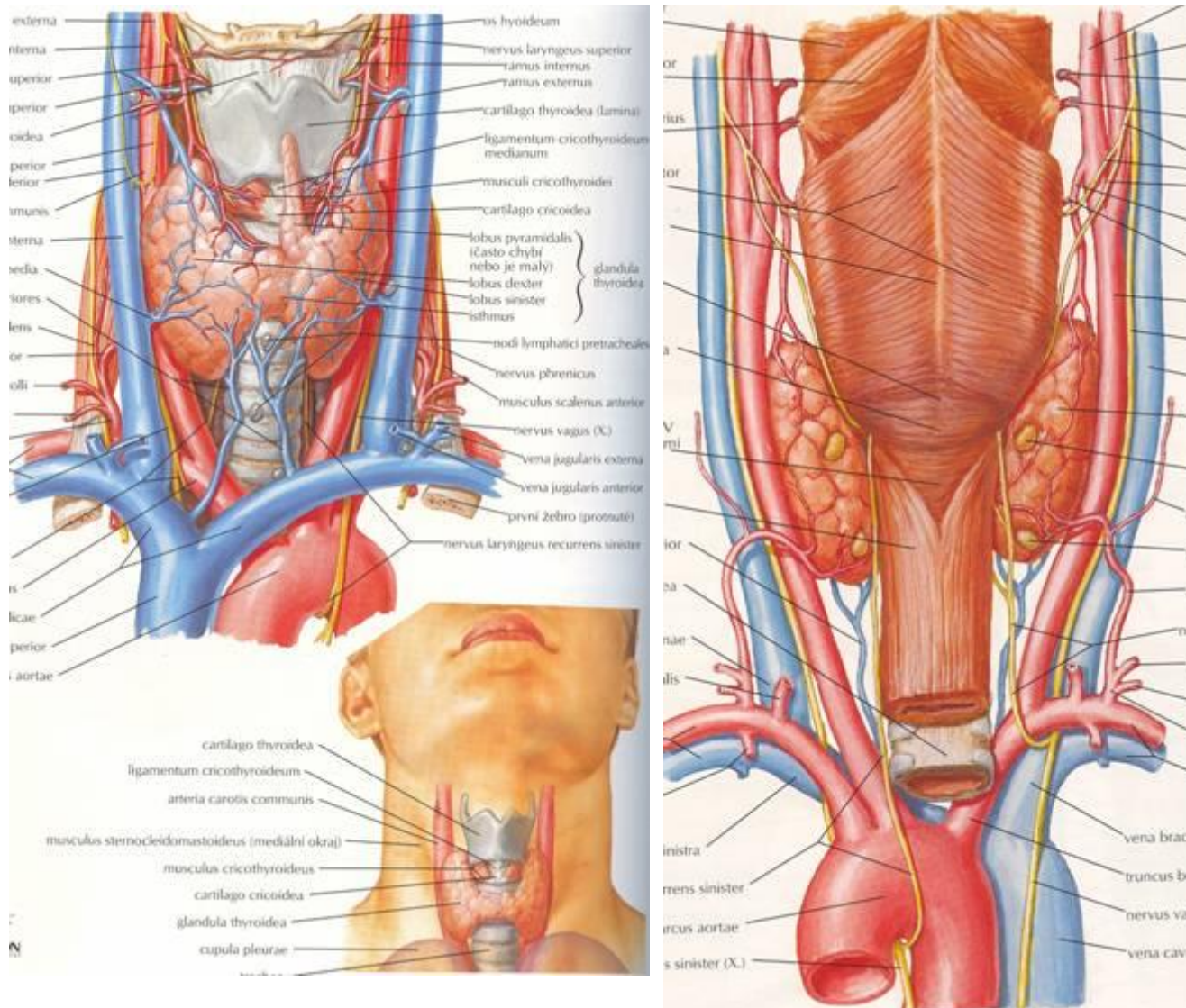
# Štítná žláza-vývoj



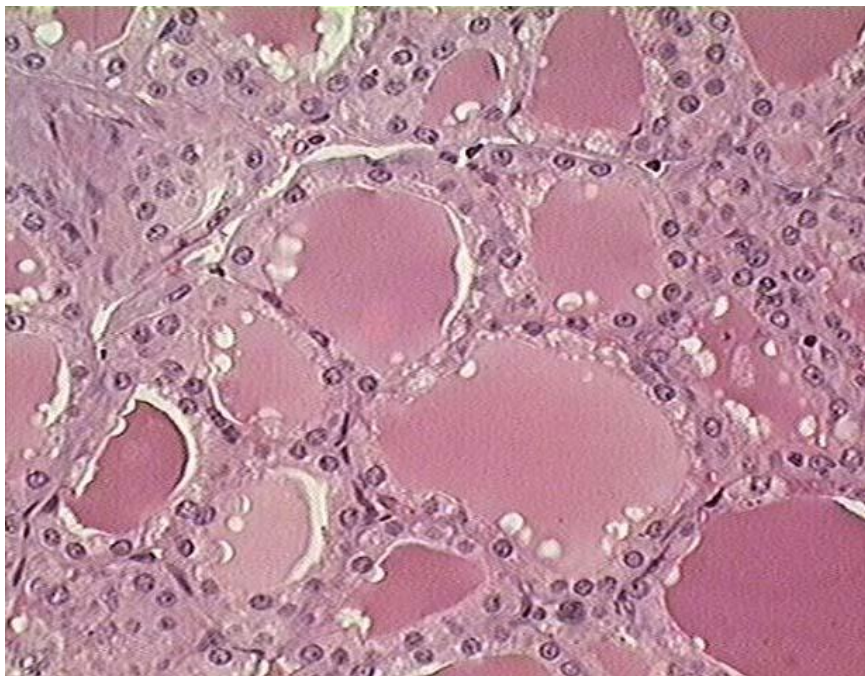
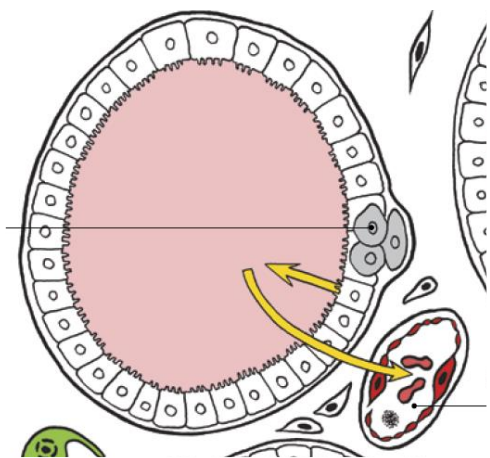
K.L. Moore: The Developing Human, W.B. Saunders, Philadelphia, 1982



# Štítná žláza a příštítná tělíska



# Štítná žláza



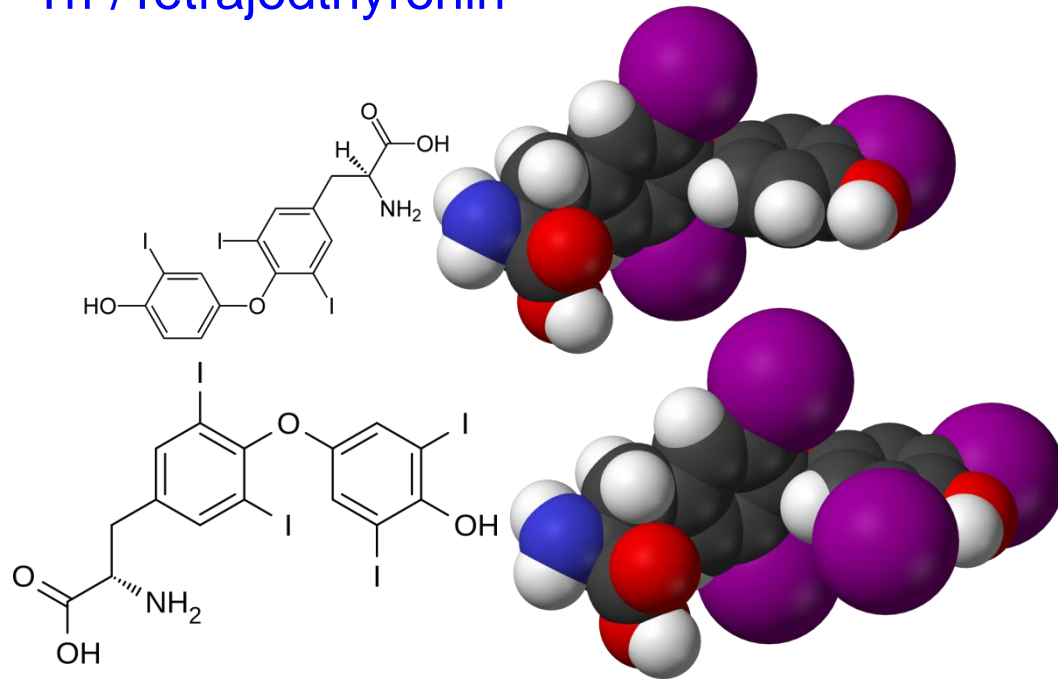
[http://www.cytochemistry.net/Endocrine\\_System/c-cell3.jpg](http://www.cytochemistry.net/Endocrine_System/c-cell3.jpg)

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<http://casweb.cas.ou.edu/pbell/Histology/Images/Slides/Glands/thyroid.plast.40x.JPEG>

## Tri-/Tetraiodthyronin



Hormony  
štítné žlázy

## Calcitonin



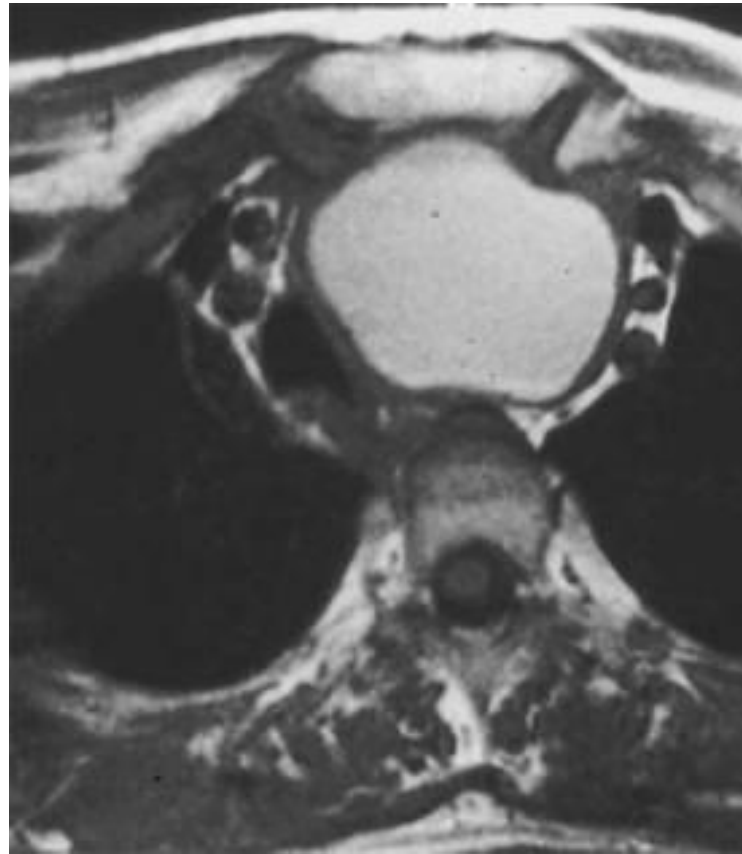
[http://en.wikipedia.org/wiki/Thyroid\\_hormone](http://en.wikipedia.org/wiki/Thyroid_hormone)

<http://en.wikipedia.org/wiki/Calcitonin>

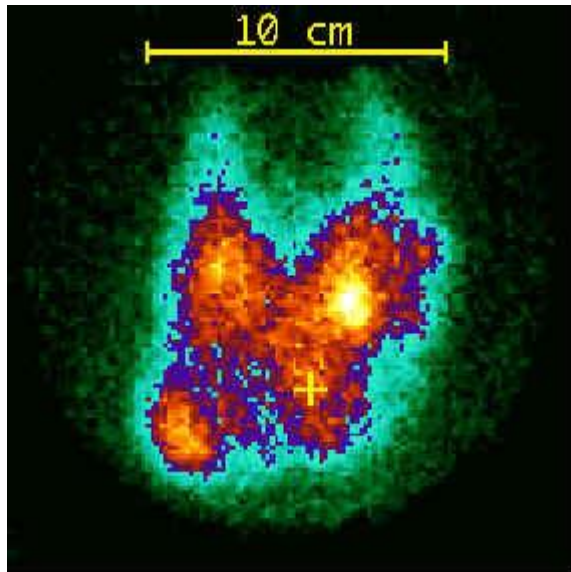




<http://www.drhermann.at/images/struma/struma1.jpg>



<http://online-media.uni-marburg.de/radiologie/bilder/endo/struma/struma3a.jpg>



## Štítná žláza -struma

[http://www.med.uni-marburg.de/stpg/ukm/lb/nuklearmed/informationen/sd\\_bspbef/aftt01s.jpg](http://www.med.uni-marburg.de/stpg/ukm/lb/nuklearmed/informationen/sd_bspbef/aftt01s.jpg)

# Kreten není nadávka



[http://www.schilddruesenordination.at/bilder\\_info/kretin.jpg](http://www.schilddruesenordination.at/bilder_info/kretin.jpg)



<https://www.priznaky-projevy.cz/interna/endokrinologie-metabolismus/523-kretenismus-priznaky-projevy-symptomy>



# Štítná žláza - odtok vody s jódem z Čech





Svatopluk Adámek  
Ondřej Naňka et al.

# PRIMÁRNÍ HYPERPARATHYREÓZA

Diagnostika a terapie

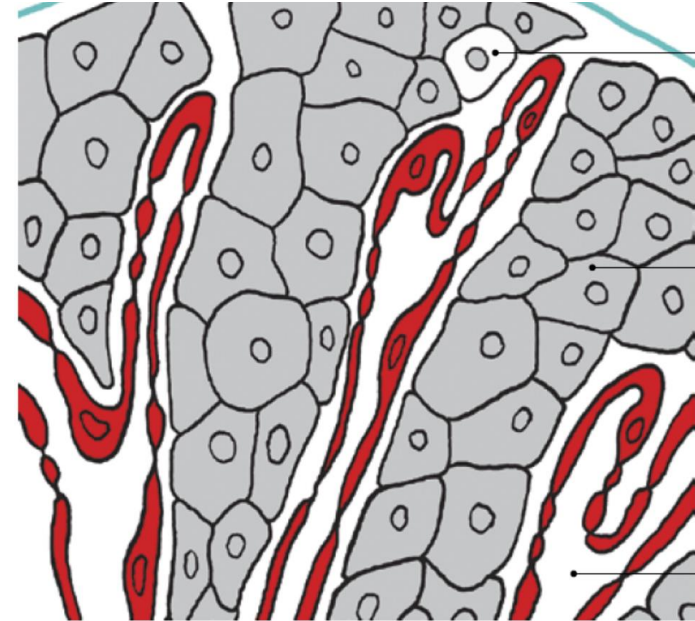


Ondřej Naňka

**Alfred Kohn** (22 February 1867 – 15 January 1959) was the head of the Institute of Histology at the Medical Faculty of German University in Prague for 26 years. He entered the history of medicine by discovery of the nature and origin of parathyroid glands and by pioneering research into chromaffin cells and sympathetic paraganglia.

[https://en.wikipedia.org/wiki/Alfred\\_Kohn](https://en.wikipedia.org/wiki/Alfred_Kohn)

# Příštitná tělíska

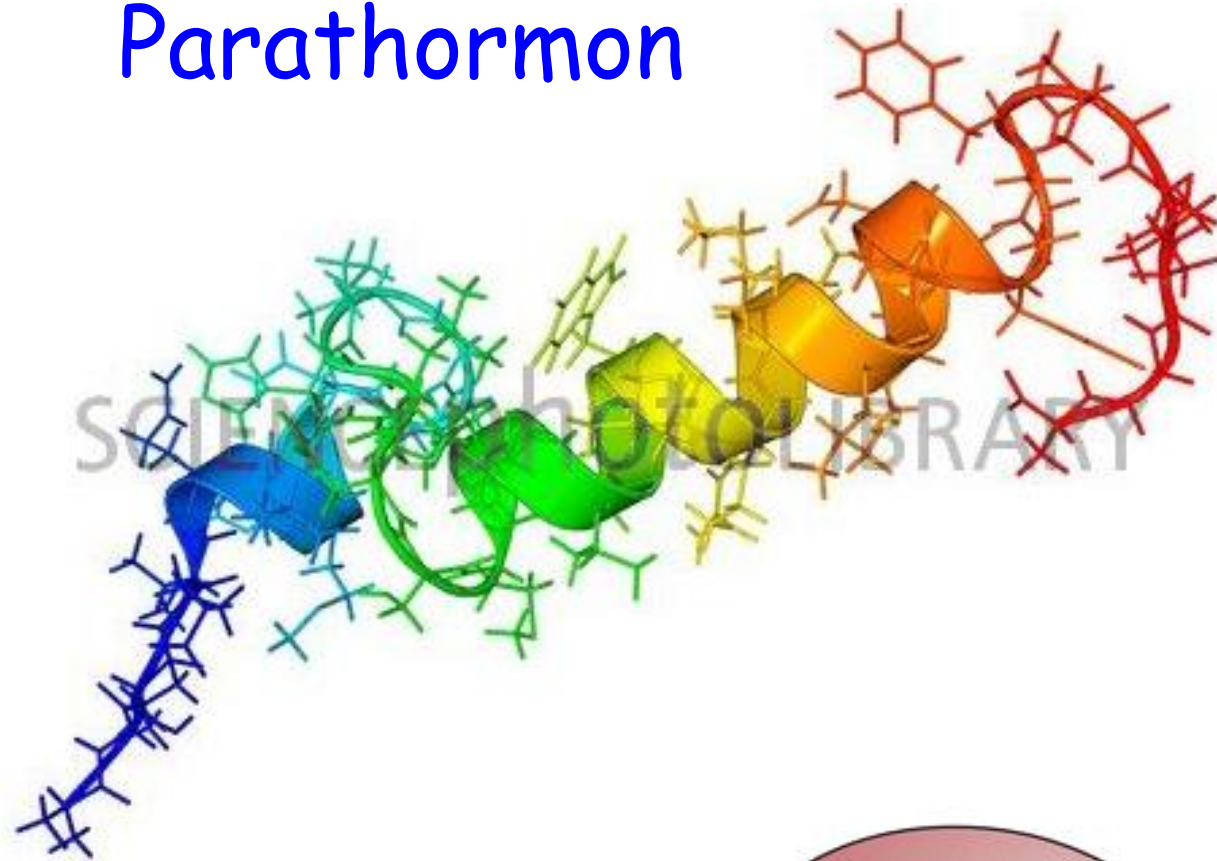


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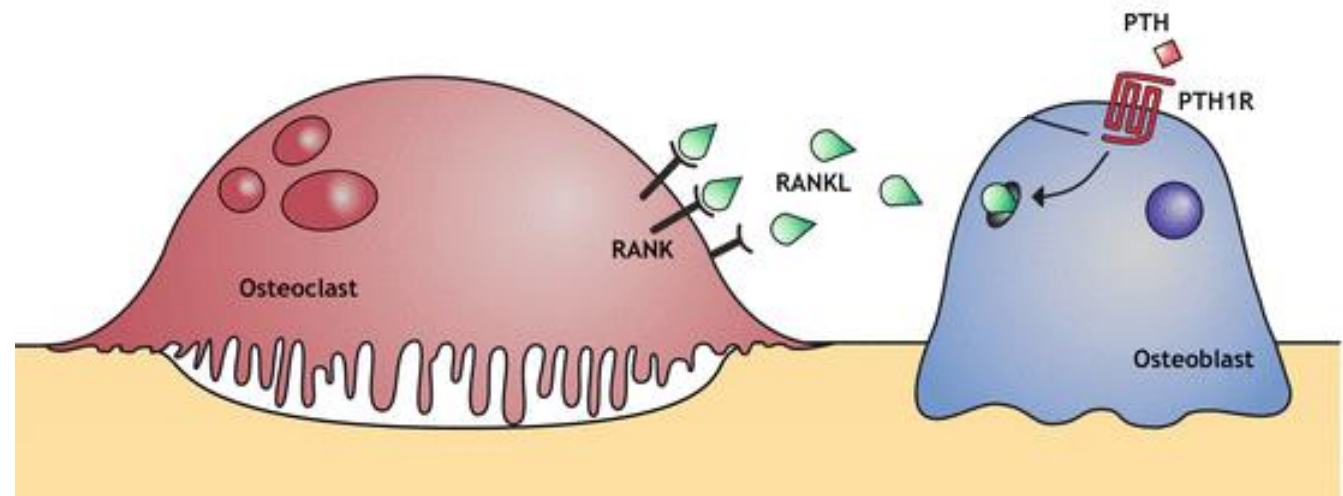
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# Parathormon



**Parathormon** aktivuje osteoblasty. Ty produkují RANK ligand a pomocí specifického receptoru stimulují osteoklastickou resorbci.

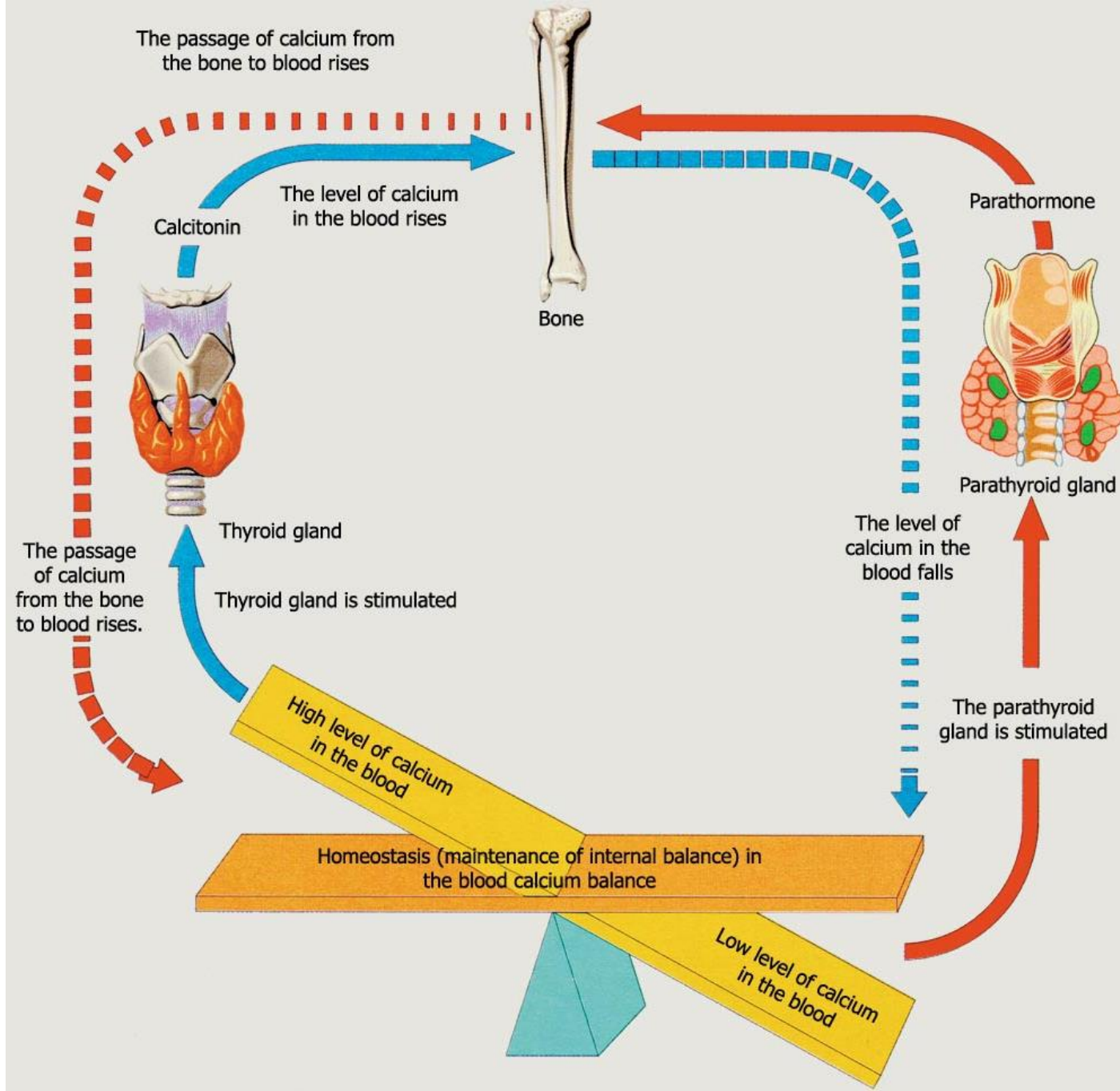


<http://www.sciencephoto.com/media/97531/enlarge>

[https://link.springer.com/referenceworkentry/10.1007/978-94-007-7693-7\\_27](https://link.springer.com/referenceworkentry/10.1007/978-94-007-7693-7_27)



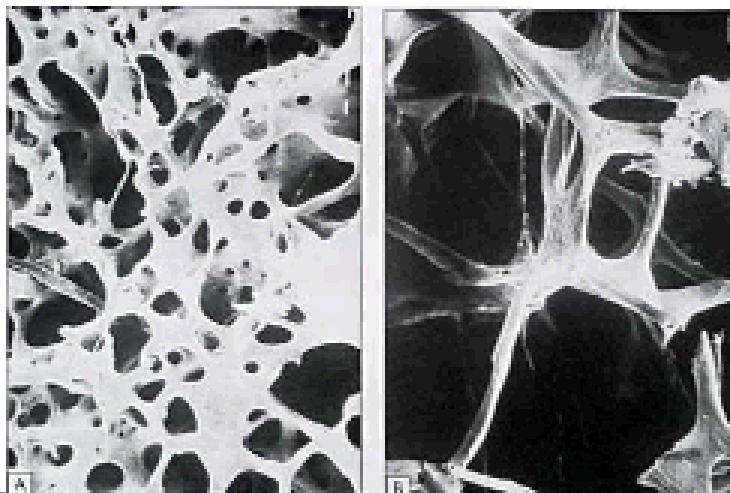
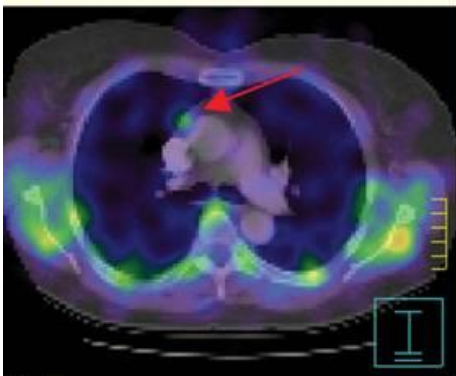
**Parathormon**  
nepřímo aktivuje osteoklastickou resorbci kosti při nízké hladině Ca v krvi. **Kalcitonin** přímo inhibuje osteoklastickou resorbci kosti při vysoké hladině Ca v krvi.



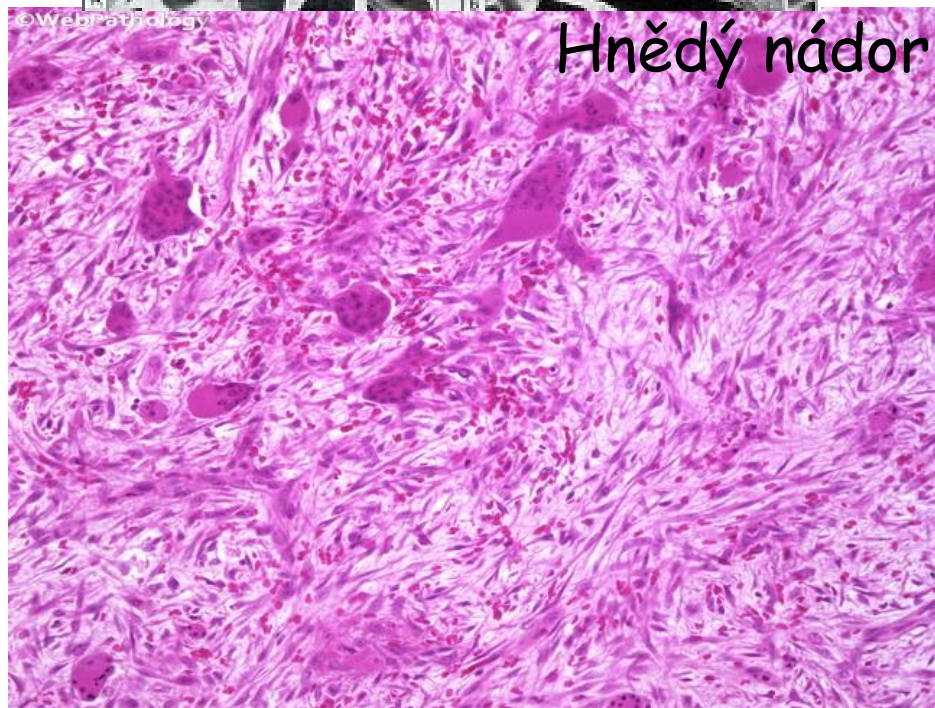
# Příštitná tělíska- ektopie, adenom



<http://www.parathyroid.com>



Osteoporosis



Hnědý nádor

## Symptoms of Parathyroid Disease

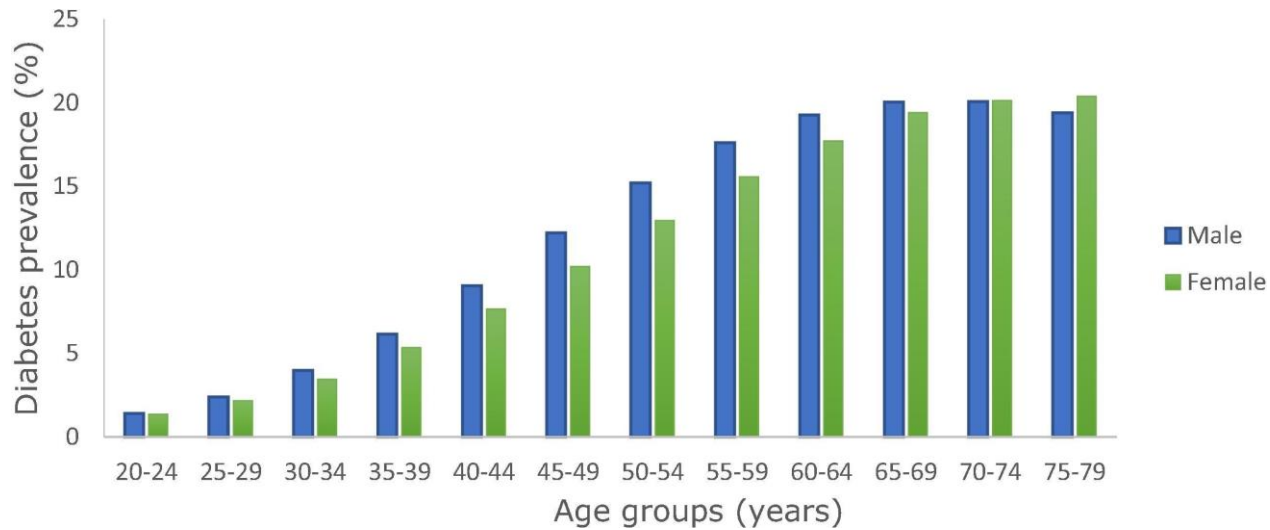
Loss of energy. Don't feel like doing much. Tired all the time. Just don't feel well; don't quite feel normal. Hard to explain but just feel kind of bad. Feel old. Don't have the interest in things that you used to. Can't concentrate, or can't keep your concentration like in the past.

Depression. Osteoporosis and Osteopenia. Bones hurt; typically it's bones in the legs and arms but can be most bones. Don't sleep like you used to. Wake up in middle of night. Trouble getting to sleep. Tired during the day and frequently feel like you want a nap. Spouse claims you are more irritable and harder to get along with (cranky, bitchy). Forget simple things that you used to remember very easily. Gastric acid reflux; heartburn; GERD. Decrease in sex drive. Thinning hair (predominately in older females). Kidney Stones. High Blood Pressure (sometimes mild, sometimes quite severe; up and down a lot). Recurrent Headaches (usually patients under the age of 40). Heart Palpitations (arrhythmias). Typically atrial arrhythmias.

Most people with hyperparathyroidism will have 3 or 4 of these symptoms. Some will have lots of them. A few people will say they don't have any... but after an operation they will often say otherwise. 97% of people with hyperparathyroidism will have 3 or more of these symptoms. In general, the longer you have hyperparathyroidism, the more symptoms you will develop.

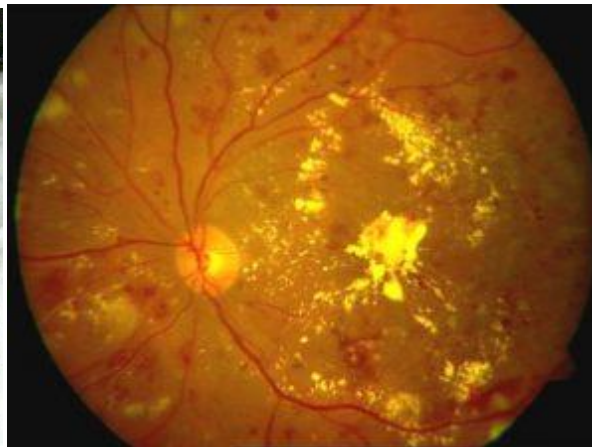


# Prevalence *diabetes mellitus* závisí na věku



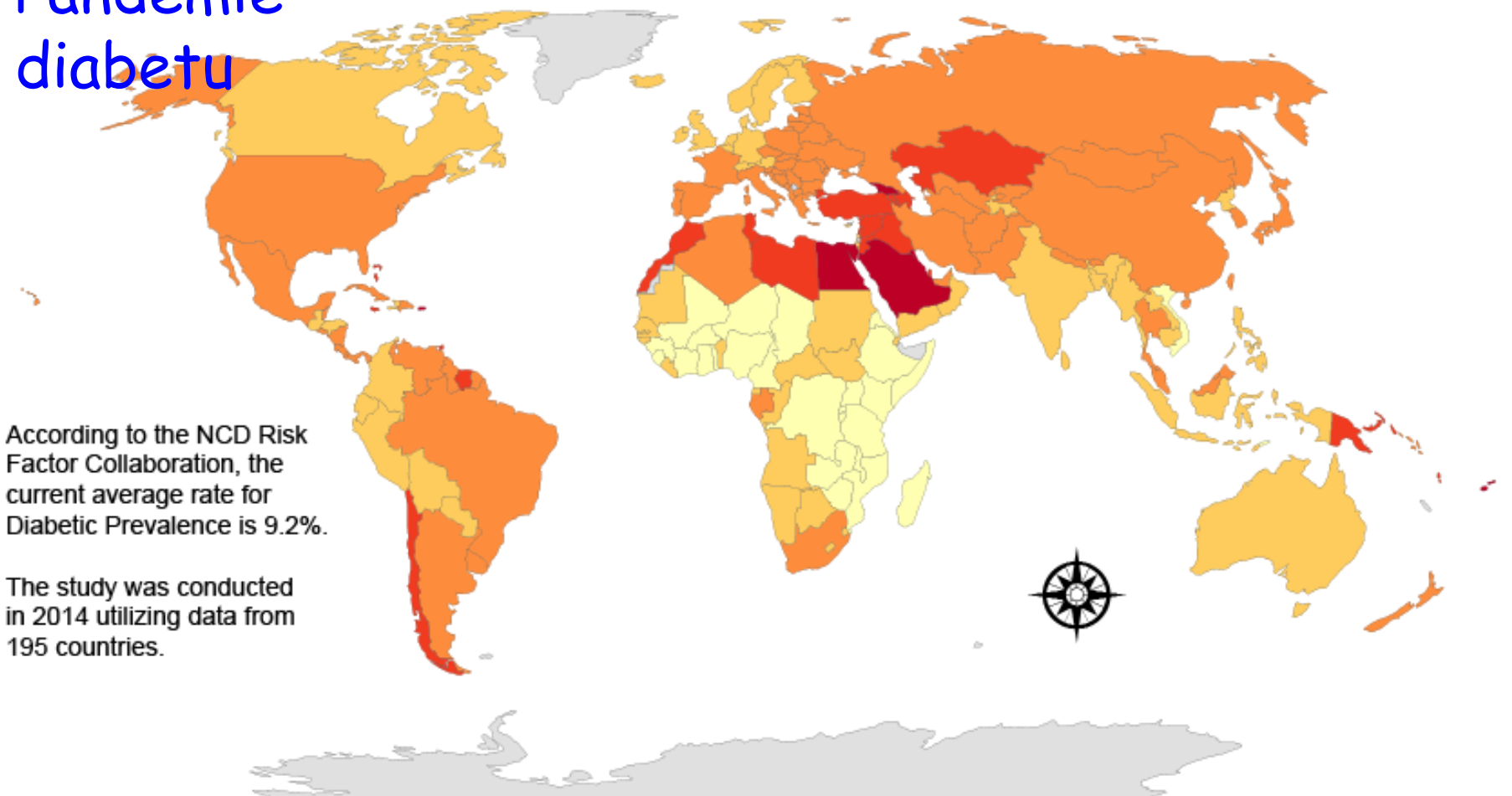
## Komplikace:

- Retinopatie
- Infarkt myokardu
- Mozková mrtvice
- Nefropatie
- Neuropatie
- Diabetická noha
- Nádory
- Sexuální dysfunkce



# Pandemie diabetu

## Global Prevalence of Diabetes (2014)



According to the NCD Risk Factor Collaboration, the current average rate for Diabetic Prevalence is 9.2%.

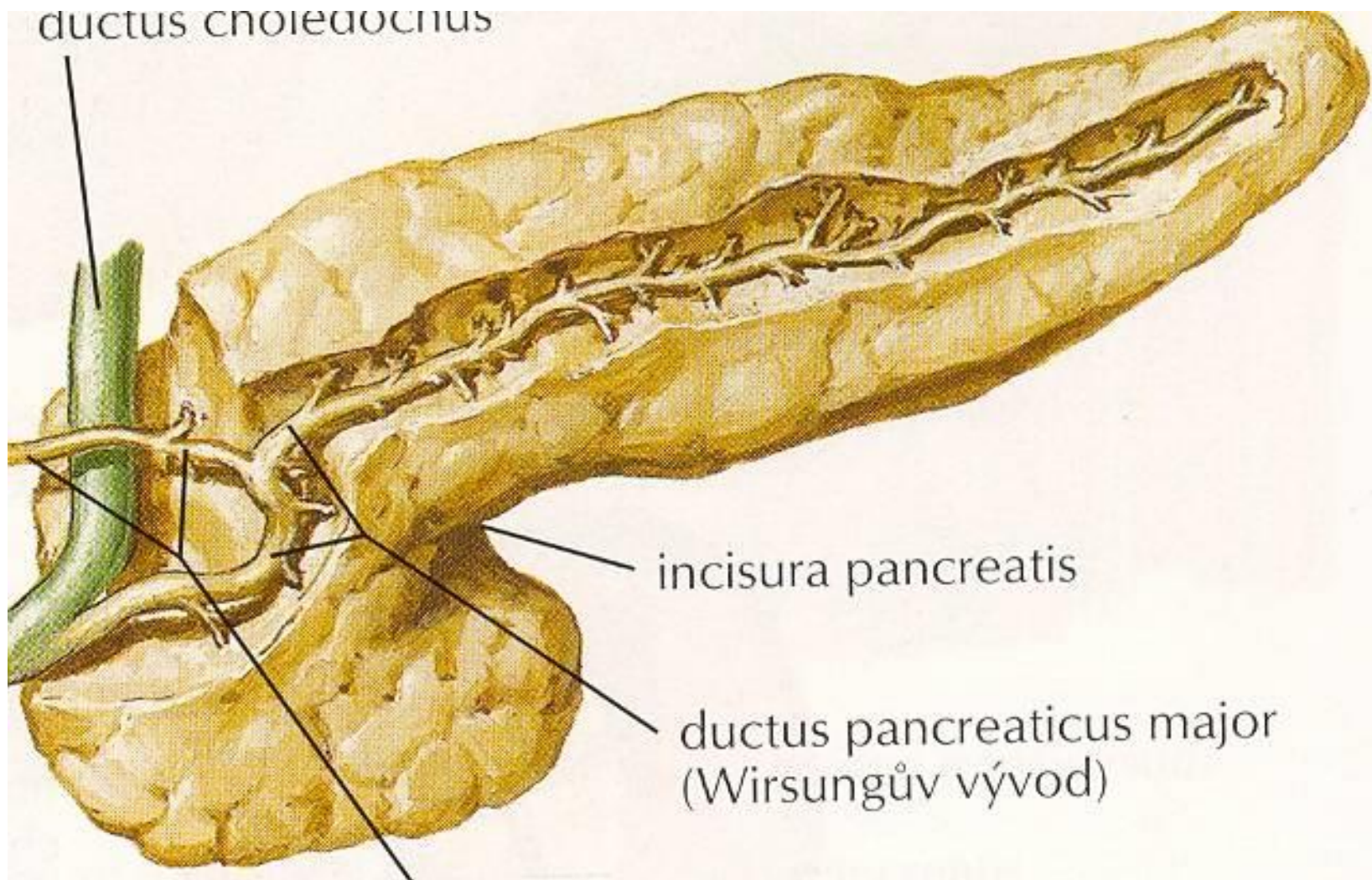
The study was conducted in 2014 utilizing data from 195 countries.

### Legend

Prevalence of Diabetes	
Percent of Country Population	
Light Yellow	2 - 5
Orange	5 - 8
Light Orange	8 - 11
Red-Orange	11 - 14
Dark Red	14 - 17
Grey	No Data

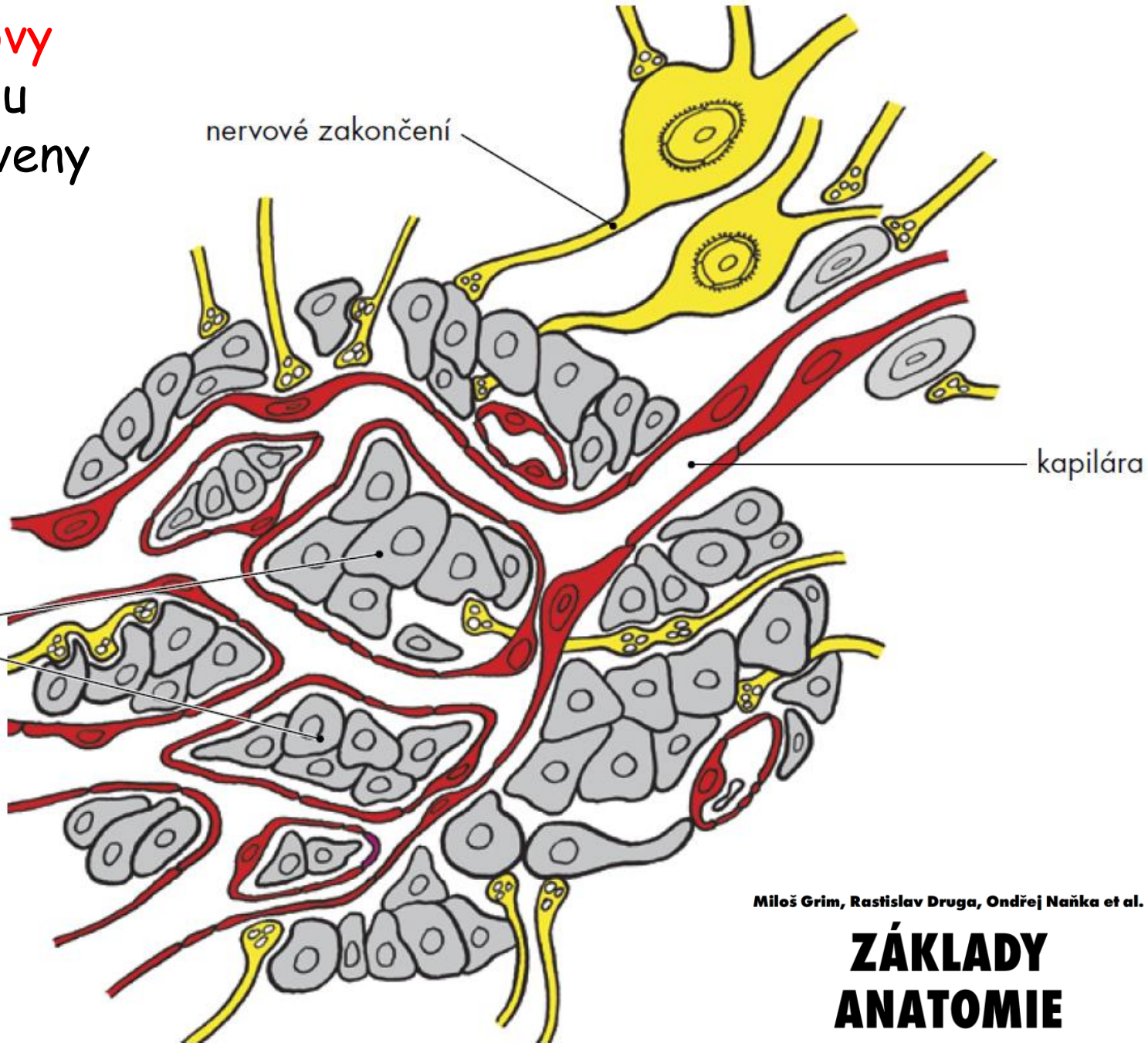
Created by Walter Scott Wilkens  
University of Illinois Urbana - Champaign  
November 7, 2018  
Sources:  
Diabetes Data - NCD Risk Factor Collaboration  
World Map - Natural Earth

# Langerhansovy ostrůvky





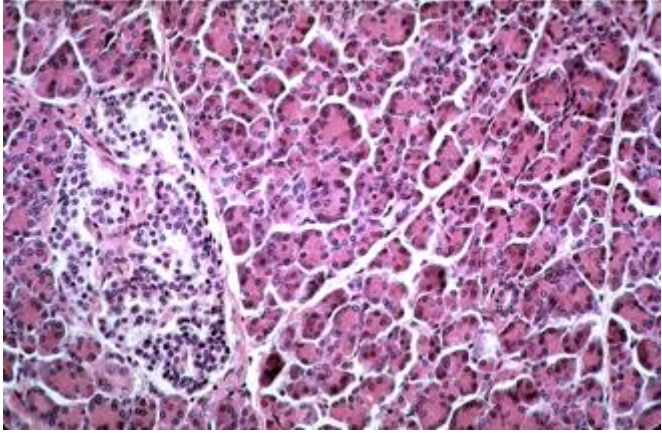
Langerhansovy  
ostrůvky jsou  
hustě prokrveny  
kapilárami a  
jsou bohatě  
vegetativně  
inervovány



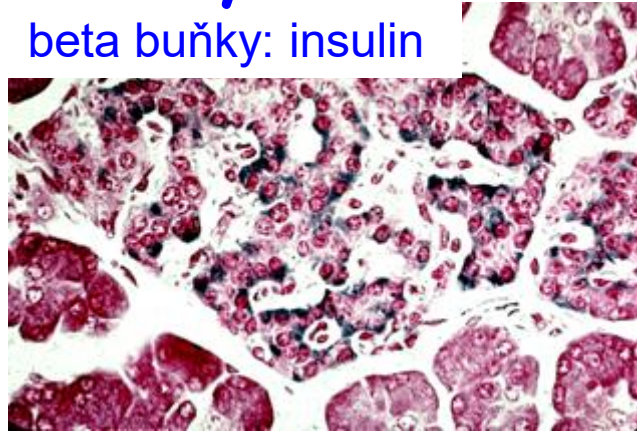
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# Langerhansovy ostrůvky



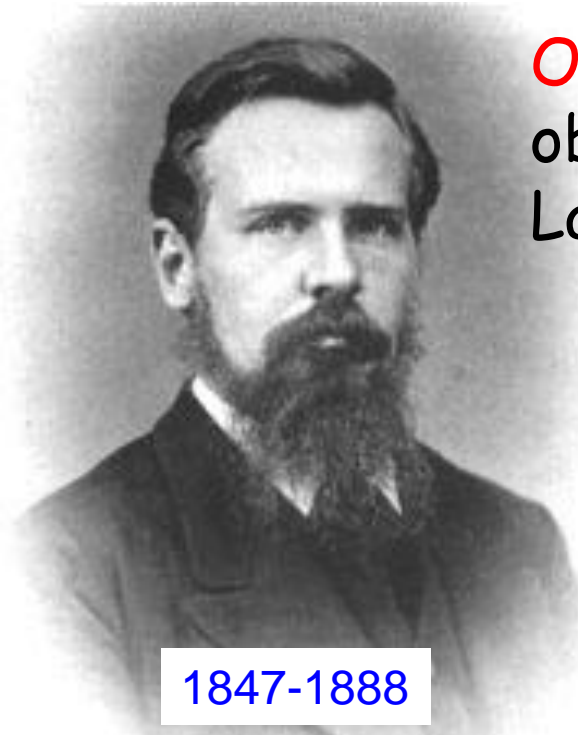
beta buňky: insulin



alfa buňky: glukagon



<http://www.udel.edu/Biology/Wags/histopage/colorpage/cp/cpil1.GIF>



Ostrůvky  
objevil Paul  
Langerhans

1847-1888

<http://daphne.palomar.edu/ccarpenter/Portraits/langherhans.jpg>



# Objev insulinu



THE CANADIAN MEDICAL ASSOCIATION JOURNAL 14

PANCREATIC EXTRACTS IN THE TREATMENT OF DIABETES MELLITUS

PREPARED BY F. G. BANTING AND C. H. BEST, Dept. of Physiology  
J. B. COLLIP, Dept. of Path. Chemistry  
W. B. GARDNER AND A. A. PLATTEN, Dept. of Medicine, University of Toronto, and  
Toronto General Hospital

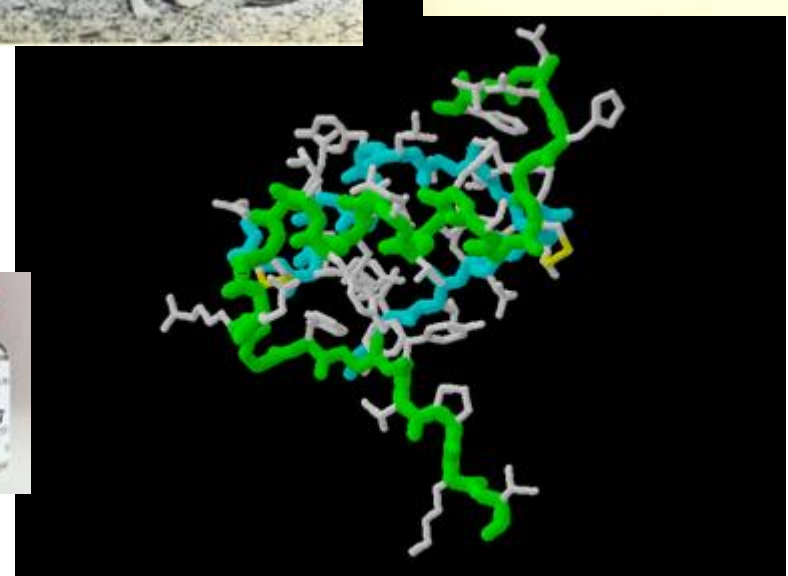
SINCE the year 1880, when von Meckel and Mikulowski (1) produced severe and fatal diabetes by total removal of the pancreas in dogs, many investigators have endeavored to obtain some beneficial effect in diabetic patients, either by feeding pancreas, or by administration of pancreatic extracts.

Minkowski, Schulzinger (2), Pfluger (3) and others found that feeding pancreas was followed by negative or even harmful results. More recently, Martin (4), Elliott (5) and Fawcett (6) have told the effects of aqueous extracts of the pancreas administered, on dehydrated animals and have found temporary reduction in the percentage of blood sugar and in the sugar excreted in the urine.

In 1907, Banting and Foster (7), recognizing the possibility that pancreatic extracts might have beneficial effects on the internal secretions, secured lobes from lobulated fishes, where the lobes separate from the rest of the pancreas, and fed it to human diabetics. Their studies demonstrated an beneficial substance on the condition of the patient. E. L. Scott (8) in 1912 sought to eliminate the influence of proteolytic enzymes by using alcoholic extracts of the pancreas. He did not find, however, that such extracts caused in method a reduction in the urinary sugar or in the G.-S. ratio as when extracts were made with distilled water. The whole question has been reviewed recently by Allen (9), by him, and, indeed, by the majority of recent writers, it is usually stated that pancreatic extracts have no effect when administered. During the past ten specific, one of us (F. G. B. and C. H. B.), working in the Department of Physiology of the University of Toronto, have investigated the problem. Certain of the results obtained have already been published, (10) others are now in press. These may be briefly reviewed here.

Believing that extracts of the pancreas, as usually prepared, did not satisfactorily demonstrate the presence of an internal secretion acting on carbohydrate metabolism, because the active principle was destroyed by the digestive enzymes also present in such extracts, attempts were made to eliminate these enzymes. In the first experiments, this was done by taking advantage of the fact that the sodium chloride from which the digestive enzymes are distilled but not the insulin of the pancreas digests (is active in ten weeks after ligation of the pancreatic ducts. Extracts were therefore made with distilled water, of digests of pancreatic tissue removed ten weeks after the ligation of the ducts. The extract obtained by the procedure, when injected intravenously or subcutaneously into diabetic dogs, temporarily secured a marked reduction in blood sugar and in the amount of sugar excreted in the urine. It also enabled a diabetic dog to retain a much higher percentage of injected sugar than it otherwise would. Extracts of liver or spleen, prepared in the same manner as the extracts of digested pancreas, were found to have neither of these effects. The active principle of the extract of digested pancreas was destroyed by heating in distilled or salt solution or by incubating for two hours at body temperature with pancreatic juice.

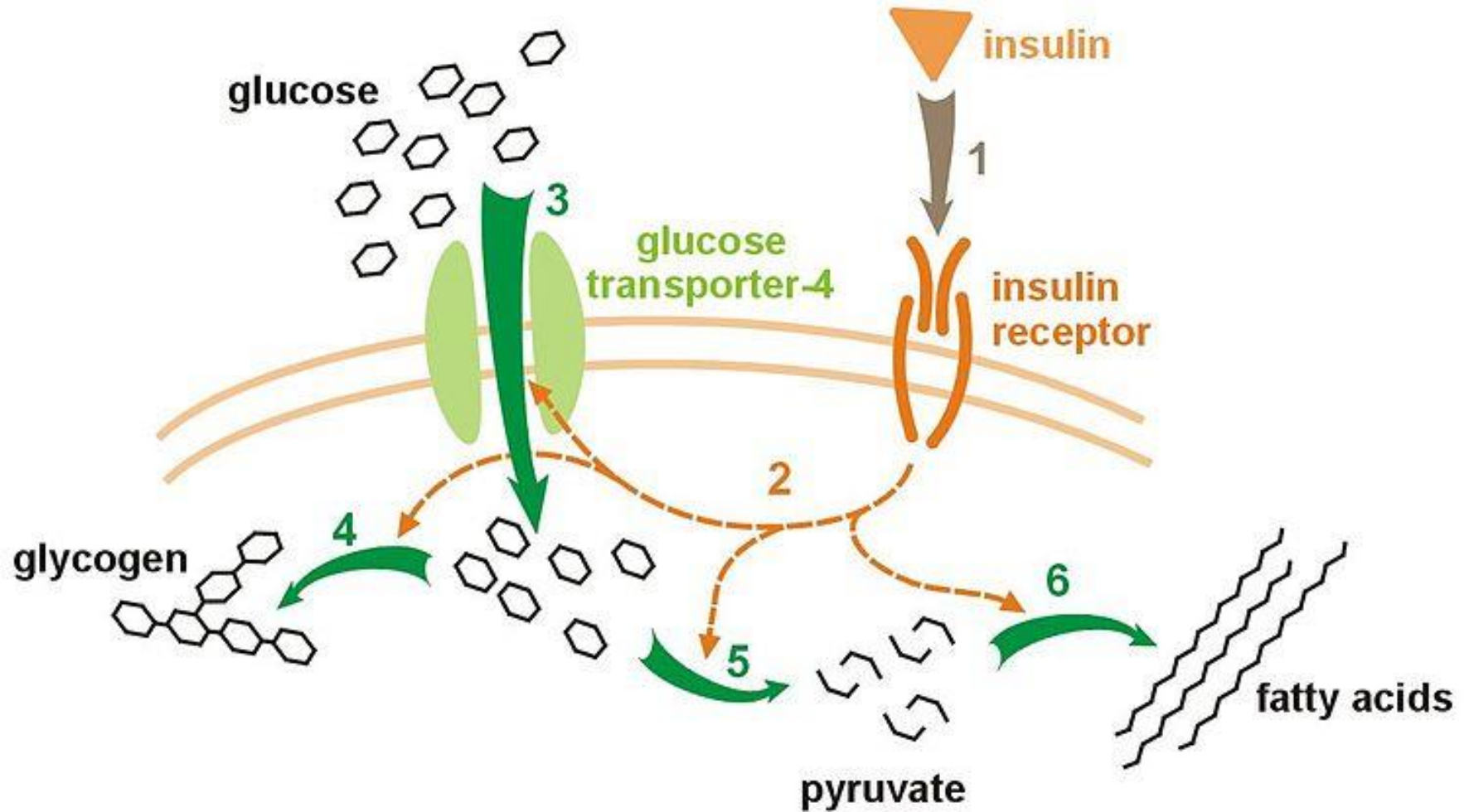
In later experiments, it was found that the pancreas of lobed fishes of early development did not contain pancreatic enzymes, thus avoiding the above-mentioned objection (11). By extracting such lobed pancreatic tissue, a highly potent and readily procurable preparation was obtained. Results allowing a much more practicable method for securing large quantities of extracts, this result demonstrated that the active principle is essentially the same, whether animal it is prepared. A method



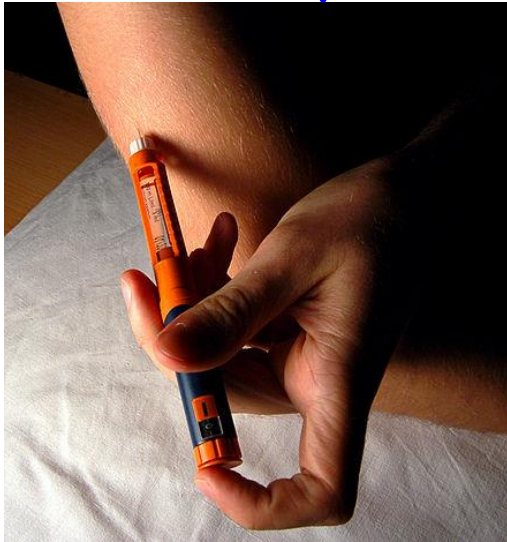
[http://www.virtualsciencefair.org/2004/mcgo4s0/public\\_html/t5/insulin.gif](http://www.virtualsciencefair.org/2004/mcgo4s0/public_html/t5/insulin.gif)



# Molekulární mechanismus působení insulínu



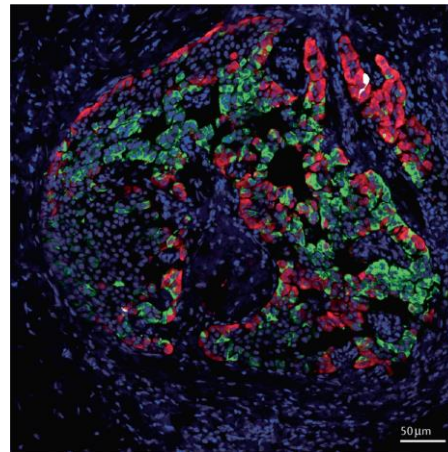
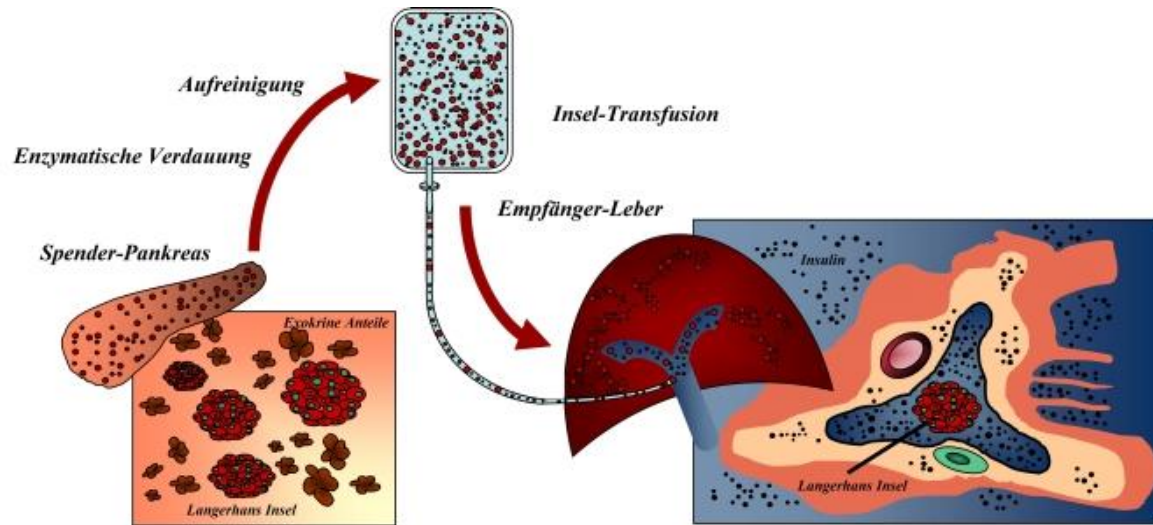
# Insulinové pero



# Insulinová pumpa



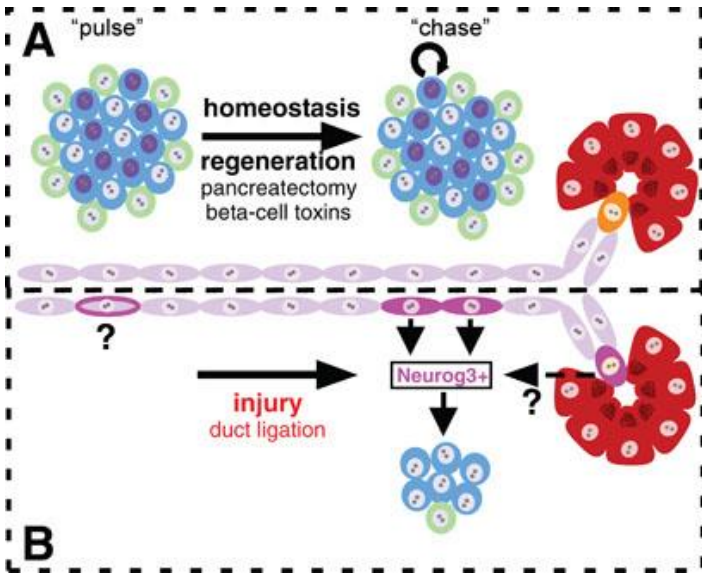
# Transplantace ostrůvků



<https://gewebenetzwerk.de/en/inselezellspende/>

<https://www.nature.com/articles/s41574-022-00651-0.pdf>

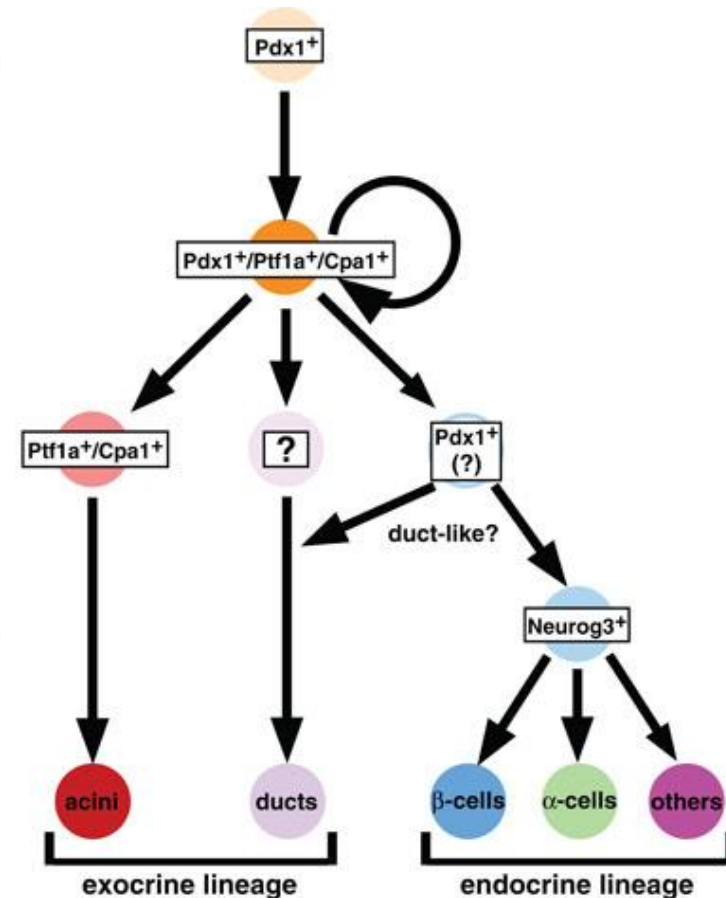
# Buňky Langerhansových ostrůvků vznikají z buněk vývodů



E8.5-9.5  
specification

E10.5-11.5  
growth

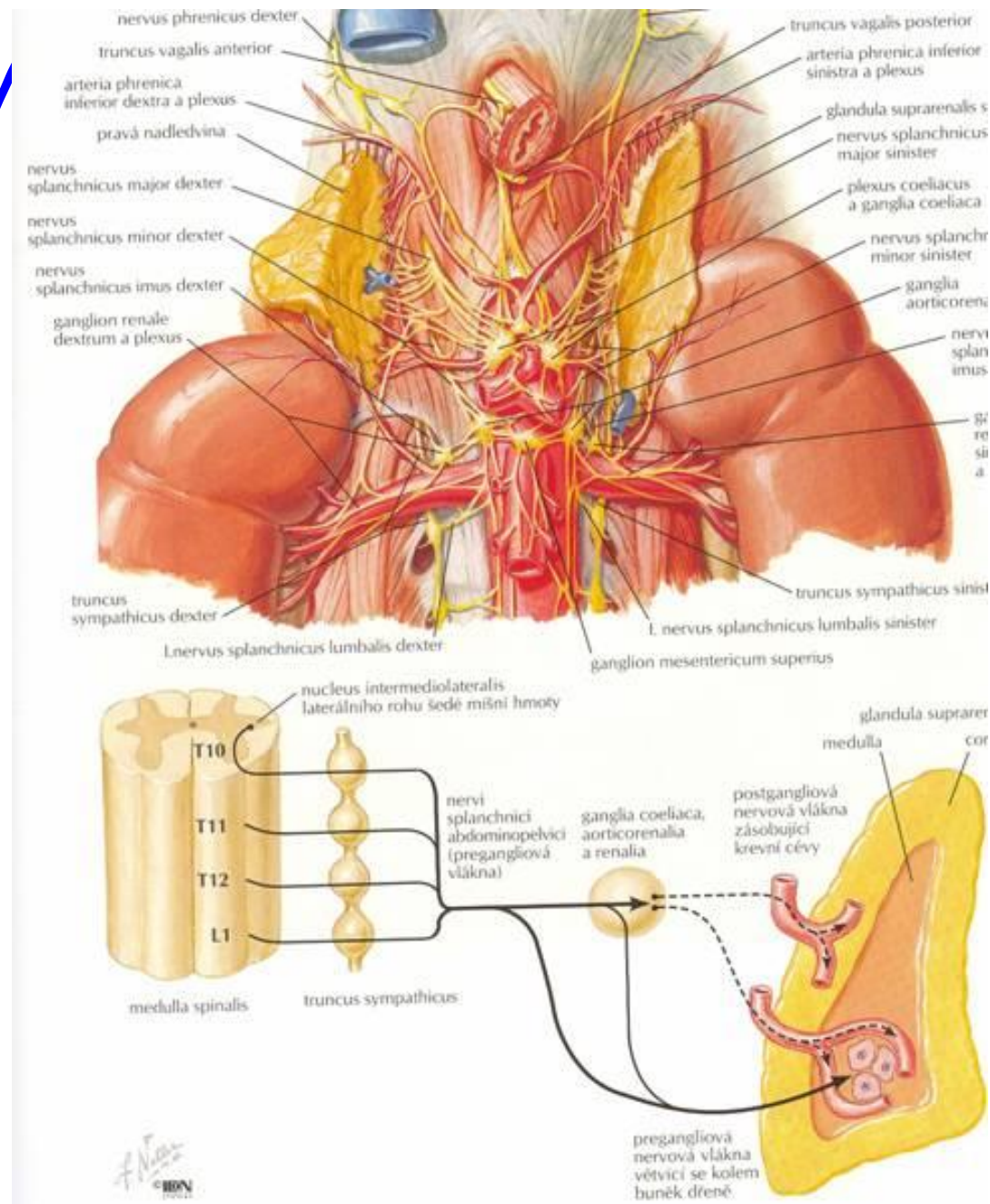
E13.5-birth  
differentiation



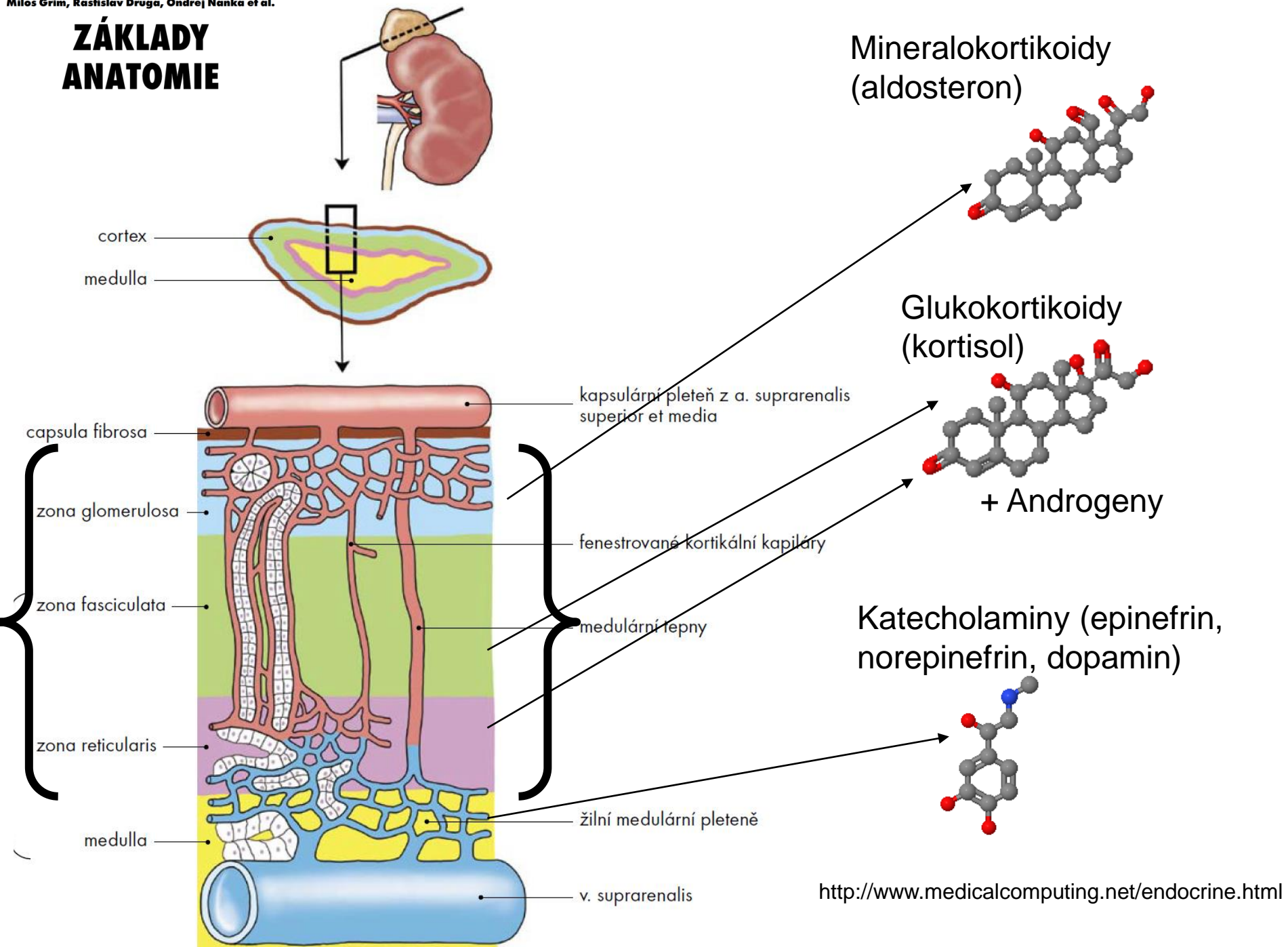
Pomocí přenosu genů pro specifické transkripční faktory lze in vitro připravit buňky ostrůvků z iPSC. Počátek nové epochy léčby diabetu?



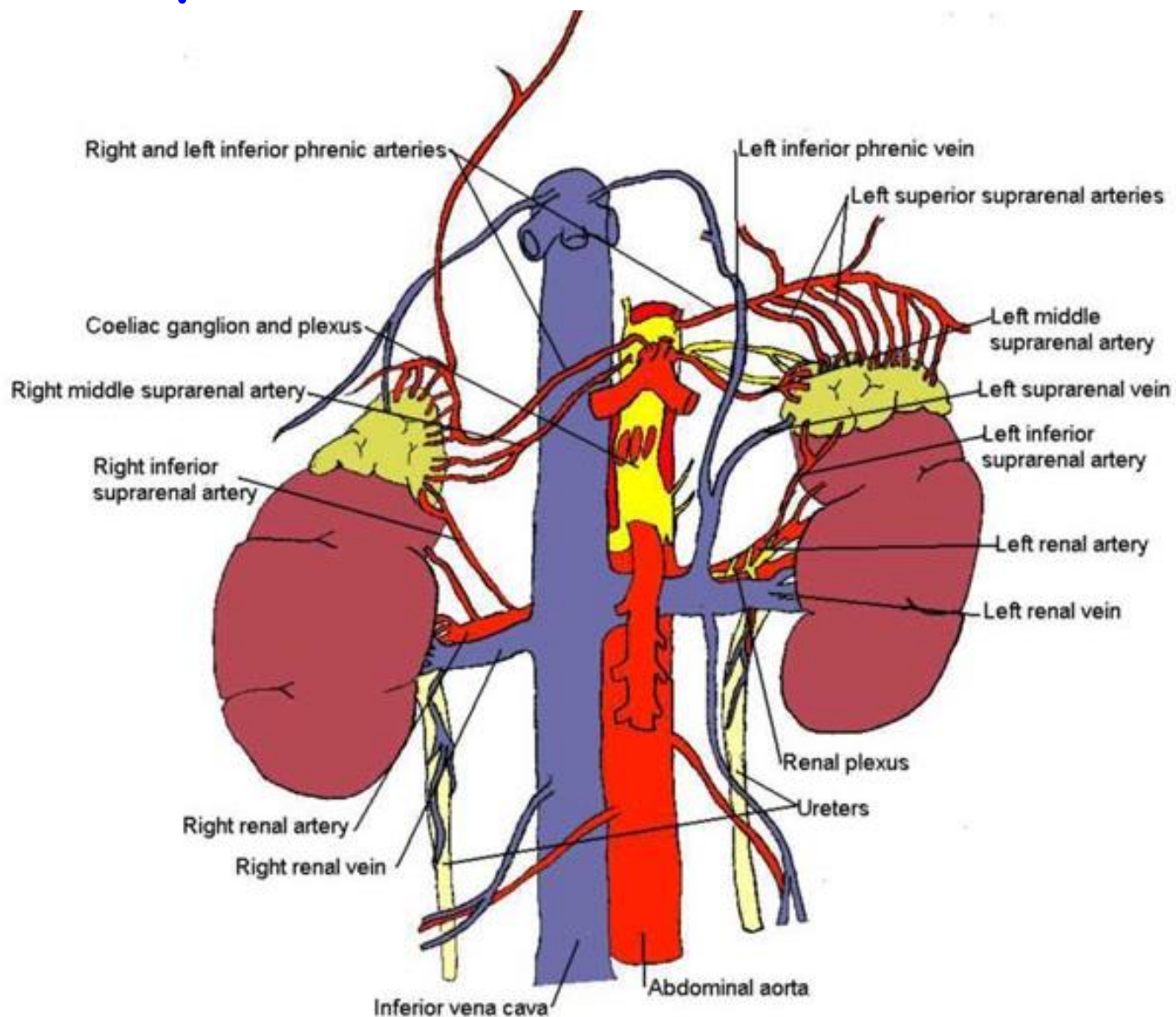
# Nadledviny



# ZÁKLADY ANATOMIE

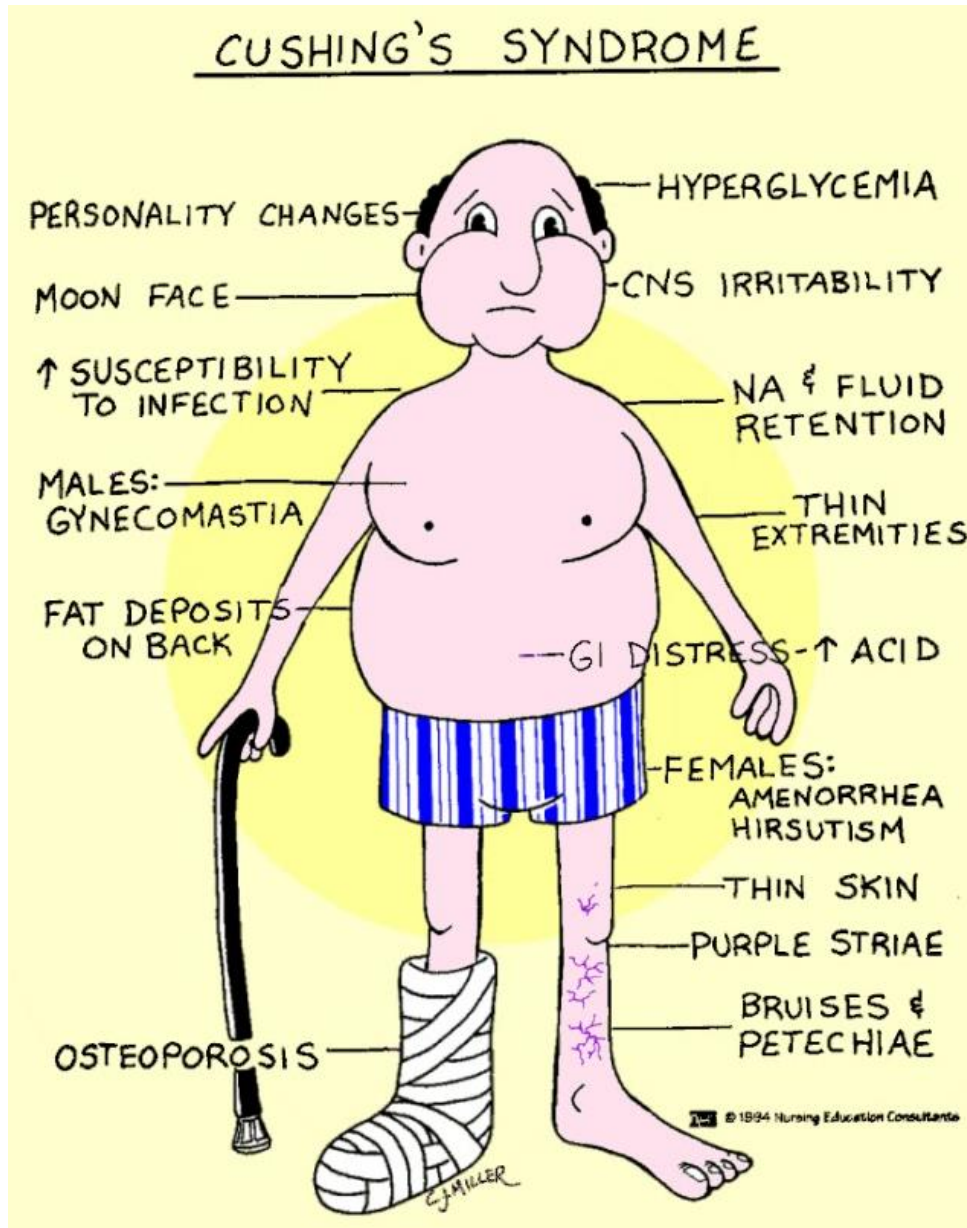


# Nadledviny-cévní zásobení





# Hyperfunkce kůry nadledvin

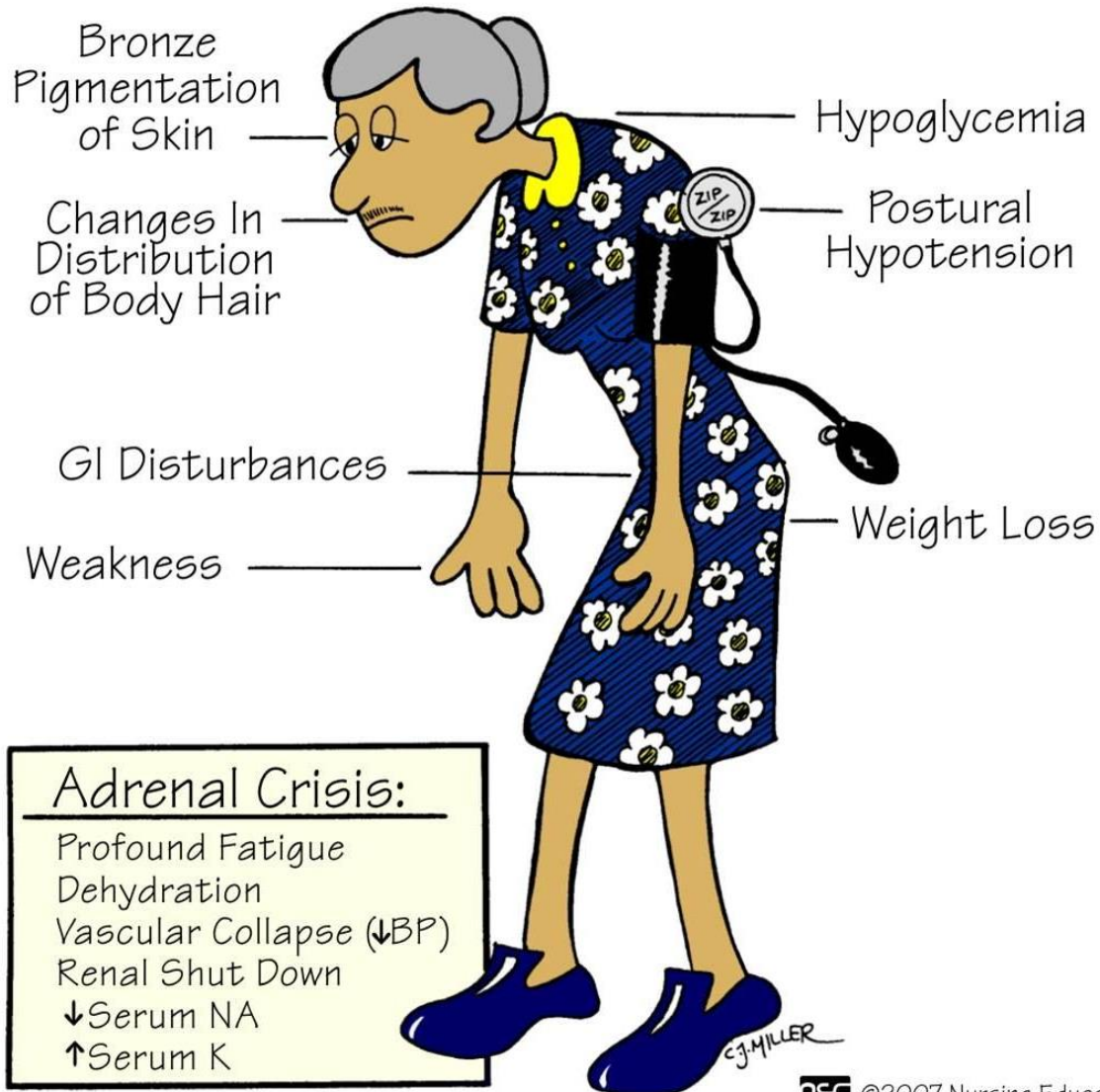


<http://all4medical.blogspot.cz/2013/08/cushing-syndrome.html>

<http://spiral.univ-lyon1.fr/polycops/Endocrinologie/Cushing.gif>

# Hypofunkce kůry nadledvin

## ADDISON'S DISEASE





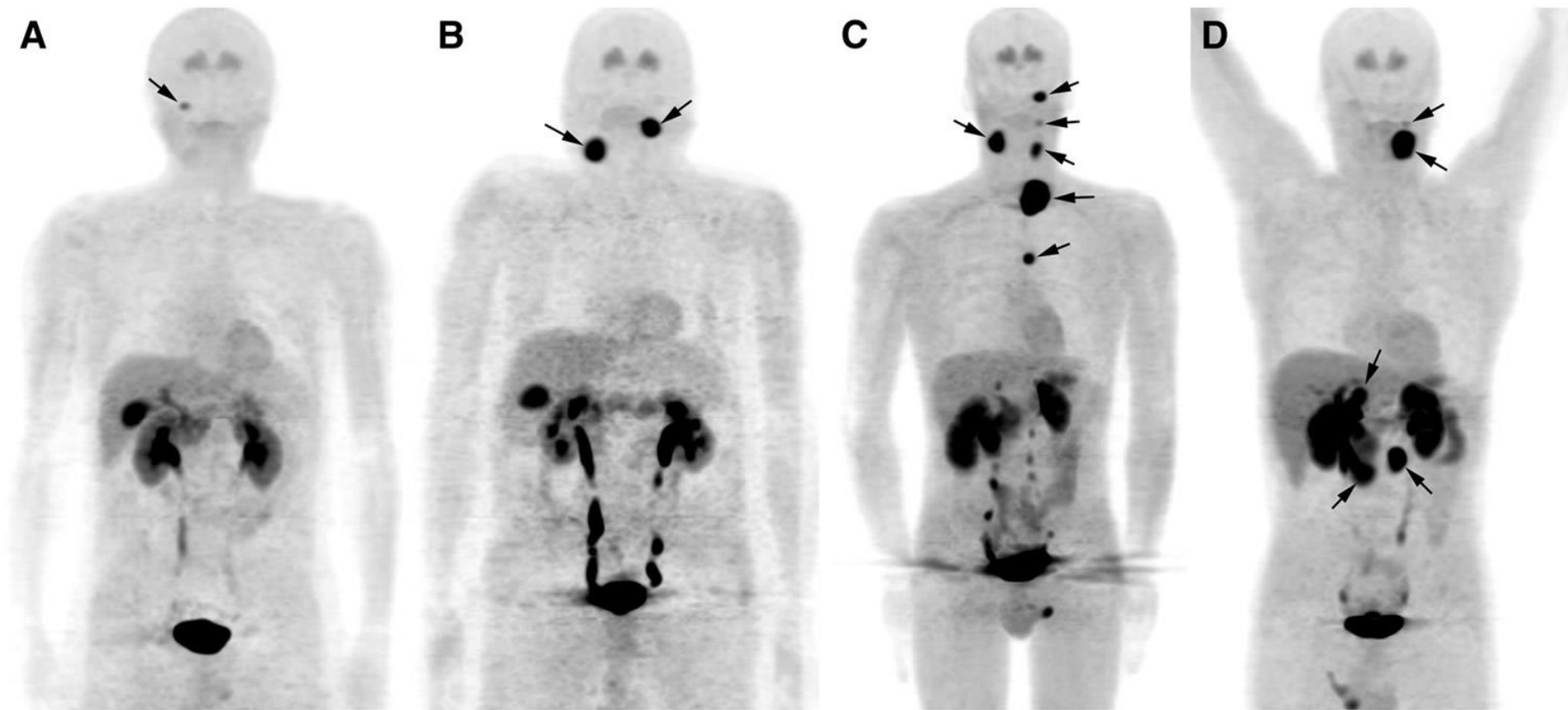
Addison sy





# Paraganglia-podobná gangliím sympatiku

(produkují katecholaminy, glomus caroticum je chemoreceptor)



Časté jsou vysoce maligní nádory!!

# Nadledviny

## Feochromocytom:

Většinou benigní, nádor dřeně, produkce katecholaminů a z toho HYPERTENZE



## Paraganglia

## Paragangliomy:

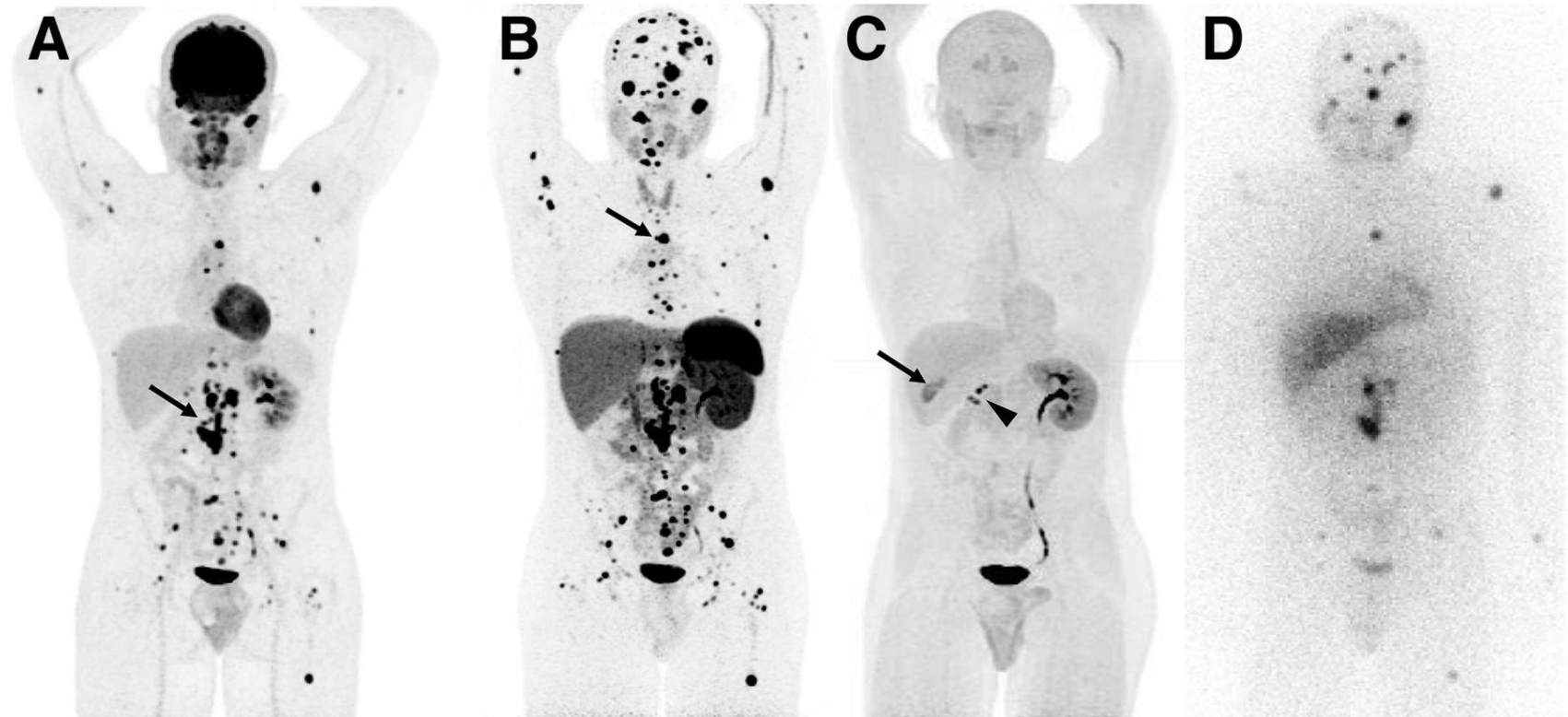
Vzácný, většinou benigní, produkce katecholaminů a z toho HYPERTENZE. Pokud je maligní velmi špatná prognóza

# Paraganglia



## Paragangliomy:

Vzácné, většinou benigní, produkce katecholaminů a z toho HYPERTENZE. Pokud jsou maligní - velmi špatná prognóza. Světová kapacita Prof. Karel Pacák (NIH + 1. LFUK)



Metastazující paragangliom

<sup>18</sup>F-FDG  
MIP

<sup>68</sup>Ga-DOTATATE  
MIP

<sup>18</sup>F-FDOPA  
MIP

<sup>123</sup>I-MIBG  
ANT PLANAR

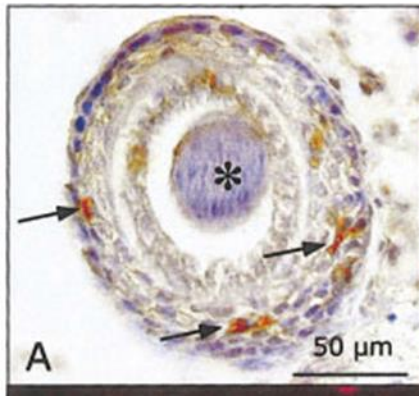


# Difusní neuroendokrinní systém

Neuro-endokrinní buňky jsou v mnoha orgánech, hlavně v epitelu (trávicí systém, dýchací systém, močopohlavní systém, kůže...), část je z neuroektodermu (neurální lišta)

Produkce hormonů: serotonin, histamin, gastrin, cholecystokinin, sekretin, **grehlin**.....

Neuroendokrinní zhoubné nádory



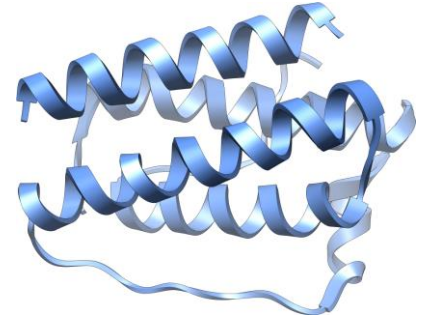
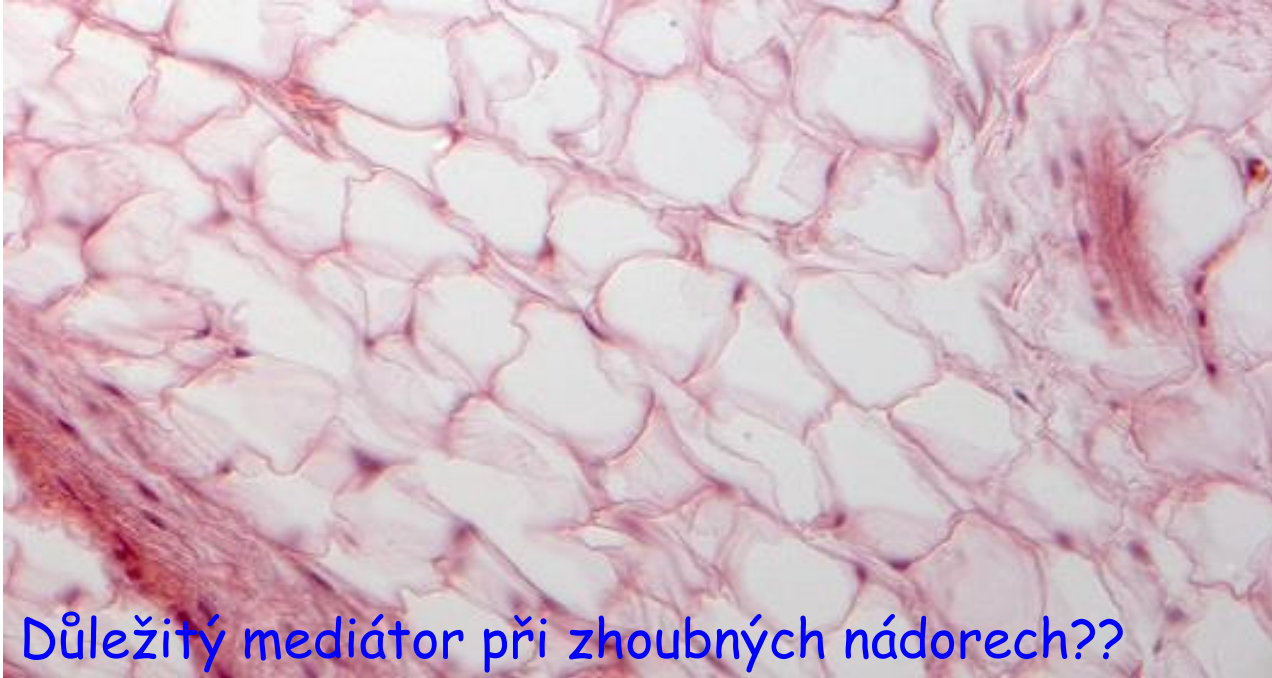
Merkel cells

Birth Defects Research (Part C) 72:162–172 (2004)



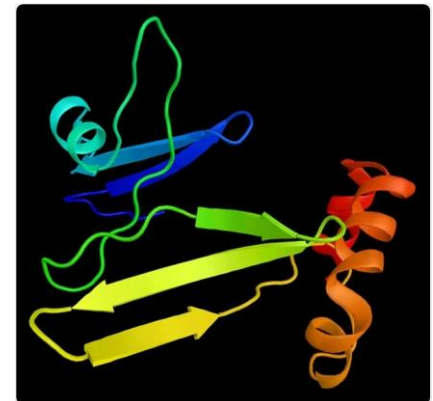
Merkel cell polyomavirus

# Tuková tkáň: **leptin** (Tlumí pocit hladu, po aplikaci nezhubneme)

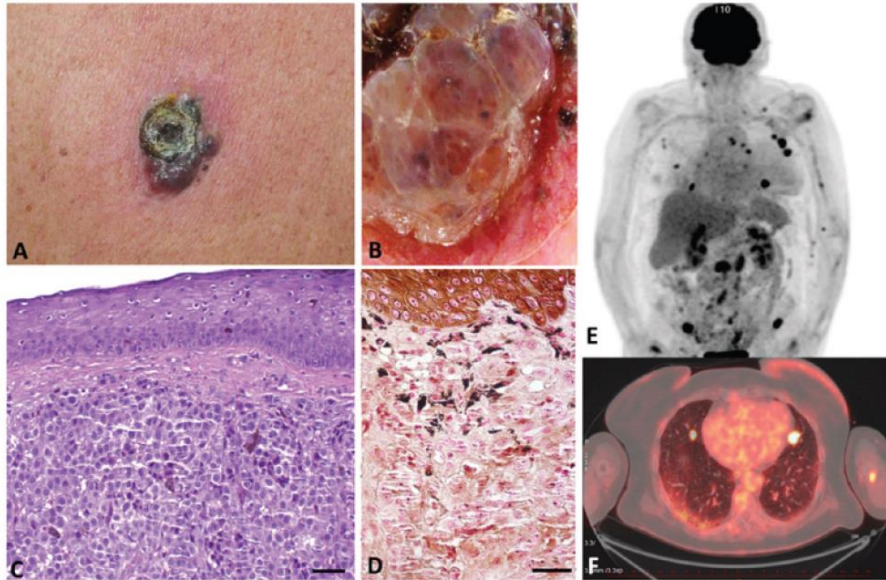


Antagonista: **grehlin** (hormon hladu)  
produkovaný sliznicí trávicí trubice

Důležitý mediátor při zhoubných nádorech??

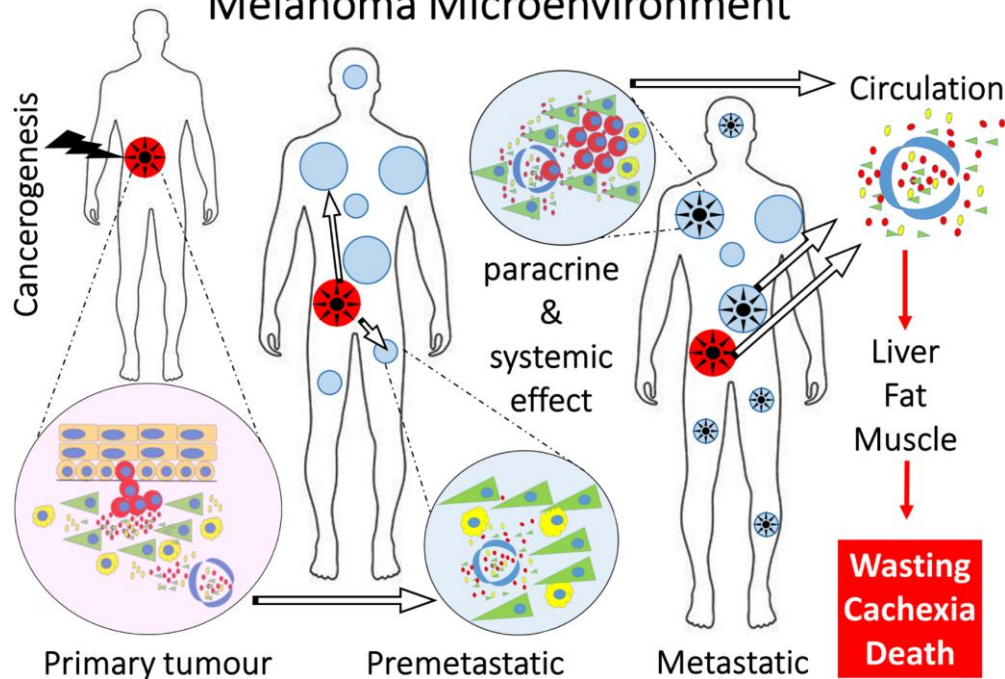


# Nádor jako endokrinní orgán?



- Faktory mezibuněčné výměny informací mezi nádorovými a nenádorovými buňkami (IL-6, TGF- $\beta$ ...) ovlivňují růst a metastazování nádorových buněk.

## Melanoma Microenvironment



- Tyto faktory jsou **cévami rozváděny po těle** a podílejí se na tvorbě premetastatické niky.
- Mohutná metastazace vede ke **zvýšení hladiny těchto faktorů v séru**. To má **systemový efekt** a ovlivní metabolismus pacienta a finálně vede k chátrání a smrti.