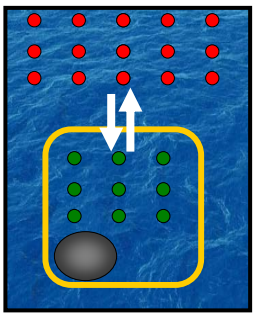
Transport rénal de l'eau

Frank Bienaimé

Service d'exploration fonctionnelle rénale Hôpital Necker

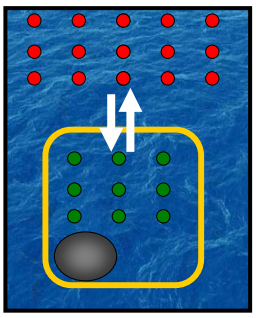
INSERM U1151

Change in extracellular fluid tonicity cause water movement in/ont of the cell



- **Extracellular non permeant solute**
- **Intracellular non permeant solute**

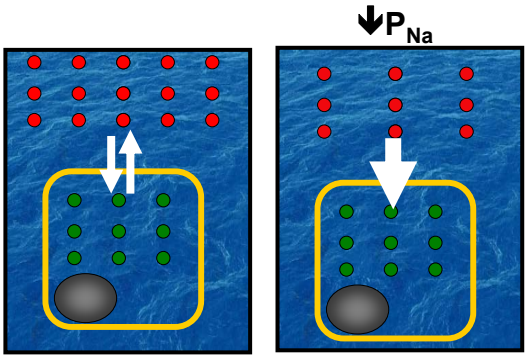
Change in extracellular fluid tonicity cause water movement in/ont of the cell



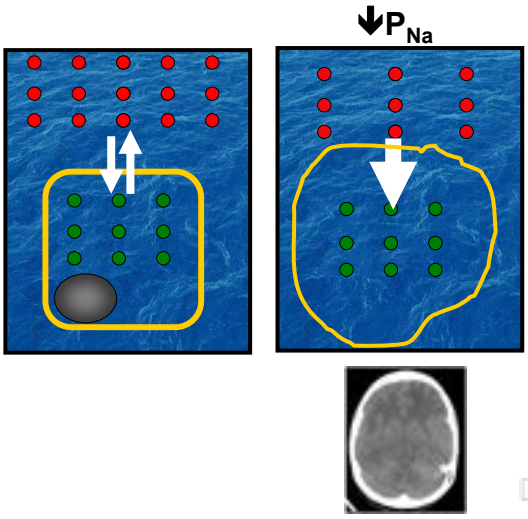
$$J_v = L_p[RT(\mathrm{Osm}_i - \mathrm{Osm}_e)]$$

- Extracellular non permeant solute
- Intracellular non permeant solute

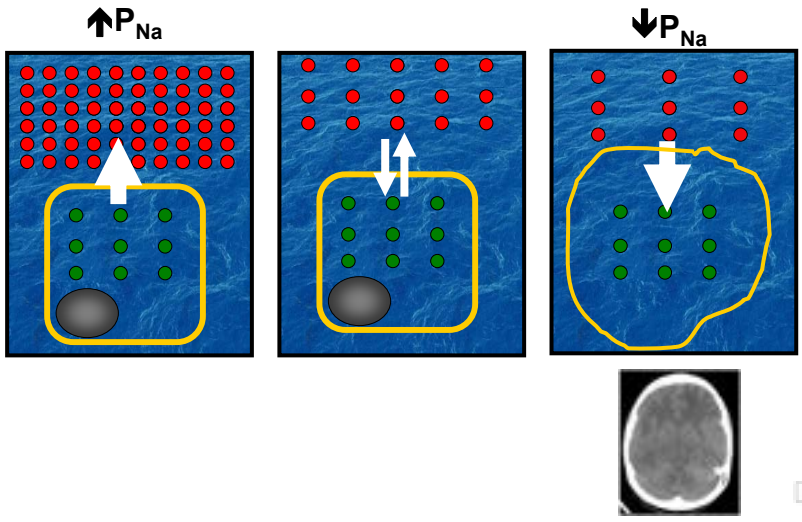
Change in extracellular fluid tonicity cause water movement in/ont of the cell



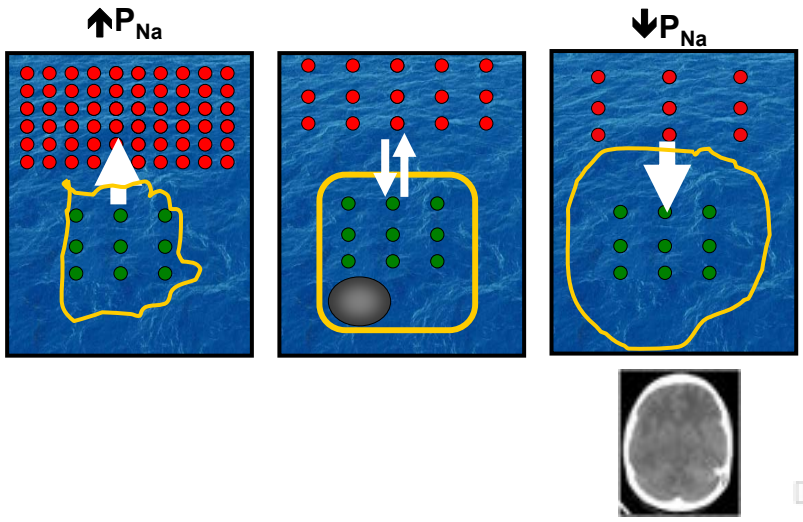
Change in extracellular fluid tonicity cause water movement in/ont of the cell



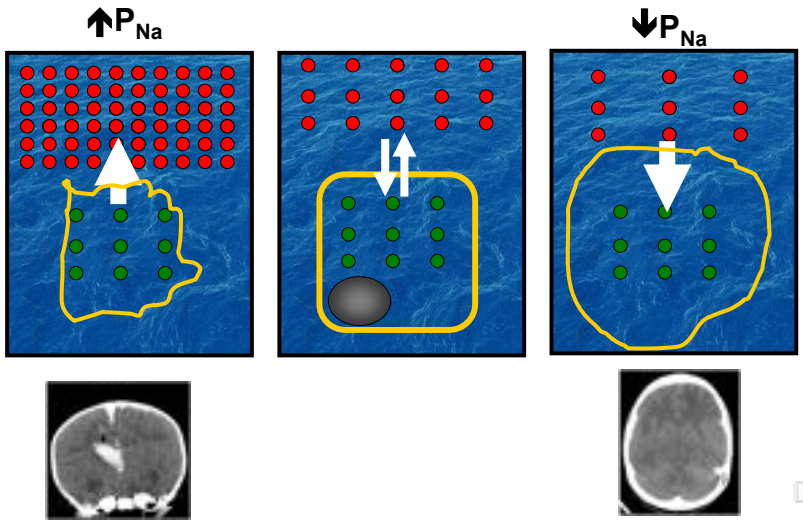
Change in extracellular fluid tonicity cause water movement in/ont of the cell



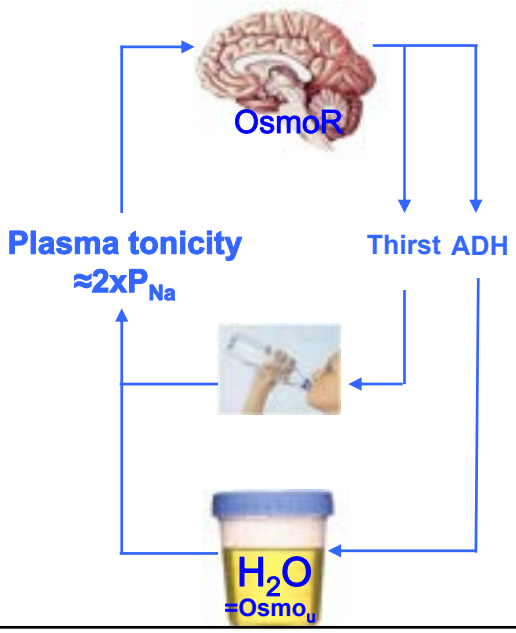
Change in extracellular fluid tonicity cause water movement in/ont of the cell



Change in extracellular fluid tonicity cause water movement in/ont of the cell

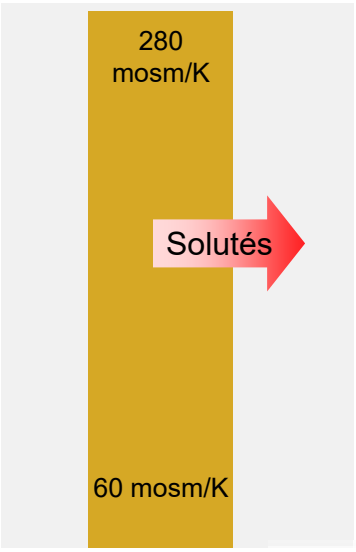


Osmoregulation in humans



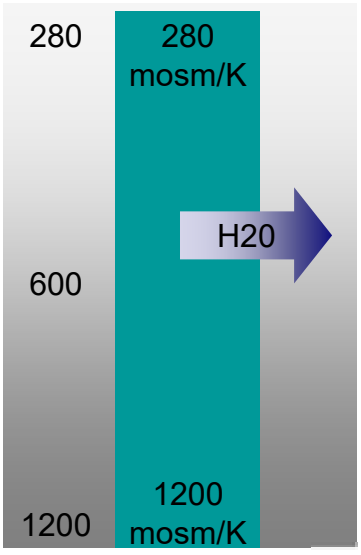
Maintien d'un milieu intérieur constant

Excrétion d'eau libre



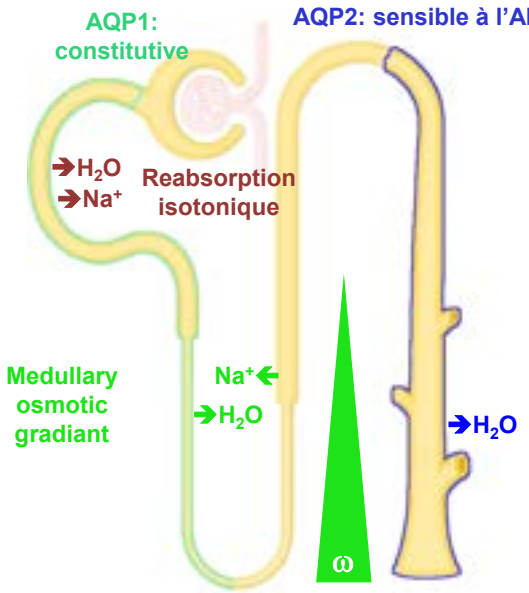
Réabsorption de solutés sans eau

Réabsorption d'eau libre



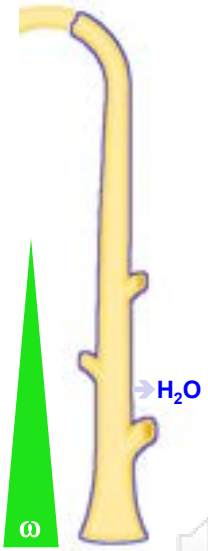
Création d' une hypertonicité interstitielle

Réabsorption d'eau par le rein



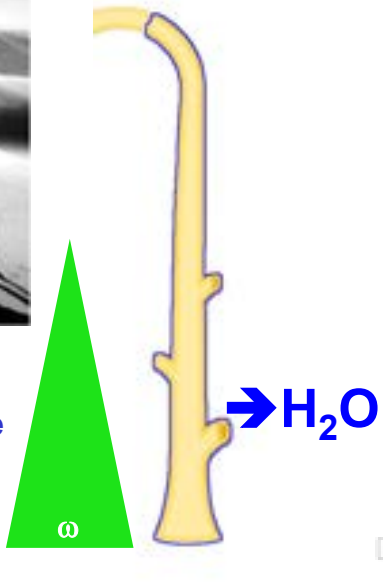
Réabsorption d'eau par le canal collecteur

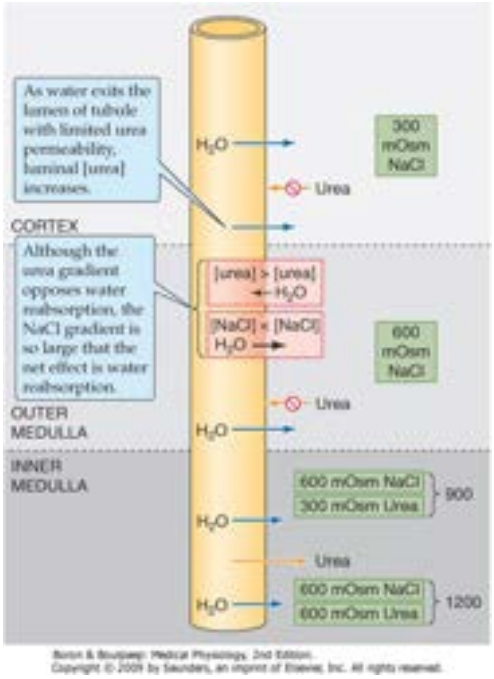
Suppression ADH
pas d'AQP2 à la membrane
Faible perméabilité hydrique



Réabsorption d'eau par le canal collecteur

Sécrétion ADH
AQP2 à la membrane
Forte perméabilité hydrique
+
Augmentation du gradiant osmotique



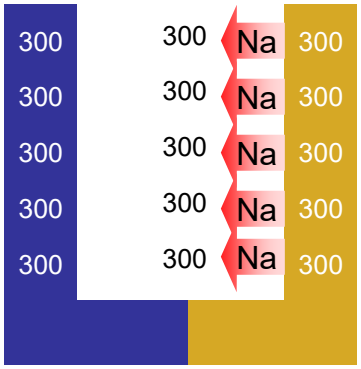


Transport multiplicateur à contre courant

+

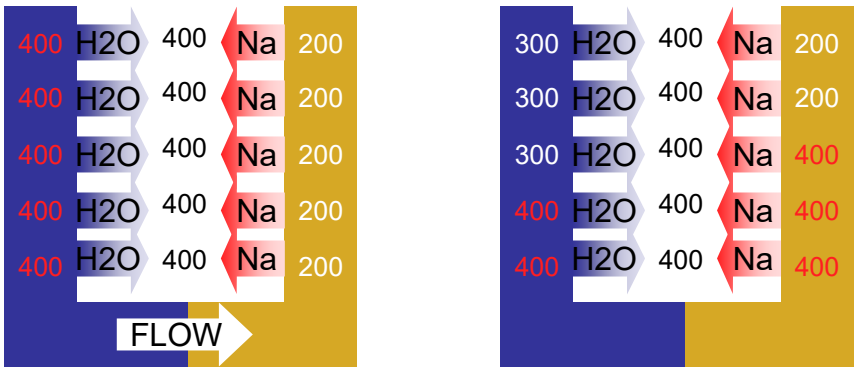
Recyclage de l'urée

Transport multiplicateur à contre courant



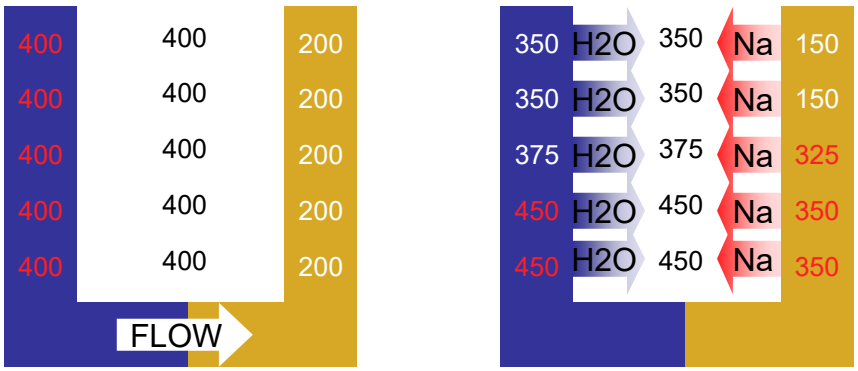
Adapté de Katz, *Advan Physiol Educ*, 1998

Transport multiplicateur à contre courant



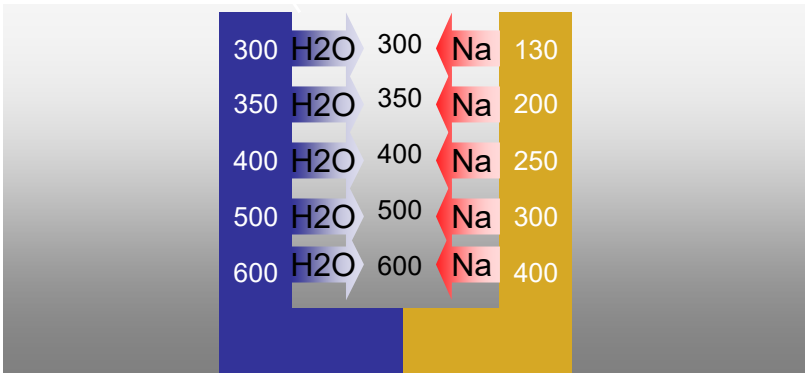
Adapté de Katz, *Advan Physiol Educ*, 1998

Transport multiplicateur à contre courant



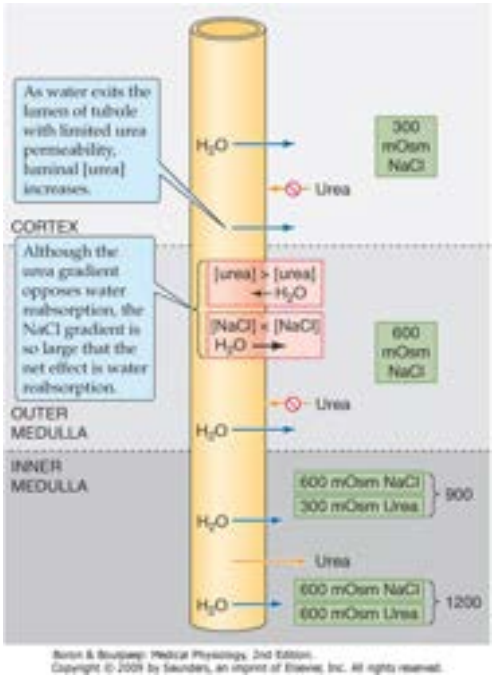
Adapté de Katz, *Advan Physiol Educ*, 1998

Transport multiplicateur à contre courant



1. Transport actif de sodium dans le BALAH
2. Perméabilité à l'eau des segments descendants mais pas ascendants
3. Perméabilité au sodium BAFAH

Adapté de Katz, *Advan Physiol Educ*, 1998



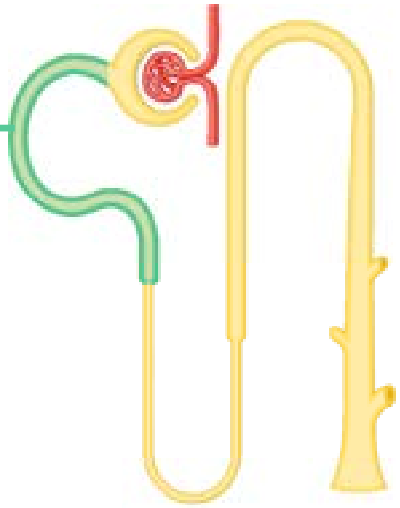
Transport multiplicateur à contre courant

+

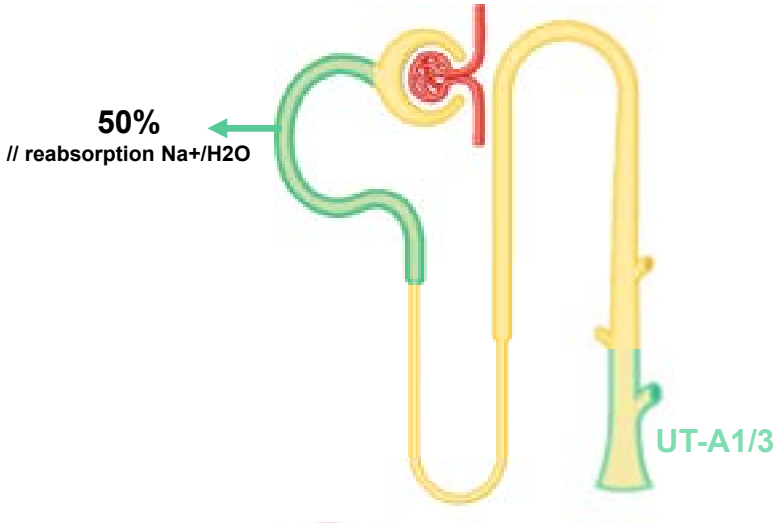
Recyclage de l' urée

Recyclage de l'urée

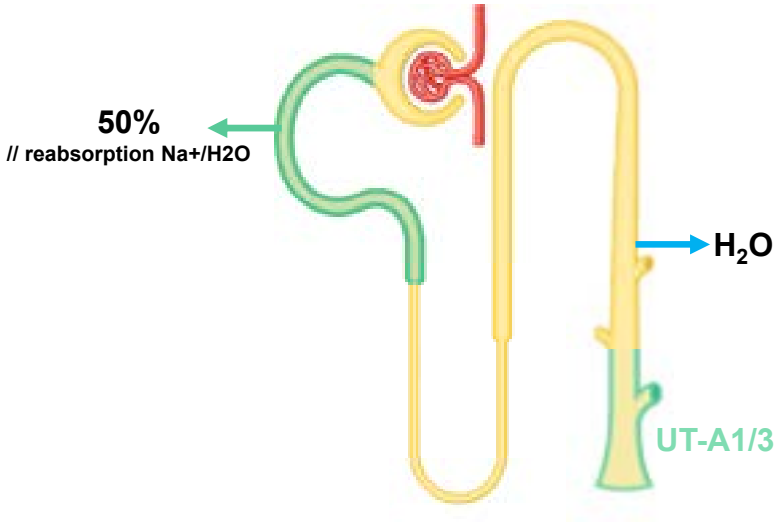
50%
// reabsorption Na+/H2O



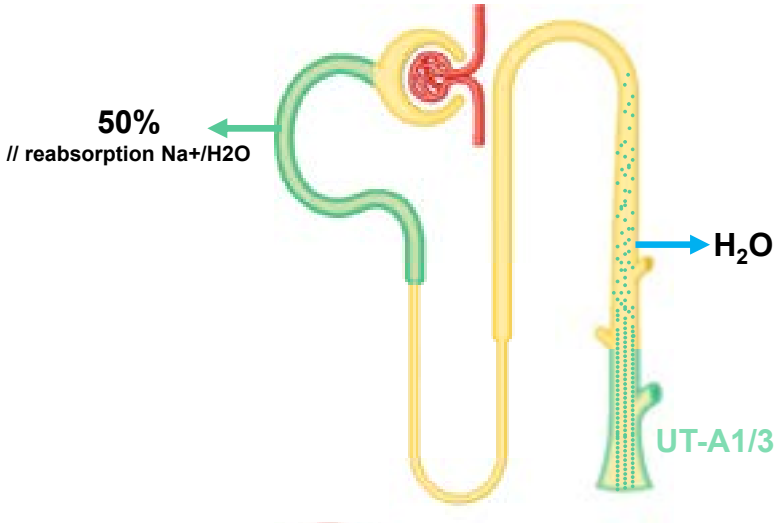
Recyclage de l'urée



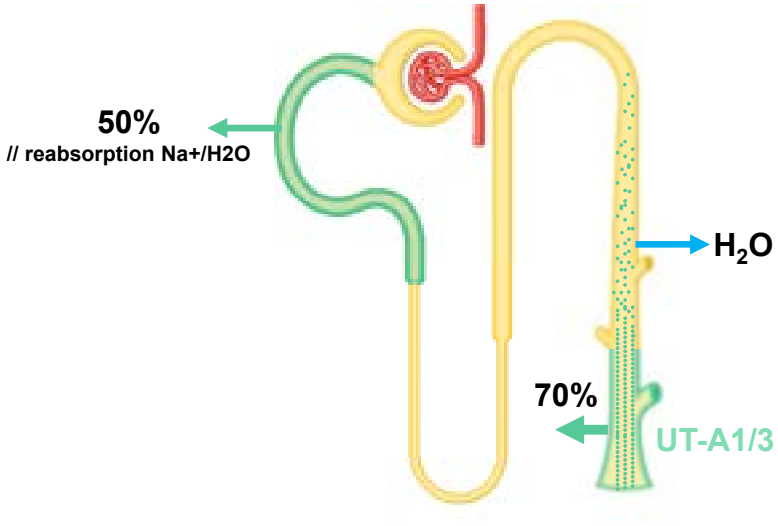
Recyclage de l'urée



Recyclage de l'urée



Recyclage de l'urée



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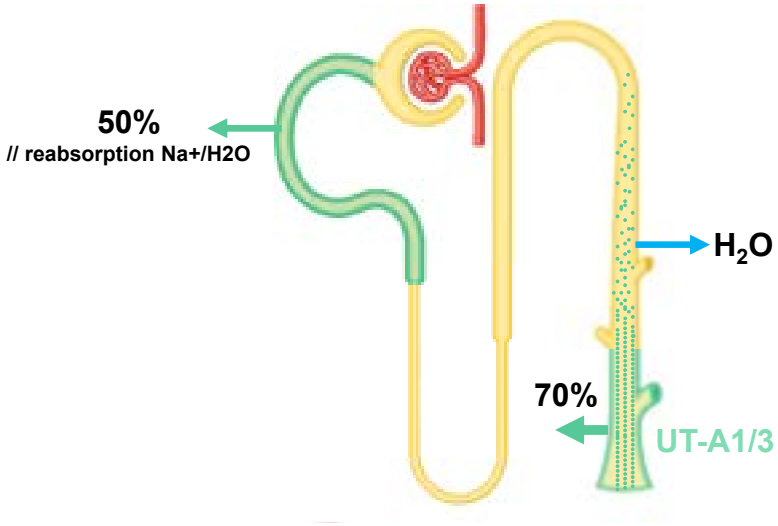

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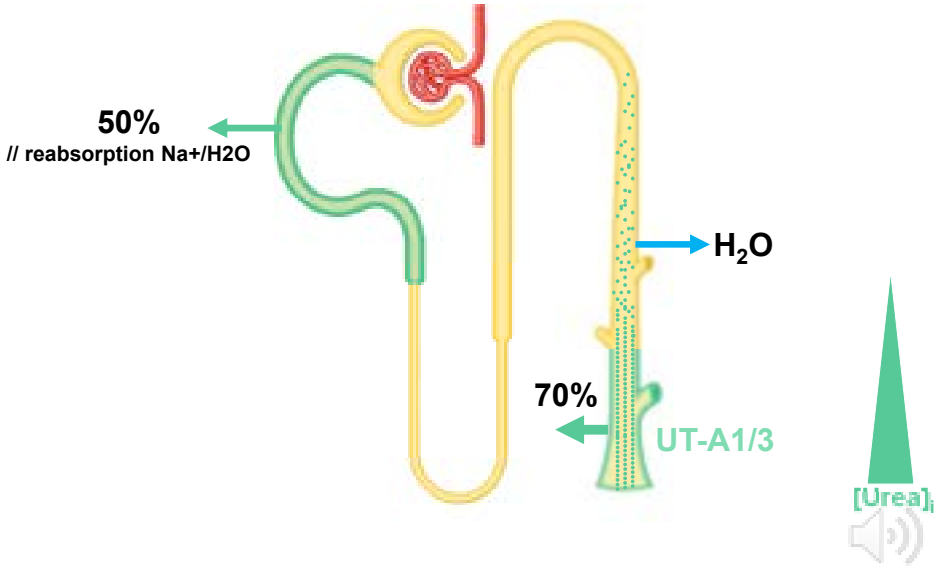

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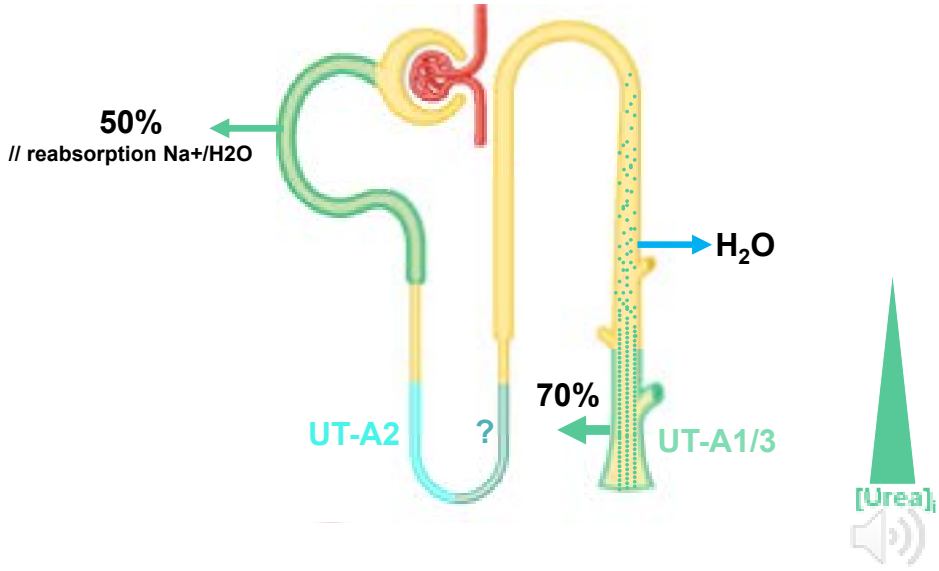
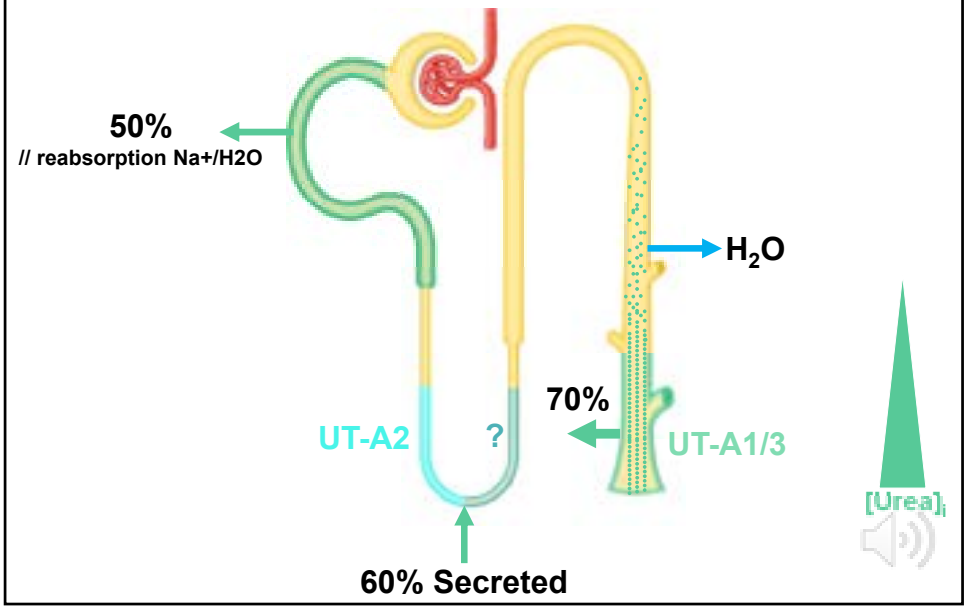
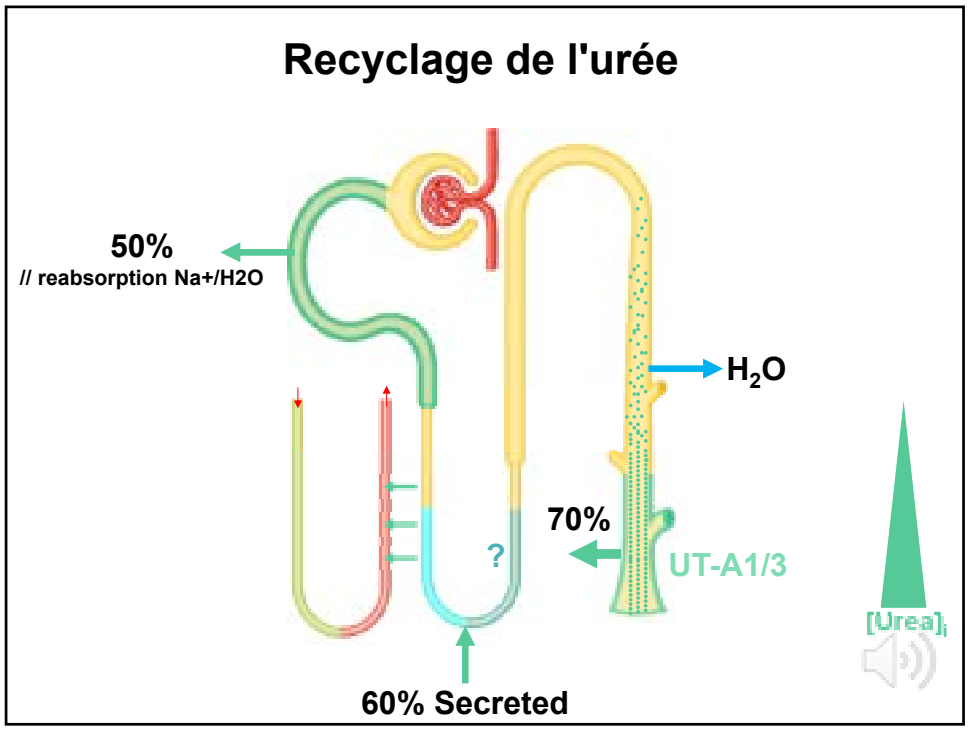
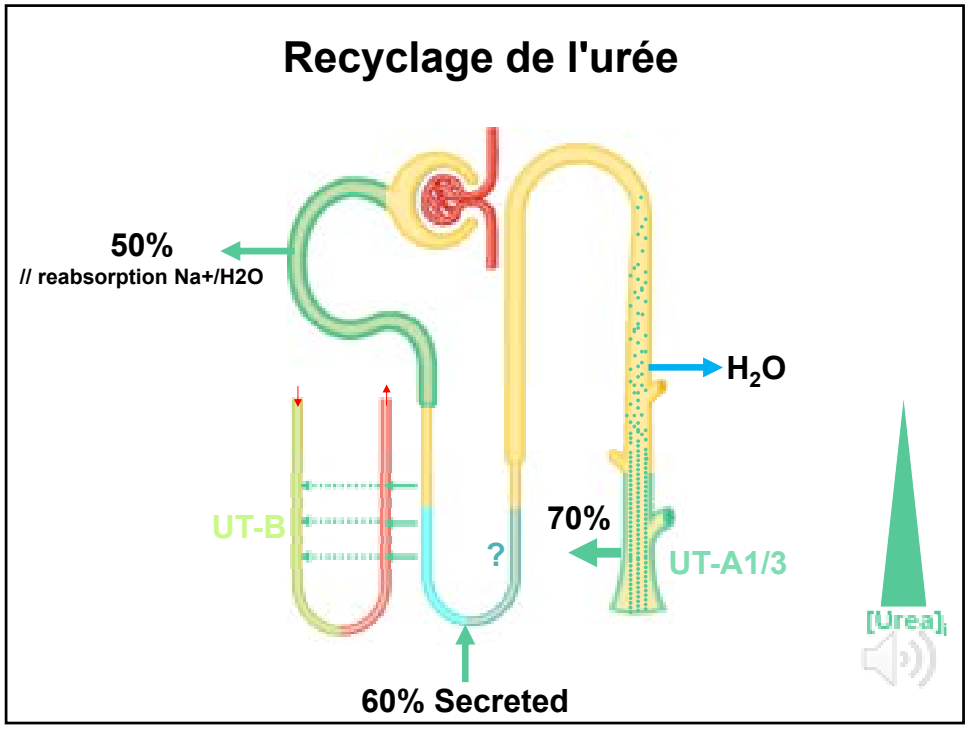


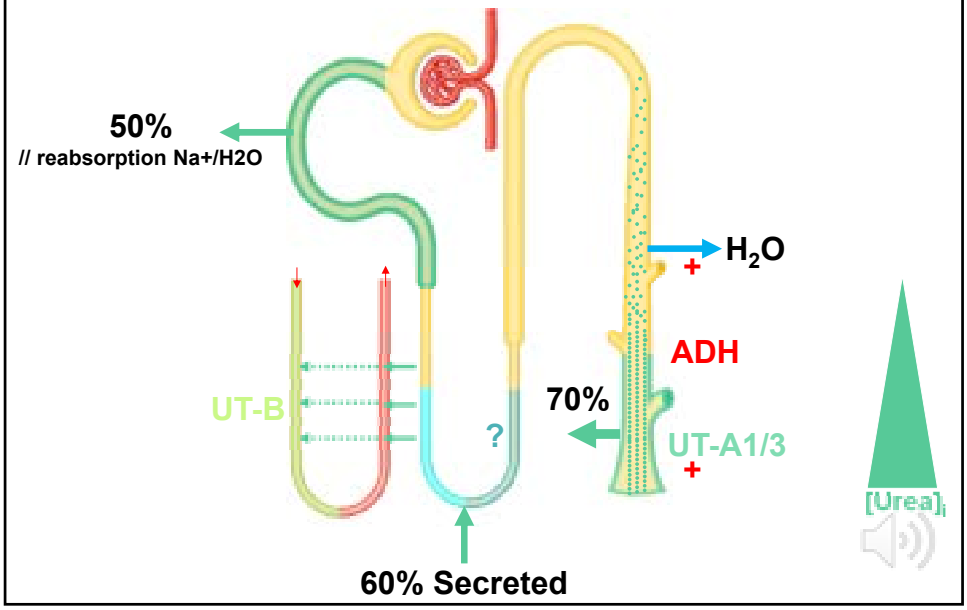
Recyclage de l'urée



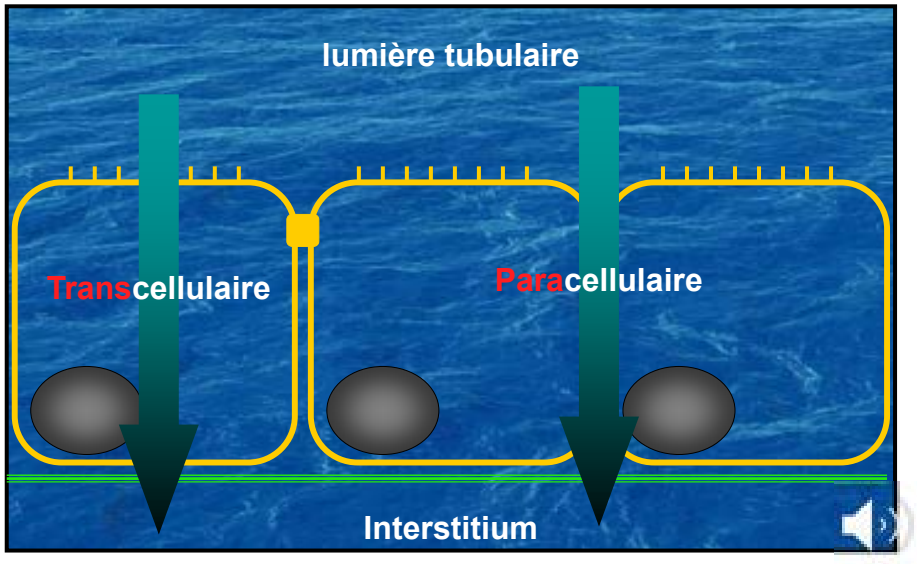

Recyclage de l'urée
50%
// reabsorption Na+/H2O
H_2O
70%
UT-A1/3
?
60% Secreted
[Urea]i


Recyclage de l'urée
50%
// reabsorption Na+/H2O
H_2O
UT-B
70%
UT-A1/3
?
60% Secreted
[Urea]i

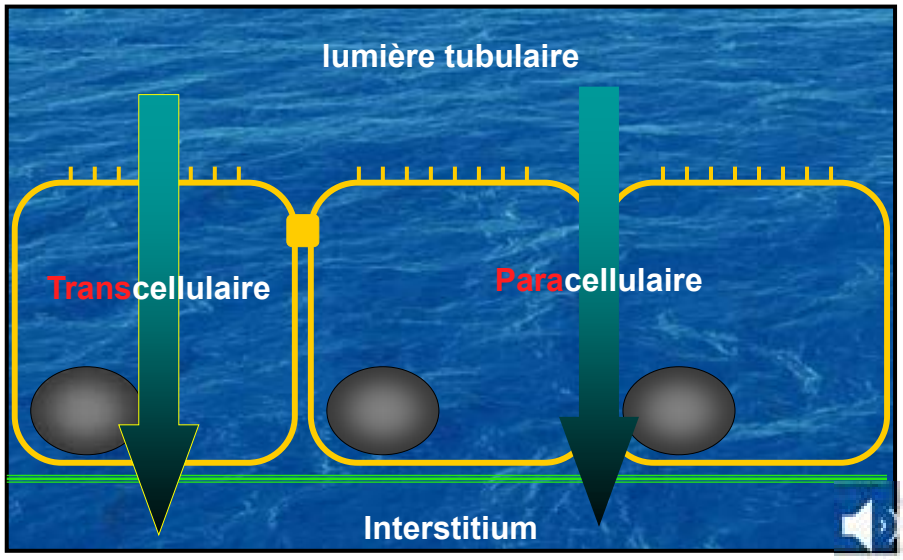
Recyclage de l'urée



Transport trans-épithélial de l'eau

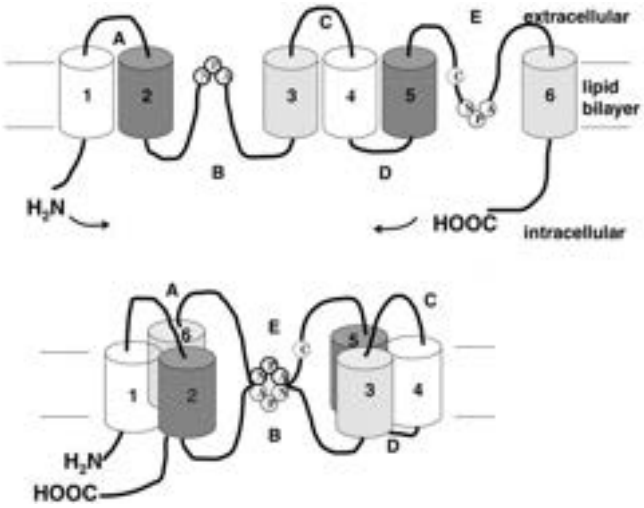


Transport trans-épithélial de l'eau



Voie transcellulaire : Les aquaporines

Les aquaporines : structure

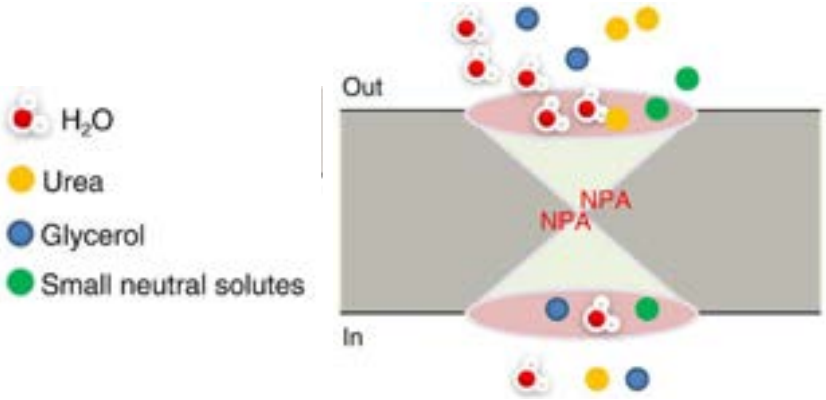


Goodman, *Advances in physiology education*, 2002

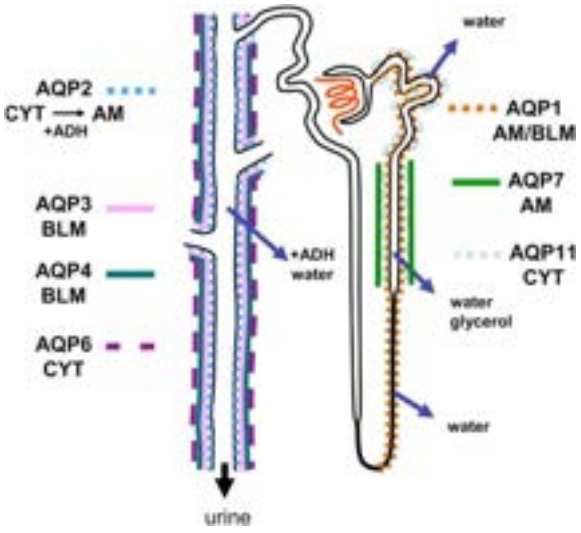
Les aquaporines

13 gènes : AQP 0-12

Classées en fonction de leur perméabilité à l'eau ou à différents solutés



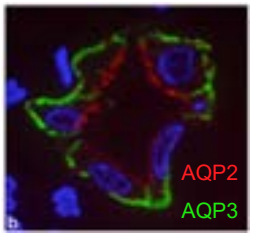
Les aquaporines rénales



AM : apical membrane

BL : basolatera membrane

Cyt : cytosolique

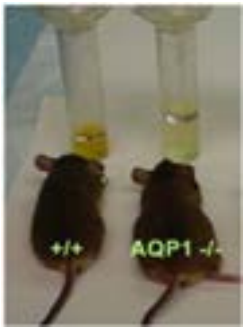


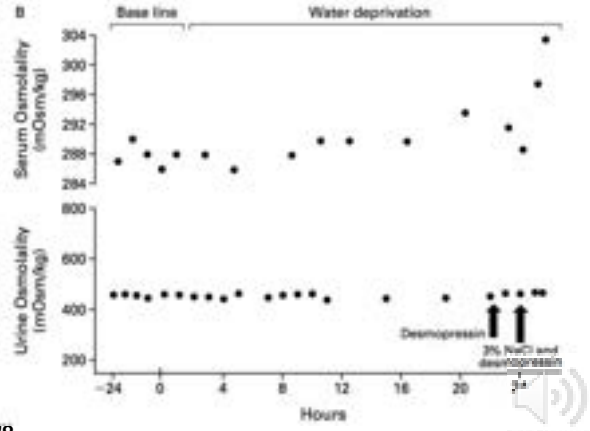
Takata, *Histochem cell biol*, 2008

AQP1 is required for urine concentration

Rein + erythrocytes, épithelium ciliaire et cristallinien, plexus choroïde, épithélium vasculaire pulmonaire

Human *AQP1*-/-
(Colton blood group neg)



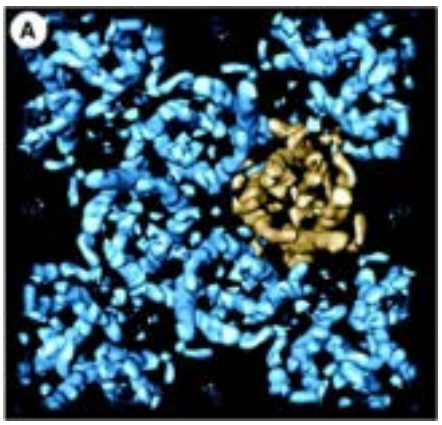


Verkman, *Semin Nephrol*, 2006

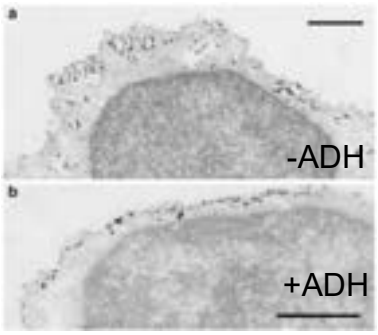
King…Agre, *NEJM2001*

AQP2

Rein + épididyme

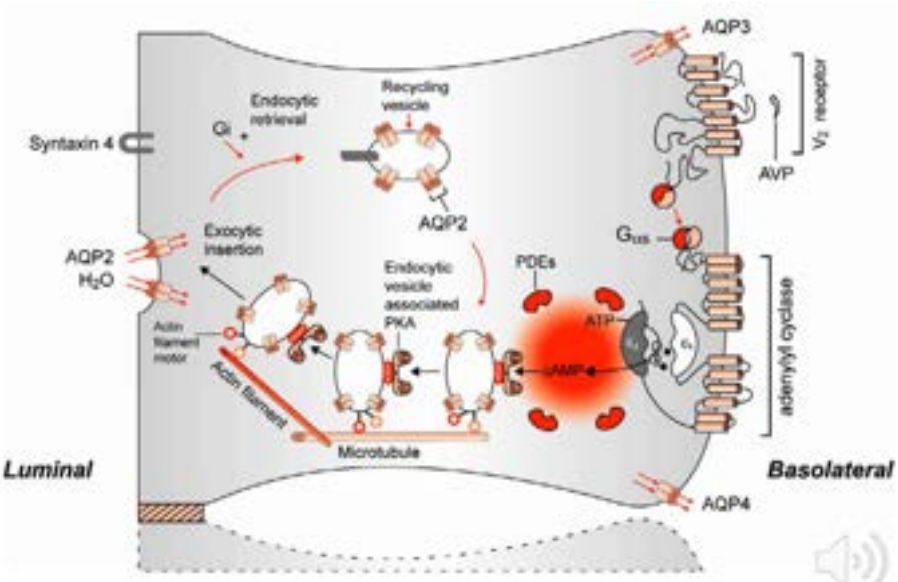


Engel, ***EMBO***, 2000

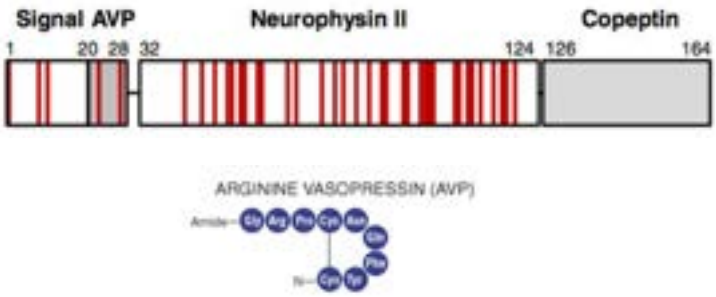


Tube collecteur de rat

Régulation de l'exocytose de l'Aquaporine 2



Hormone anti-diurétique



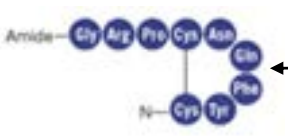
- V1aR : largement exprimé, effets vasopresseurs
- V1bR : hypophyse et ilots pancréatiques,
  favorise la libération d'ACTH et d' insuline
- V2 : rein, homéostasie hydrique, endothelium

Sécrétion d'ADH adaptée

SIAD eutopique

Hypertonicité
Hypovolémie efficace sévère

Carence en cortisol
Médicaments
Pathologie pulmonaire
Pathologie cérébrale
Douleur



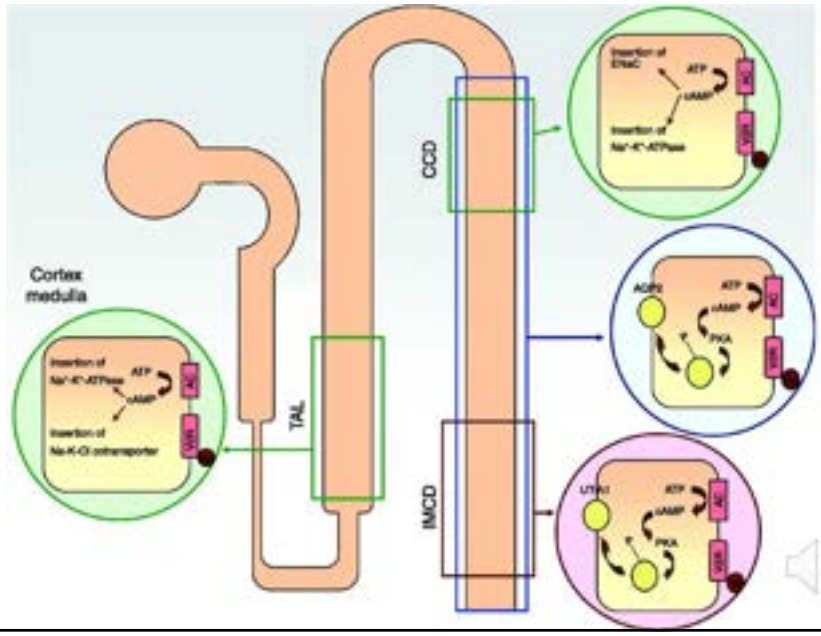
Réabsorption de l'eau (V2R)

Sécrétion vWF (V2R)

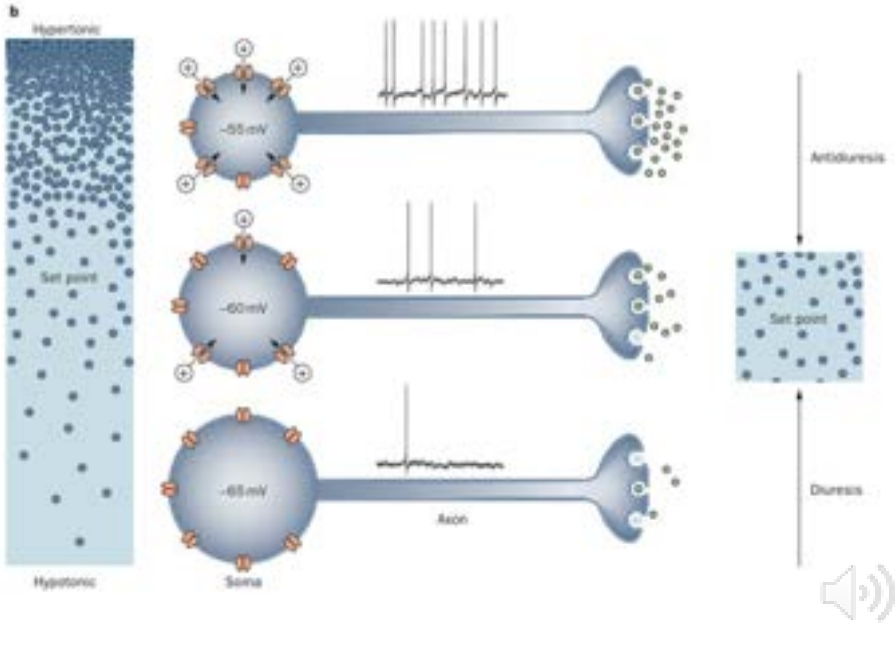
Vasoconstriction (V1aR)

SIAD ectopique

Effets rénaux de l'ADH



Control of vasopressin release



Control of vasopressin release

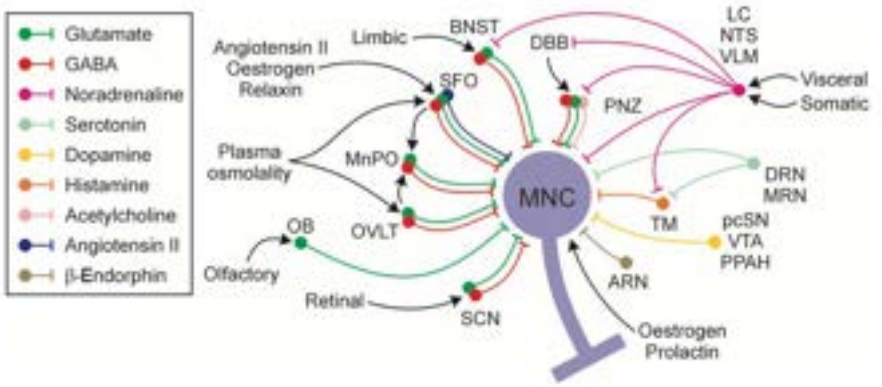
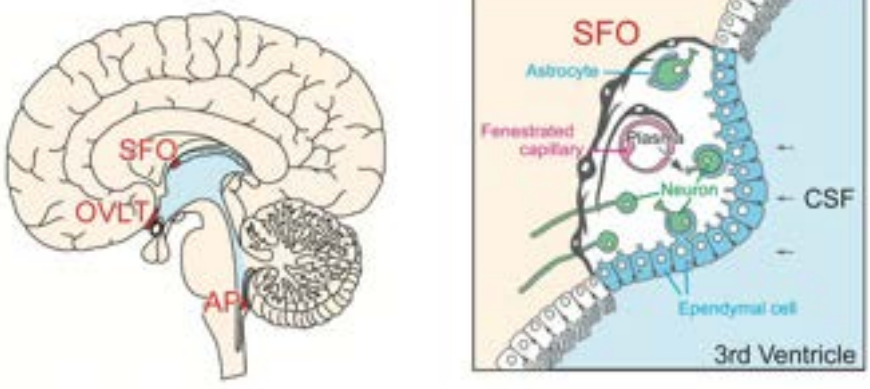


Figure 2 Schematic representation of some of the major peripheral and afferent inputs to magnocellular neurosecretory cells. See text for details of the physiological functions of each of the inputs. Abbreviations: ARN: arcuate nucleus; BNST: bed nucleus of the stria terminalis; DBB: diagonal band of Broca; DRN: dorsal raphe nucleus; LC: locus coeruleus; MNC: magnocellular neurosecretory cell (magnocellular neuron); MnPO: median preoptic nucleus; MRN: median raphe nucleus; NTS: nucleus tractus solitarius; OB: olfactory bulb; OVLT: organum vasculosum of the lamina terminalis; pcSN: pars compacta of the substantia nigra; PNZ: perinuclear zone; PPAH: preoptic periventricular /anterior hypothalamic region; SCN: suprachiasmatic nucleus; SFO: subfornical organ; TM: tuberomammillary nucleus; VLM: ventrolateral medulla; VT: ventral tegmental area. Reproduced, with permission, from [57].

Brown. Comp Physiol 2016

Rôle de l'organe subfornical et de l'organe vasculaire de la lame terminale dans l'homéostasie hydrique



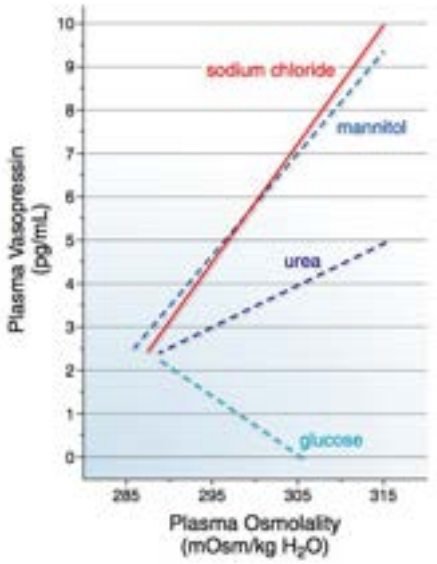
RESEARCH ARTICLE

Adipsic hypernatremia without hypothalamic lesions accompanied by autoantibodies to subfornical organ

Takeshi Y. Hiyama[1,2*]; Akari N. Utsunomiya[3*]; Masahito Matsumoto[1]; Akihiro Fujikawa[1]; Chia-Hao Lin[1]; Keiichi Hara[4]; Reiko Kagawa[3]; Satoshi Okada[3]; Masao Kobayashi[3]; Mayumi Ishikawa[3]; Makoto Aruzo[3]; Hideo Cho[3]; Shinobu Takayasu[3]; Takeshi Nigawara[3]; Makoto Daimon[3]; Tomohiko Sato[1]; Kiminori Terui[1]; Etsuro Ito[1]; Masaharu Noda[1,2]

Hiyama Neuroscience Research 2016
Hiyama, Brain Pathology, 2016

What do brain osmoreceptors respond to ?

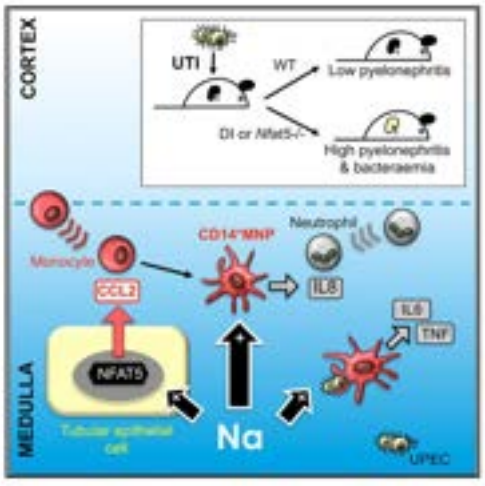


Verbalis, J Am Soc Nephrol, 2007
Zerbe, Am J Physiol, 1983

Beyond water reabsorption...

Cell

Renal Sodium Gradient Orchestrates a Dynamic Antibacterial Defense Zone



Berry, Cell 2017