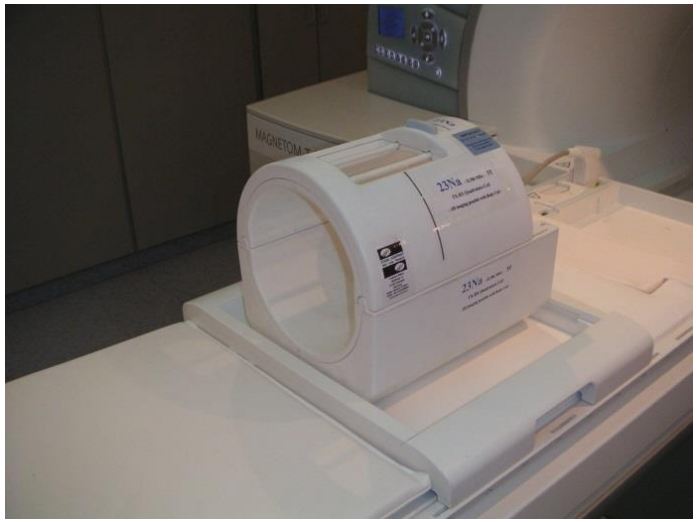
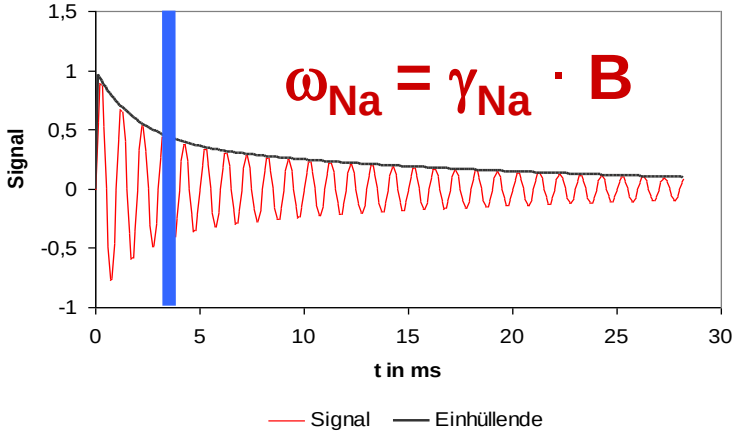
Na-MRI can help us find the salt



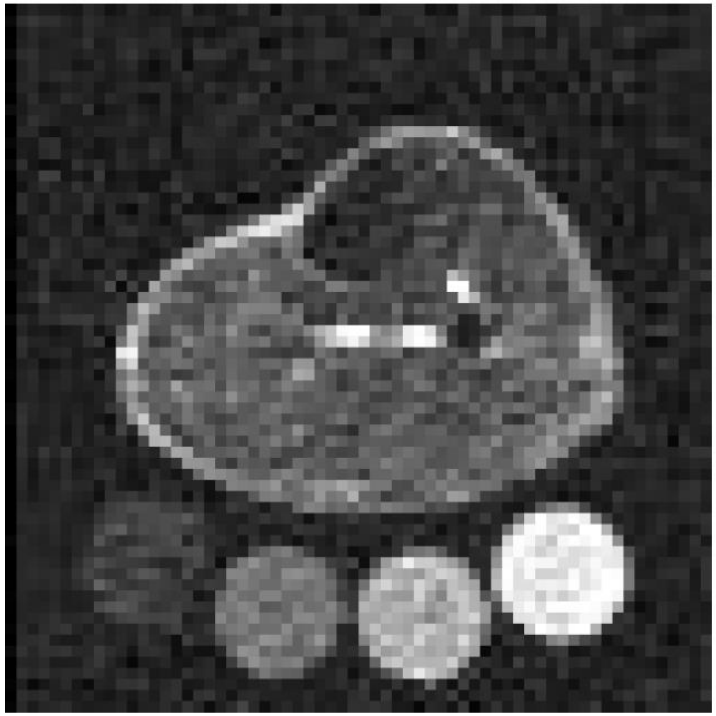
TE = 2…3 ms



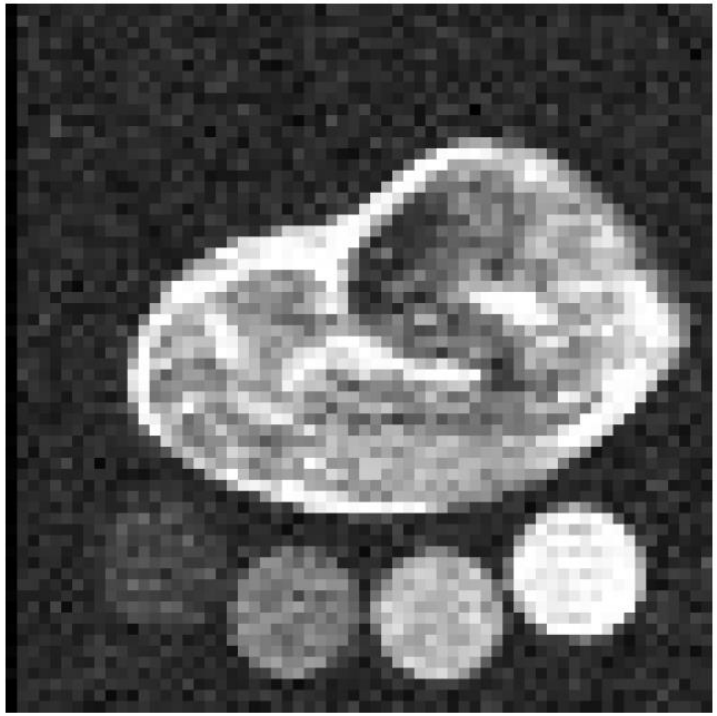
Sodium research – quo vadis?

23Na MRI of tissue Na^+ content

Man, 24 y, healthy



Man, 85 y, hypertension



Hypertension, 2012 Hypertension, 2013 Kidney International 2015

Na^+ storage and cardiovascular outcome

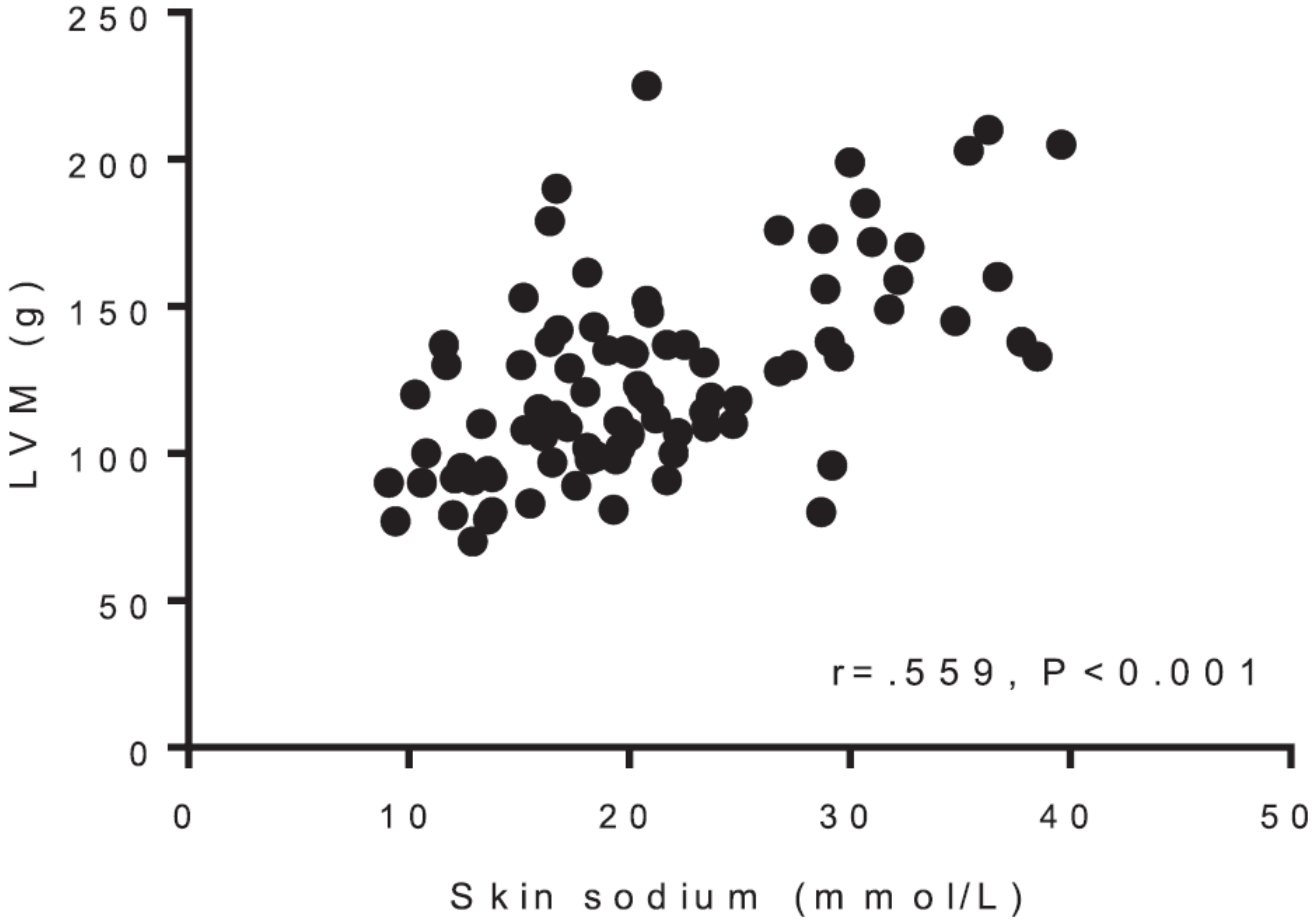
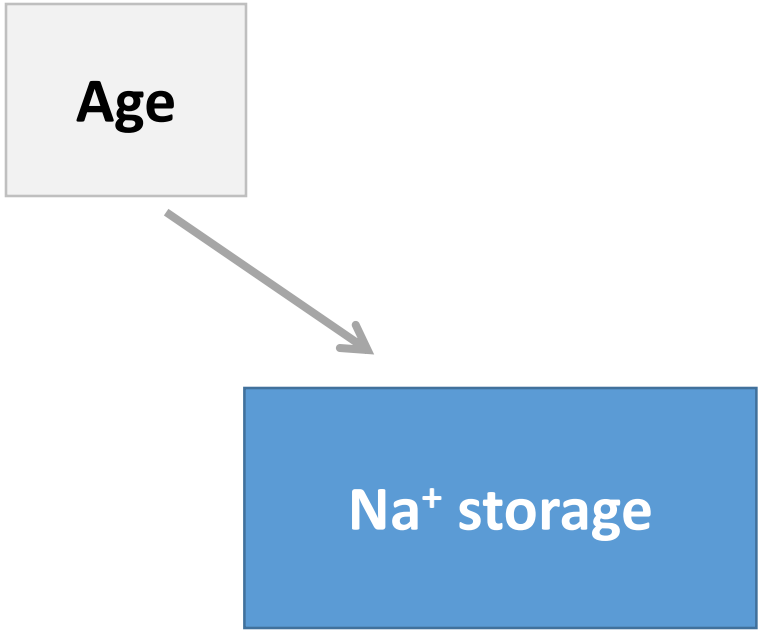


Figure 4. Relationship between skin sodium content and LVM.

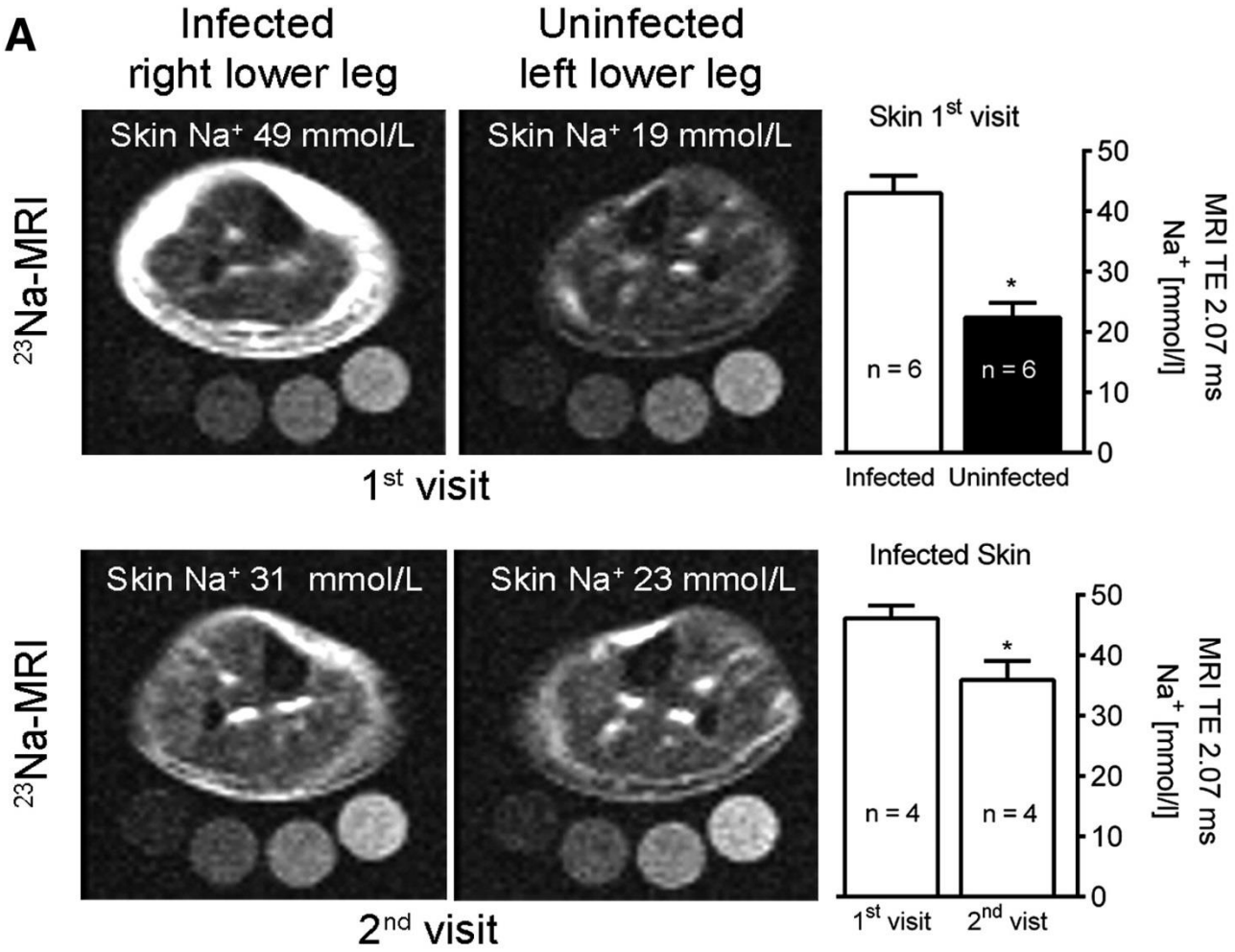
J Am Soc Nephrol. 2017



Why would we kill ourselves?

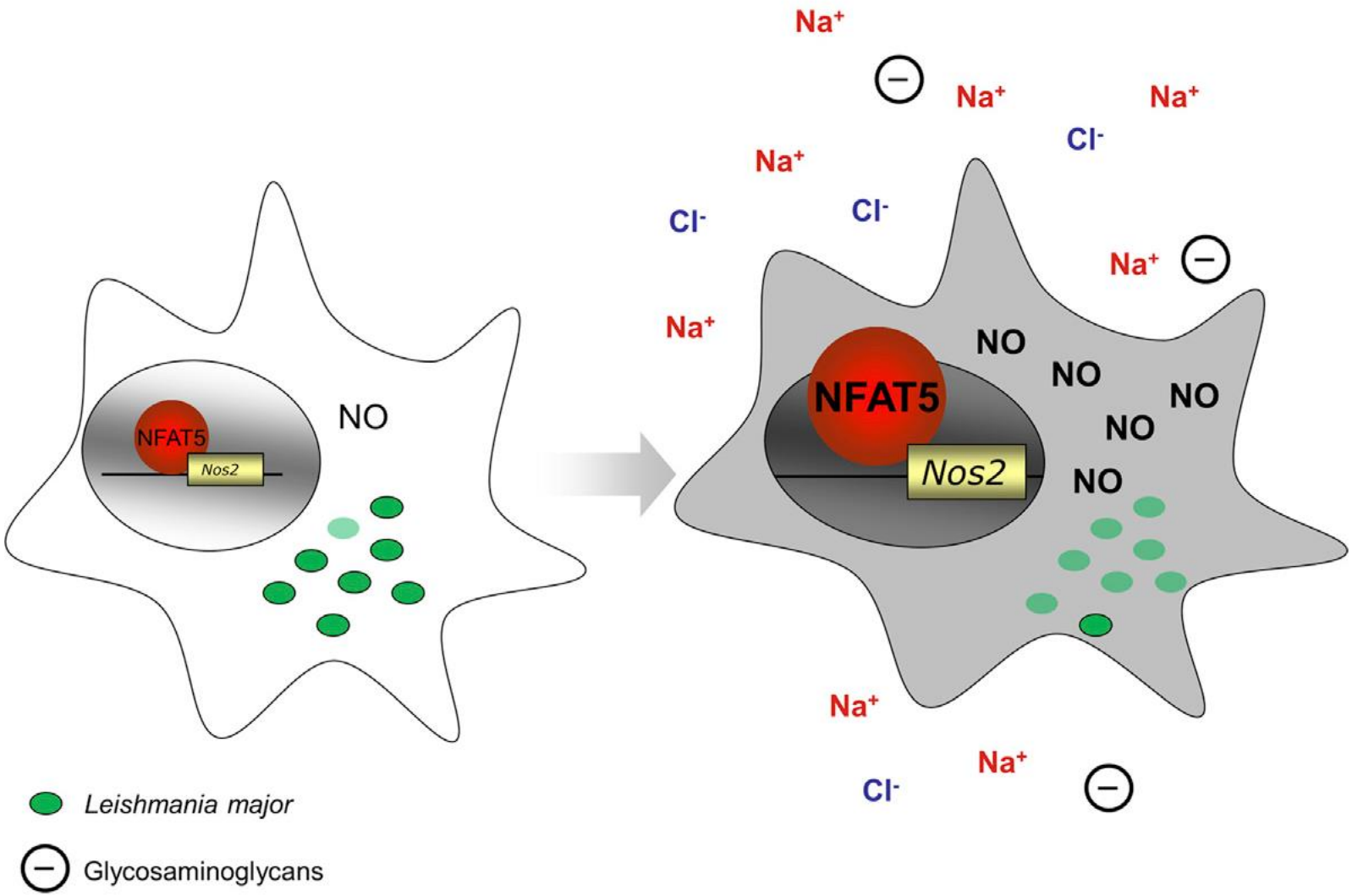
ENCEPHALOMYELITIS
HYPERTENSION
CVD

Salt barrier formation to ward off infections



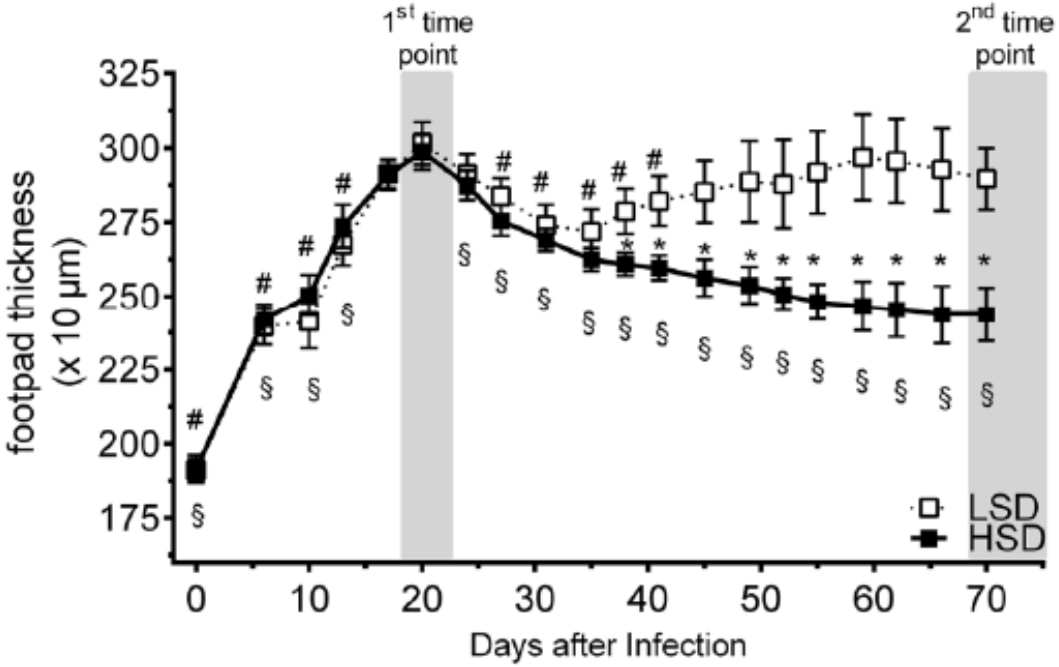
Cell Metabolism, 2015

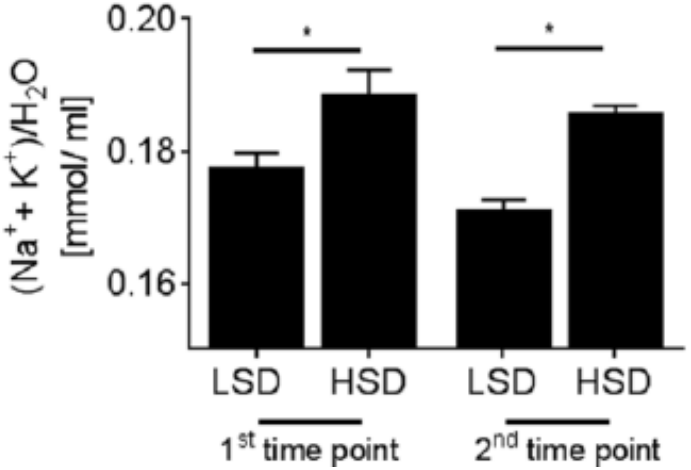
Salt barrier formation to ward off infections

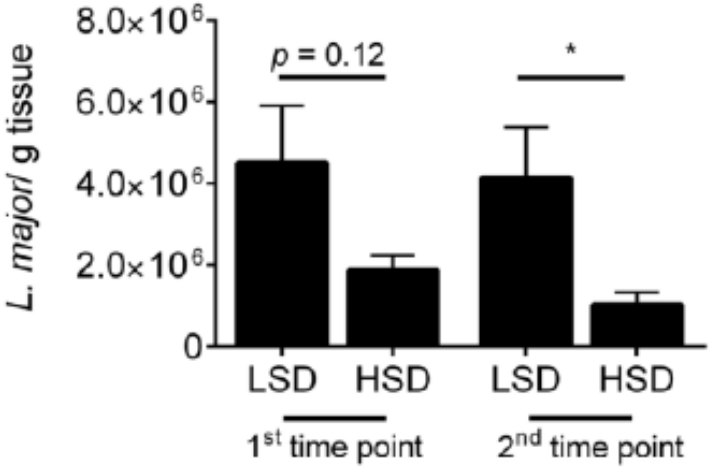


Cell Metabolism, 2015

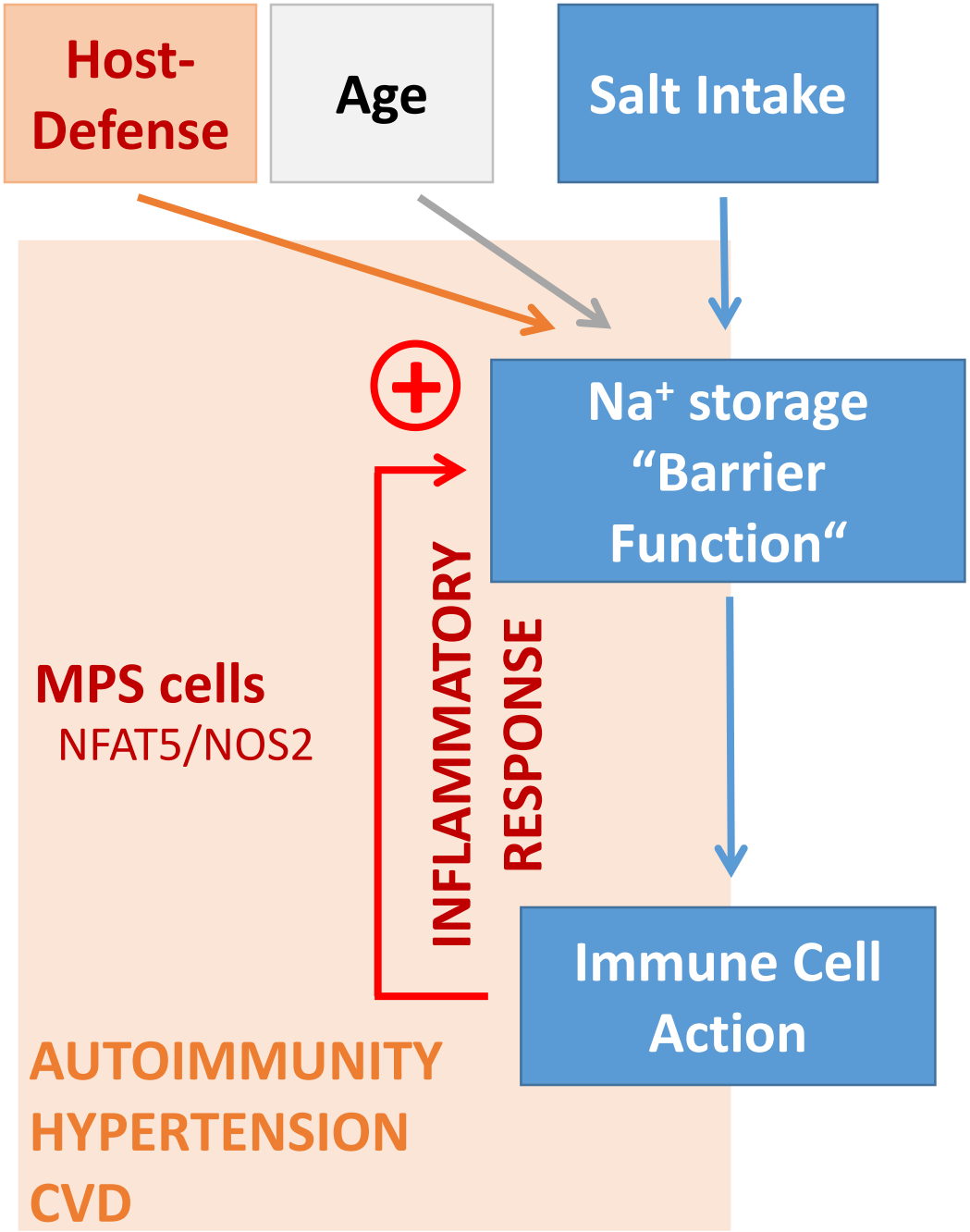
Salt barrier formation to ward off infections







Cell Metabolism, 2015


Host-Defense
Age
Salt Intake
Na+ storage "Barrier Function"
INFLAMMATORY RESPONSE
MPS cells
NFAT5/NOS2
Immune Cell Action
AUTOIMMUNITY
HYPERTENSION
CVD

Autoimmunity – a mislead host defense.

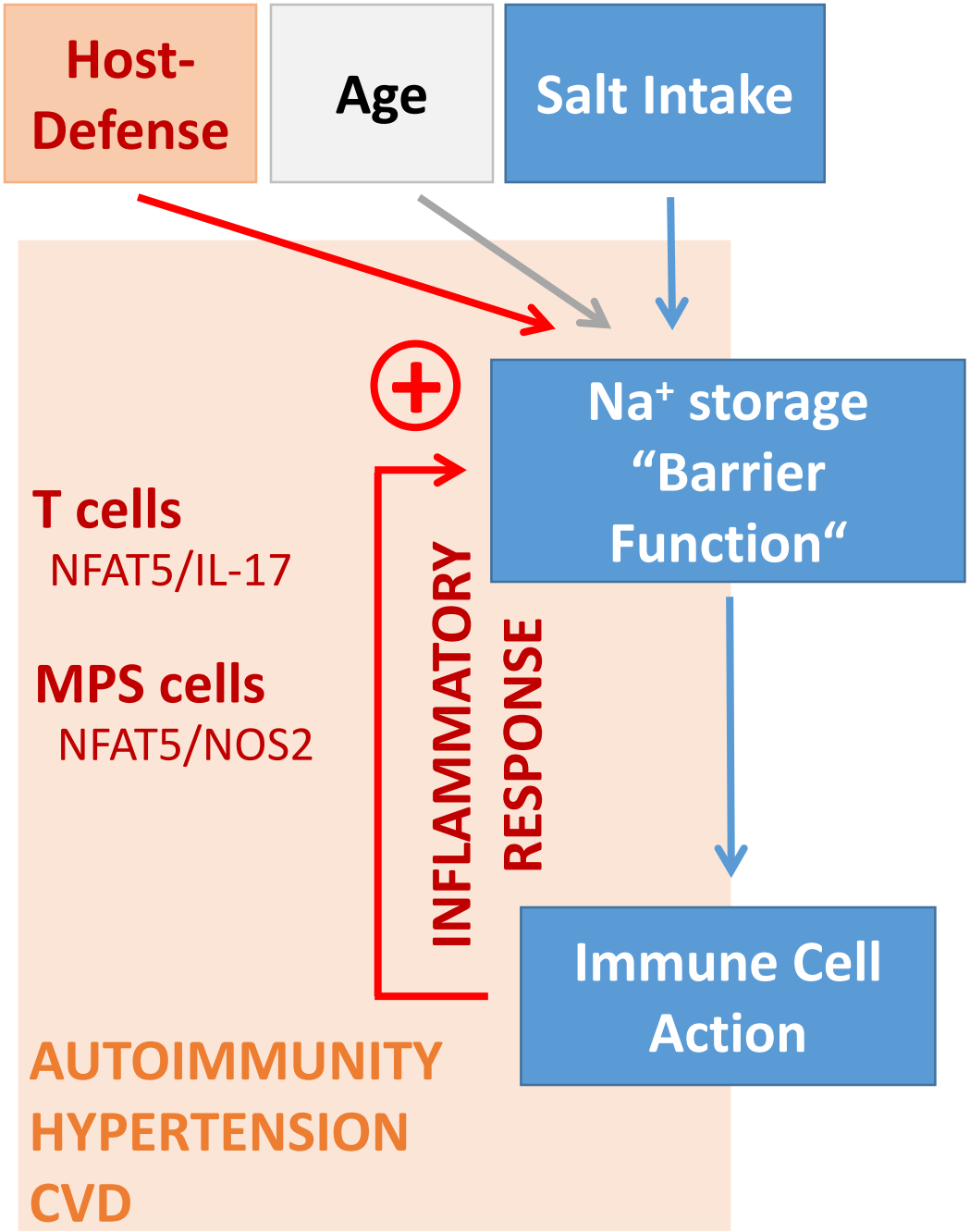
LETTER

doi:10.1038/nature11868

Sodium chloride drives autoimmune disease by the induction of pathogenic T_H17 cells

Markus Kleinewietfeld[1,2], Arndt Manzel[3,4], Jens Titze[5,6], Heda Kvakan[7,8], Nir Yosef[2], Ralf A. Linker[3], Dominik N. Muller[7,9]* & David A. Hafler[1,2]*

Nature, 2013


Host-Defense
Age
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AUTOIMMUNITY
HYPERTENSION
CVD

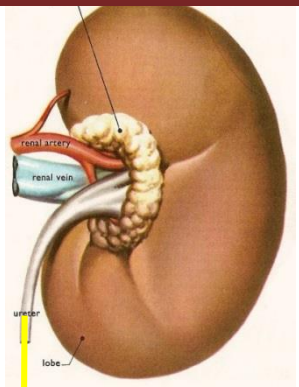
Local control of salt metabolism by homeostatic immune cells

What I have learned at school

Skin

Blood

Kidney



Clearance

Equilibrium

Na^+

Cl^-

Urine

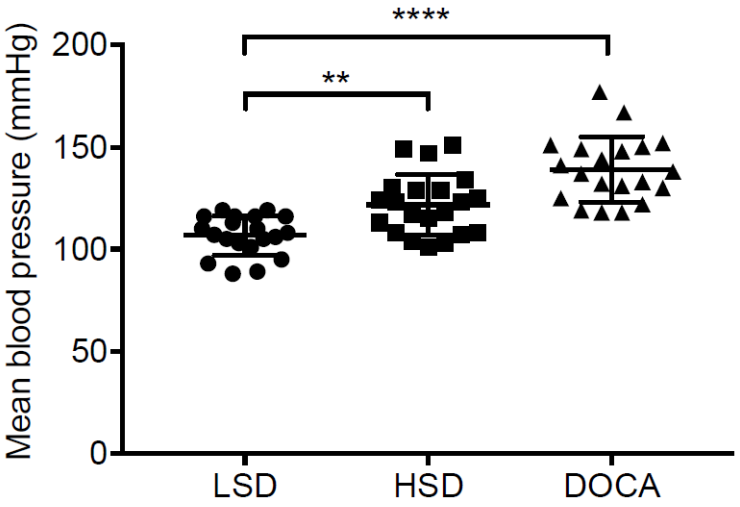
Skin sodium storage in guinea pigs and rats

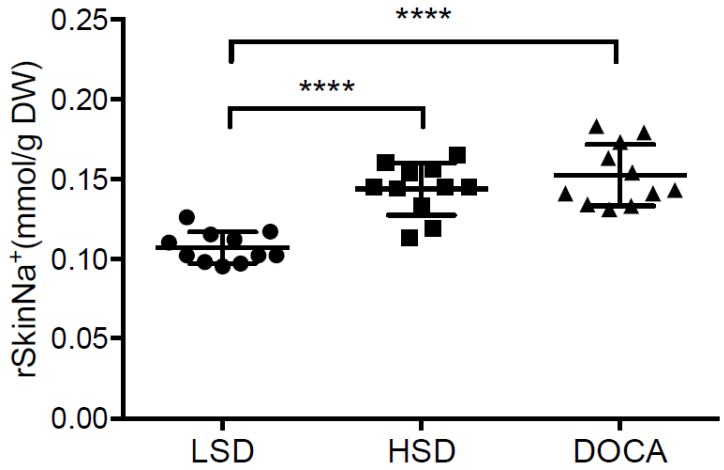
Stratum Corneum	30 mmol/kg
Stratum Granulosum	160 mmol/kg
Stratum Spinosum	374 mmol/kg
Stratum Germinativum	313 mmol/kg
Dermis	530 mmol/kg

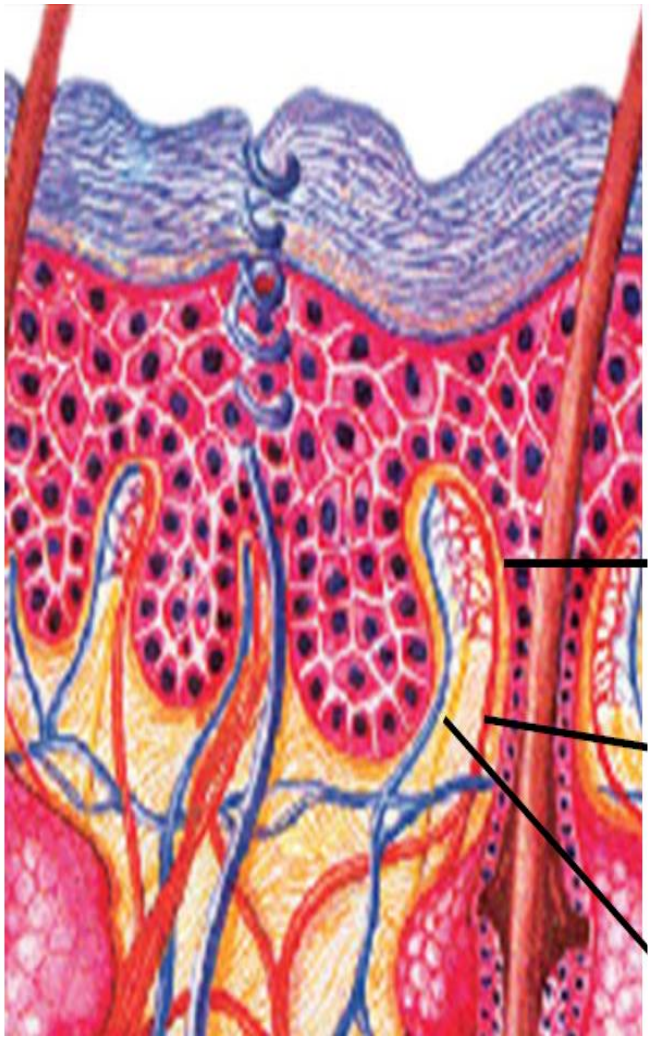
J Investig Dermatol 79(3):167–169, 1982

Pflugers Arch - Eur J Physiol 467:551–558, 2015

Skin sodium storage and hypertension in rats

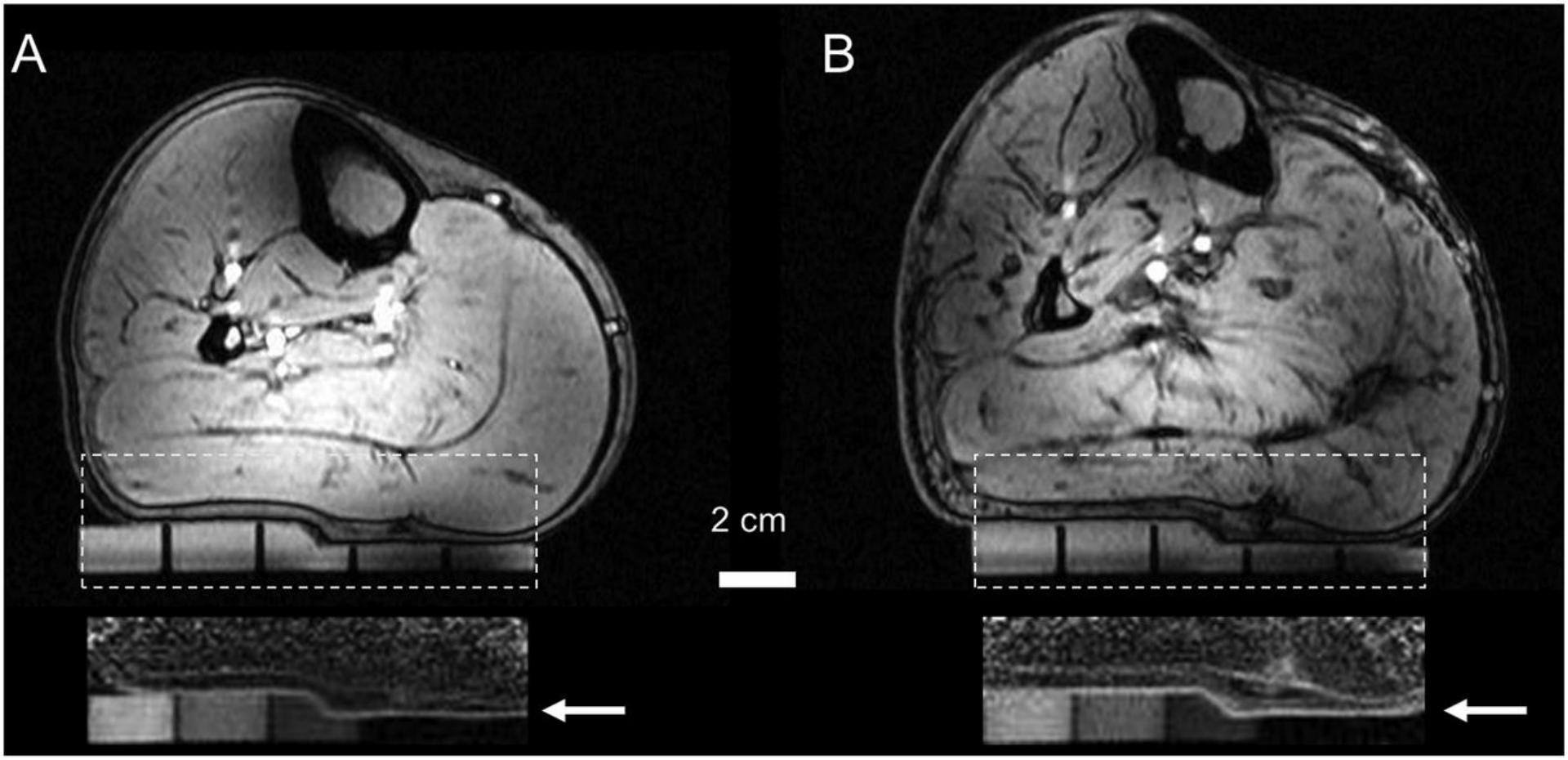






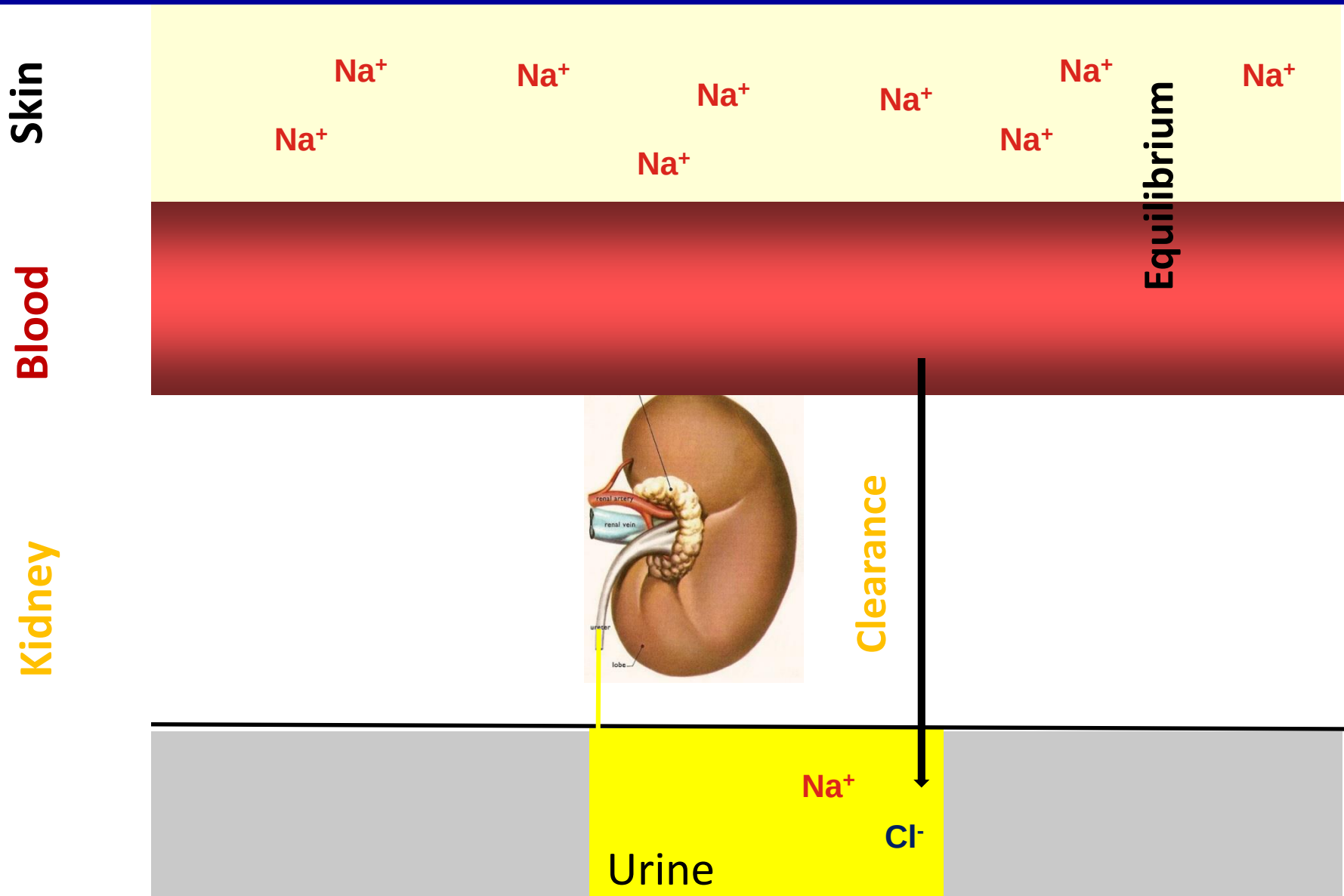
Nikpey et al, Hypertension, 2017

7T Na-MRI can help us find the salt much better

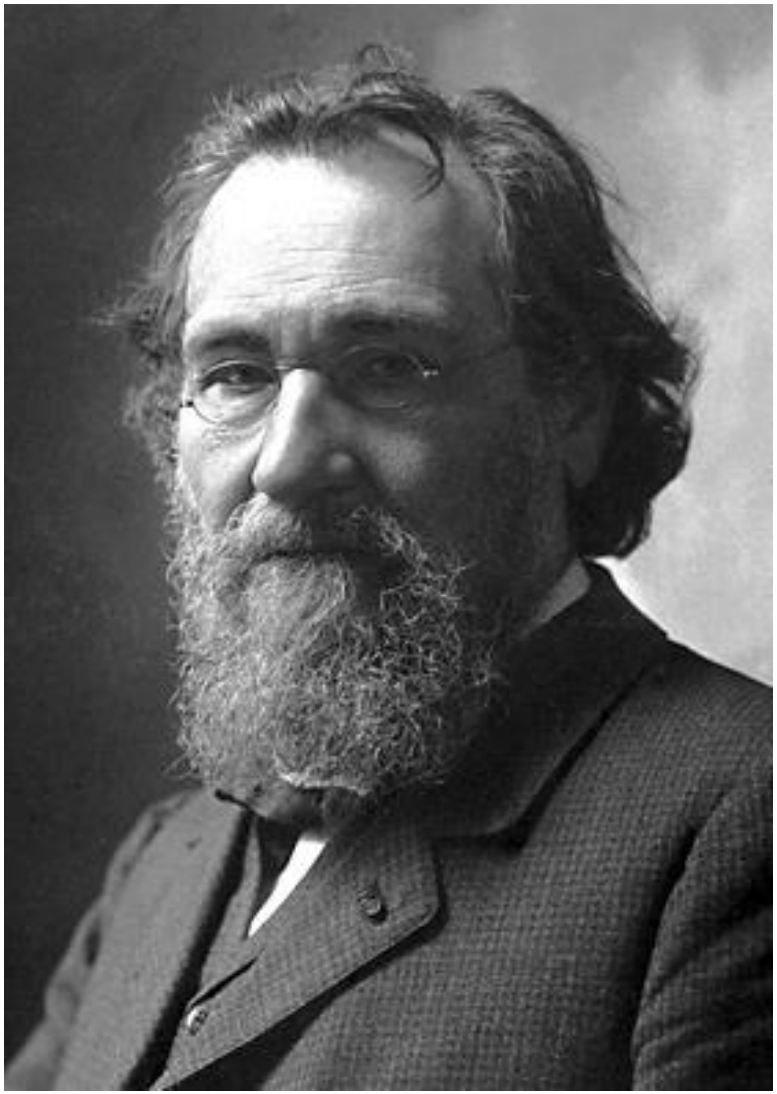


NMR in Biomed 28: 54–62, 2015

The problem with what I have learned at school



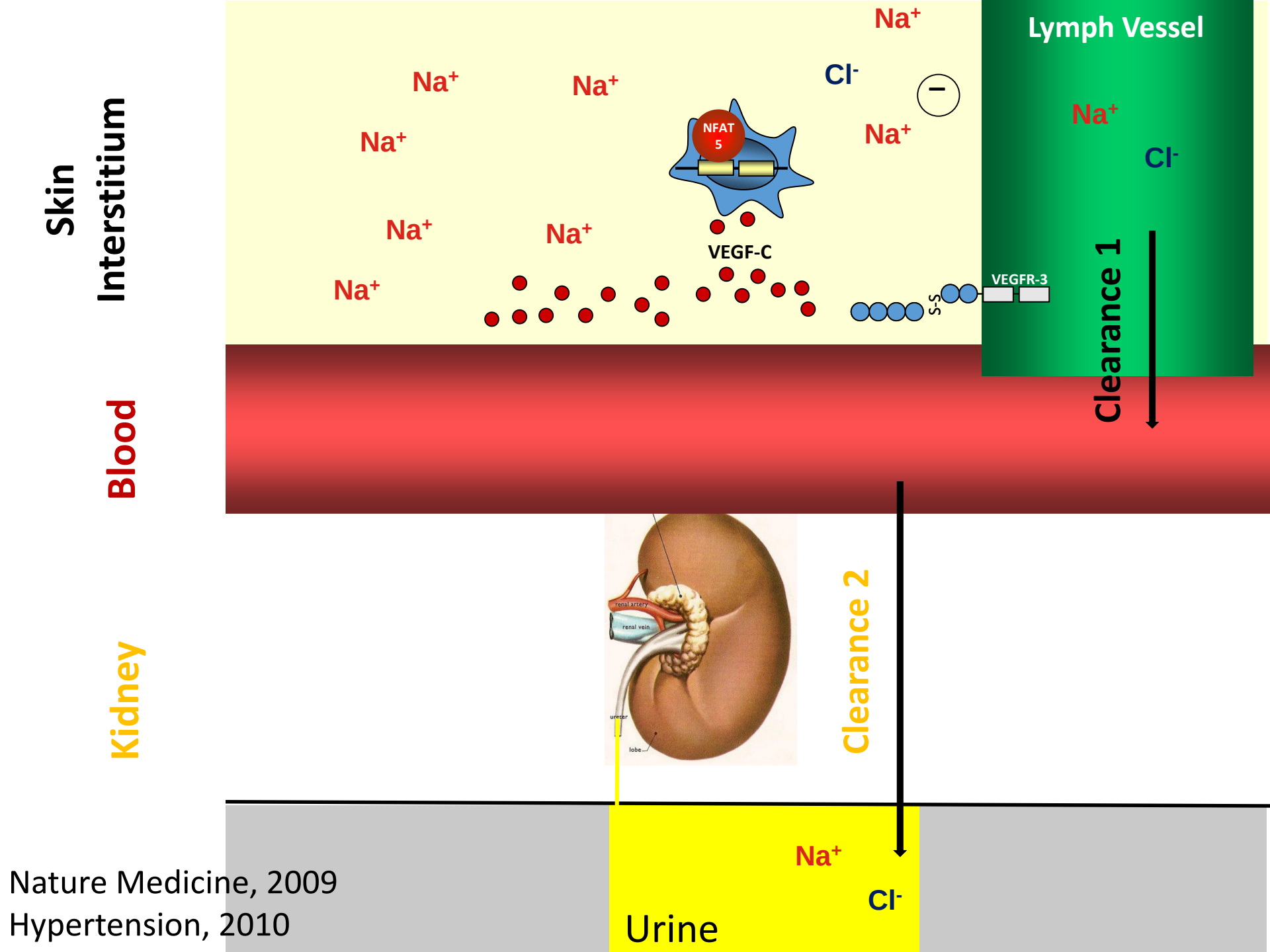
What is immune function?



Physiological inflammation:

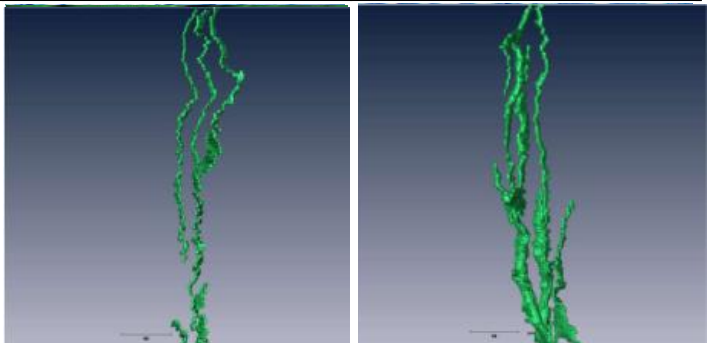
Phagocytes are engaged in essentially the same process — clearing the body of dysfunctional elements (endogenous ‘other’) and unwanted external intruders.

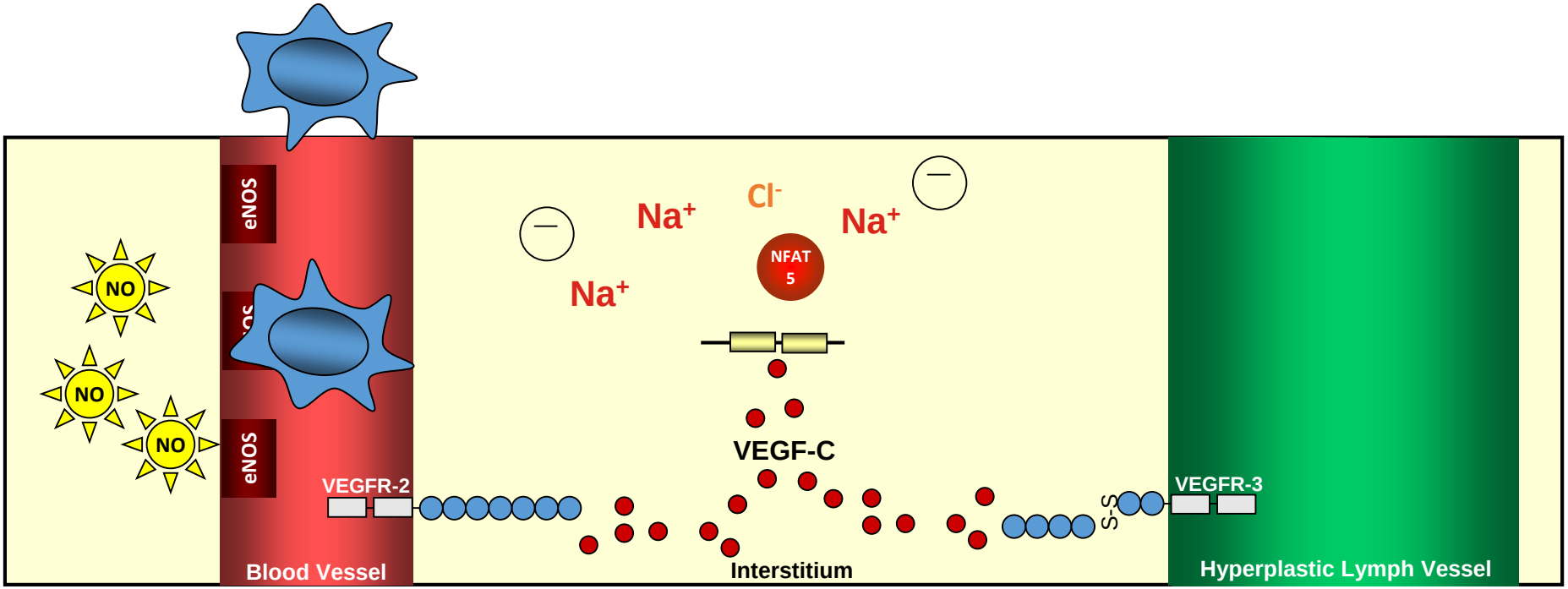
Tauber AI.
Nat Rev Mol Cell Biol. 2003 Nov;4(11):897-901



Nature Medicine, 2009
Hypertension, 2010

	LSD	HSD
Blood: [$Na^+ + K^+$]	143 ± 2 mM	145 ± 2 mM
Skin: [$Na^+ + K^+$]	177 ± 8 mM	191 ± 7 * mM

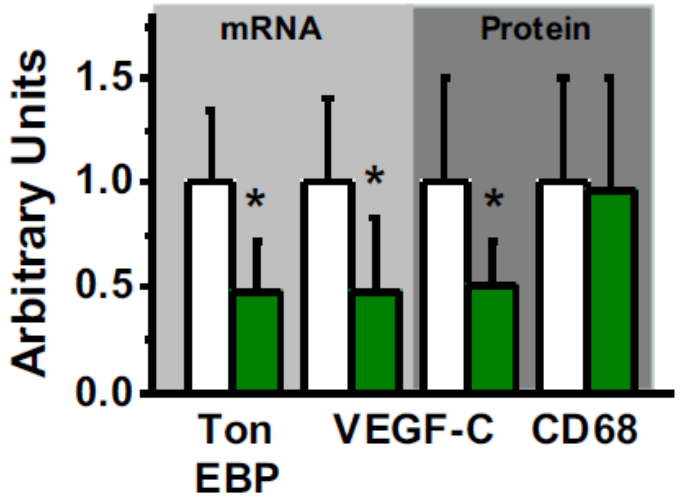




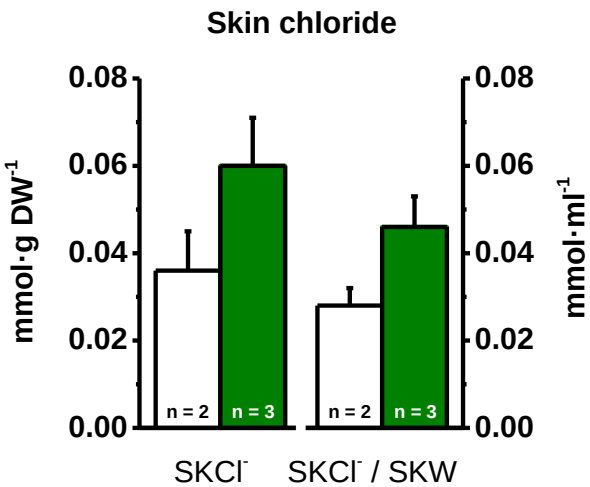
Nature Med, 2009 Hypertension, 2010

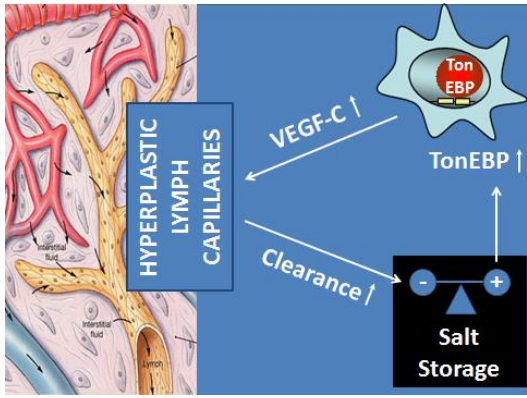
Macrophages and skin electrolytes and pressure

A

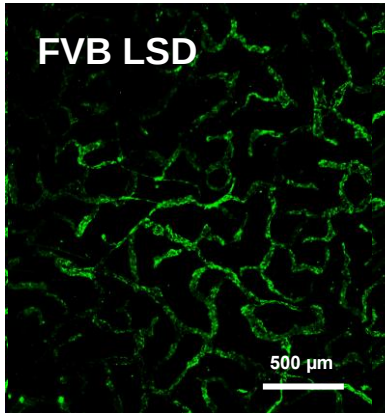


C

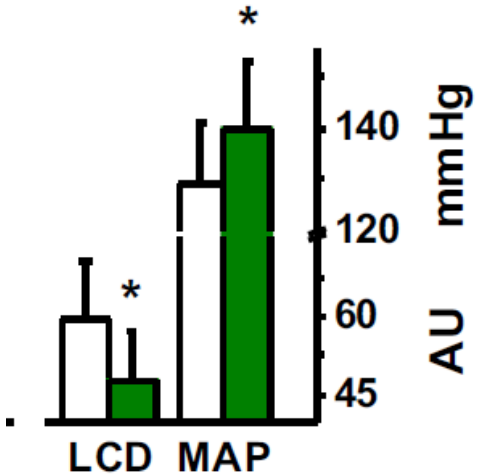




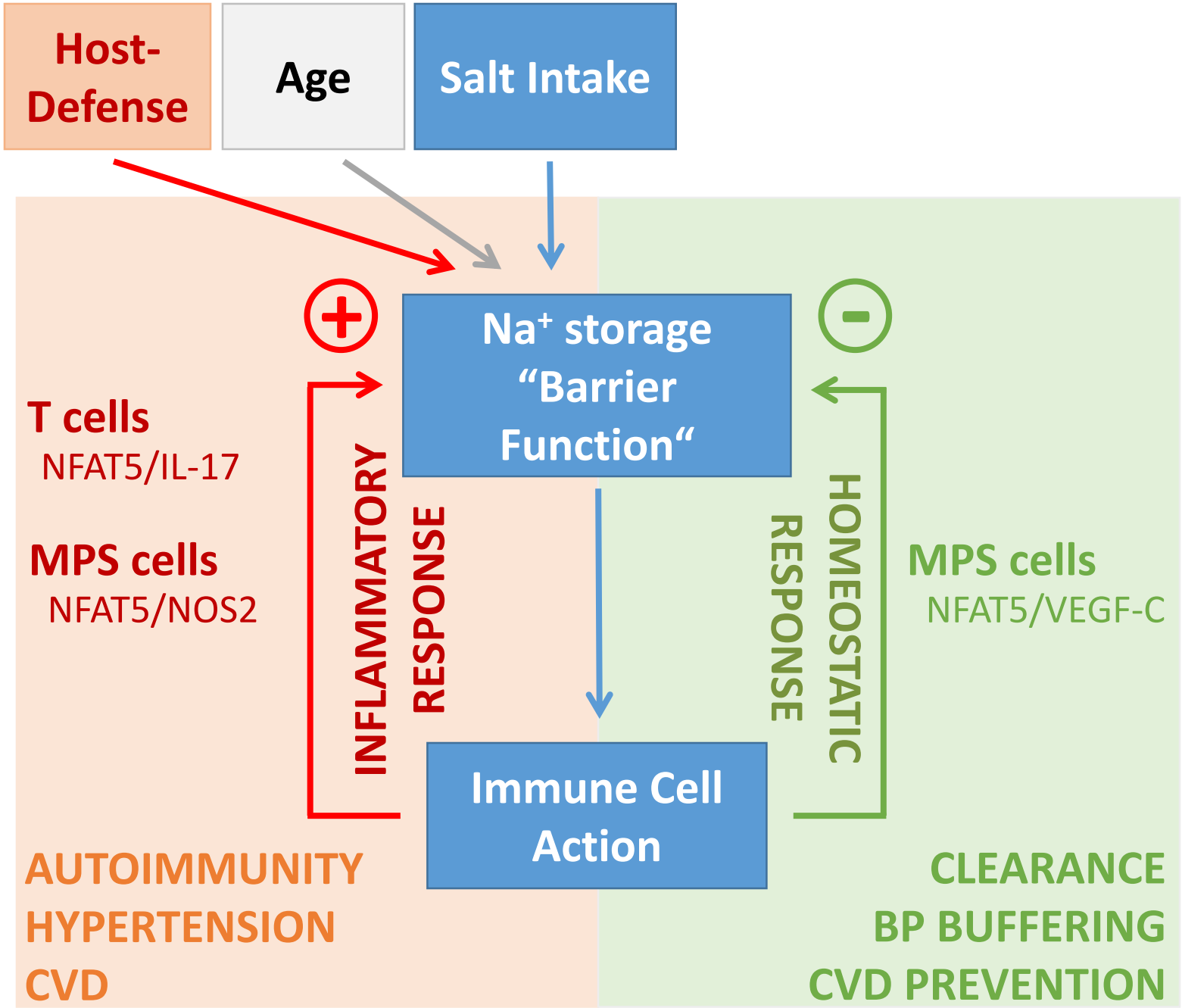
B



D



J Clin Invest, 2013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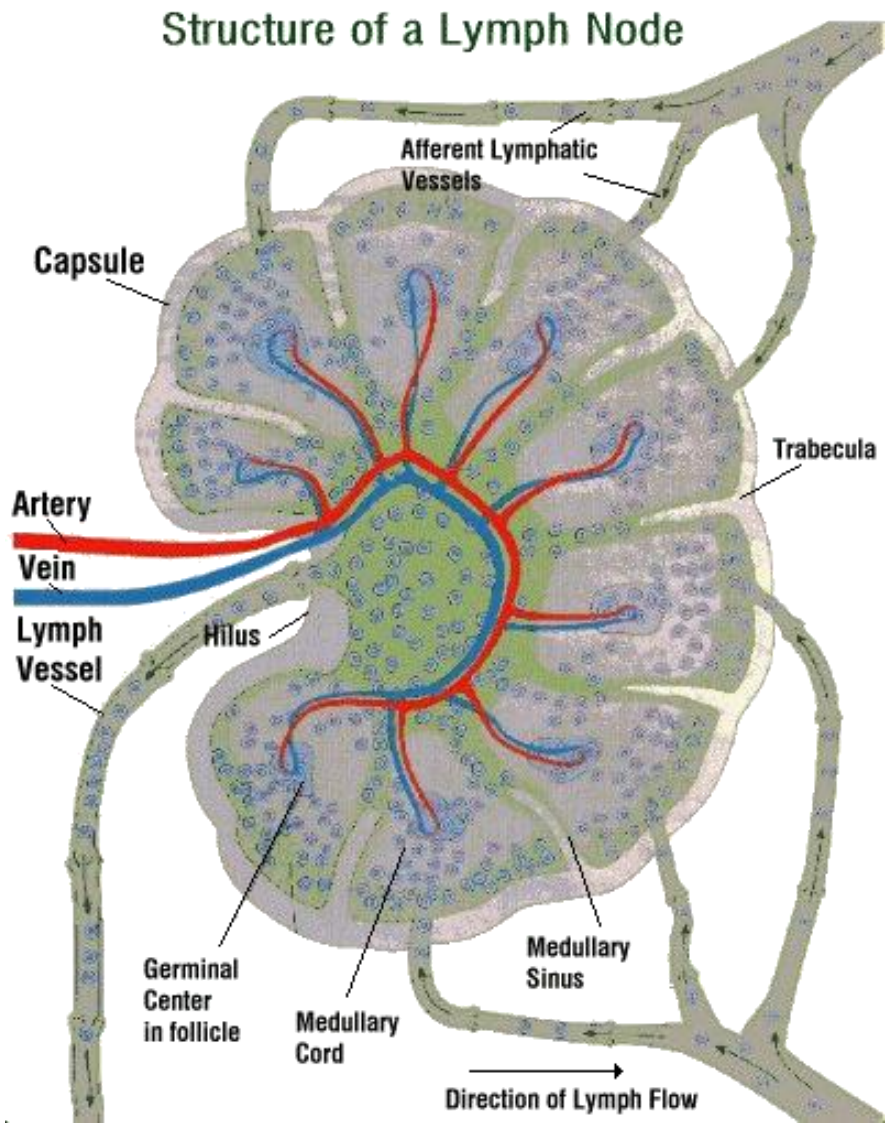
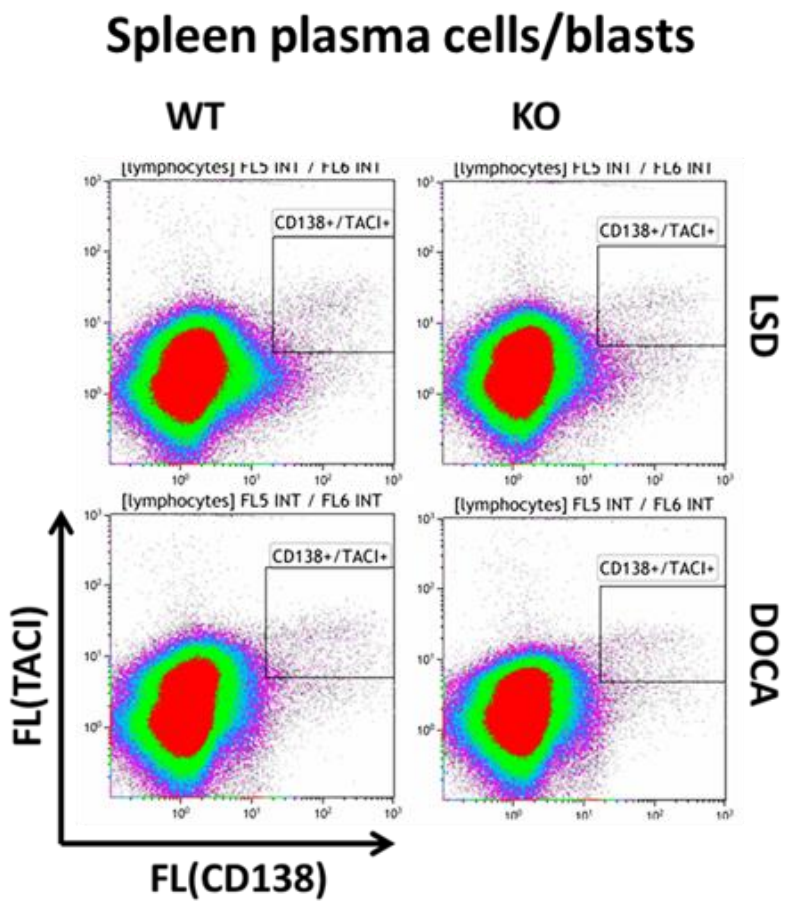
B cells in salty microenvironments

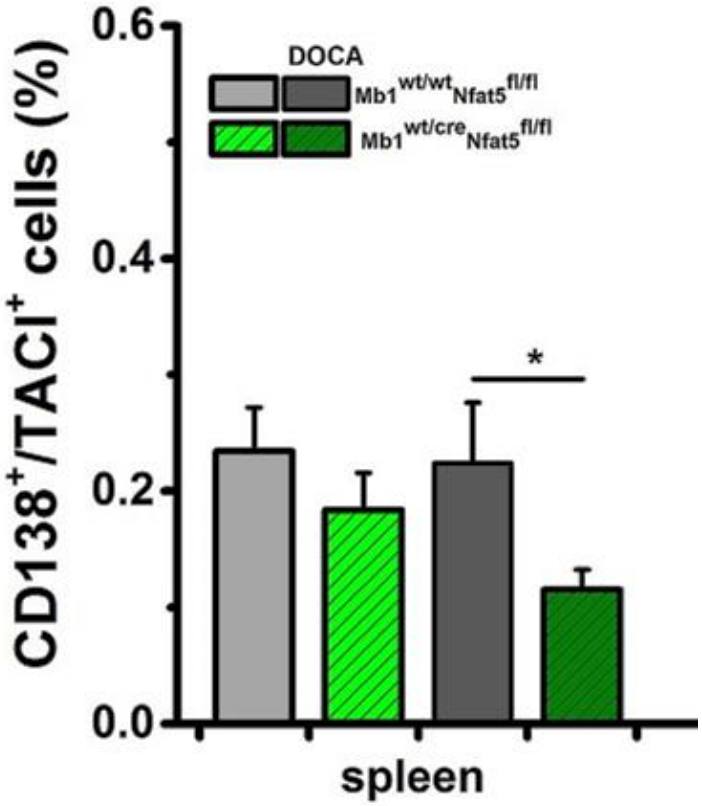


www-s.acm.illinois.edu

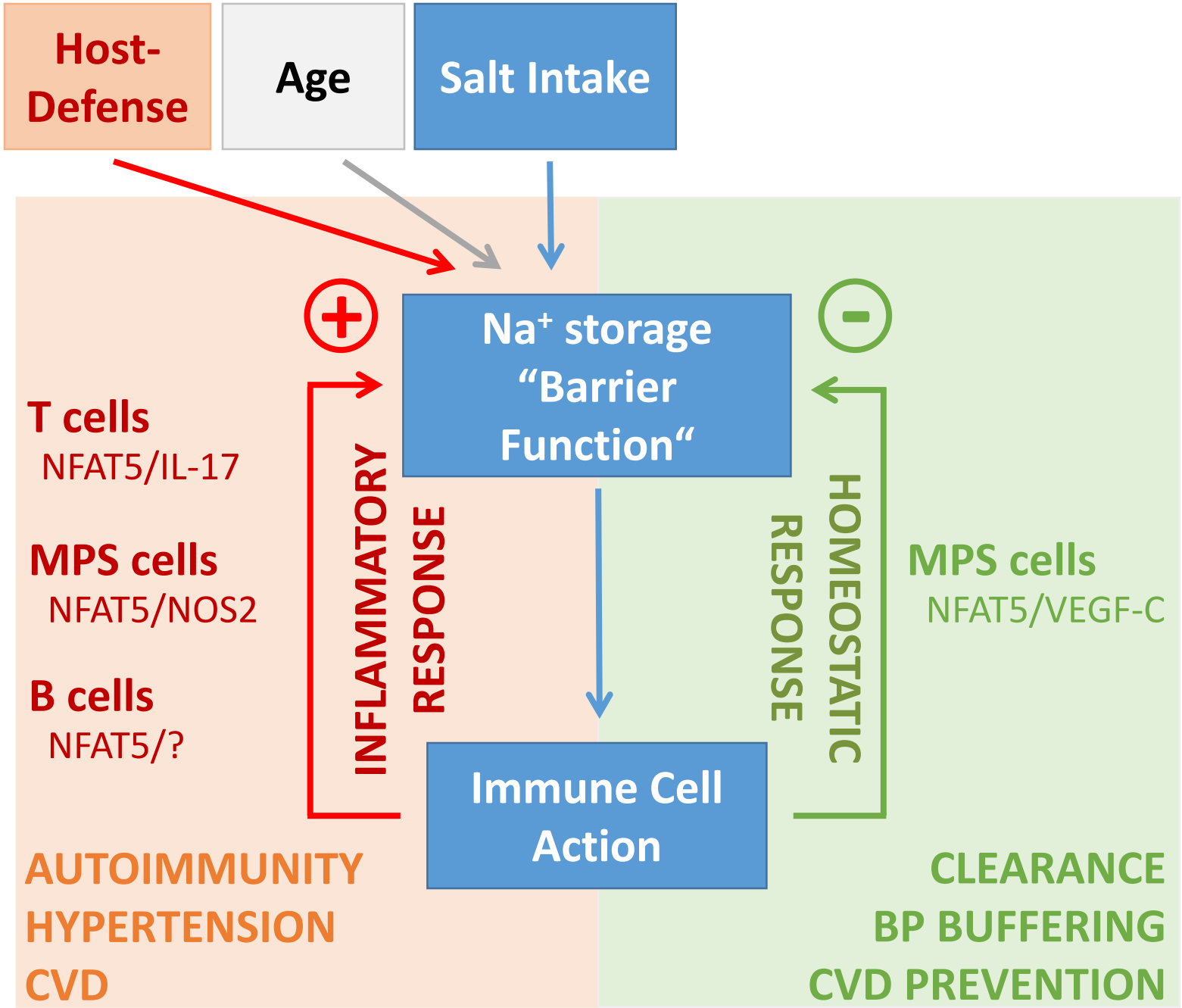
B cells in salty microenvironments

Lilijana Rokvic
Wolfgang Schuh
Hans-Martin Jäck





work in progress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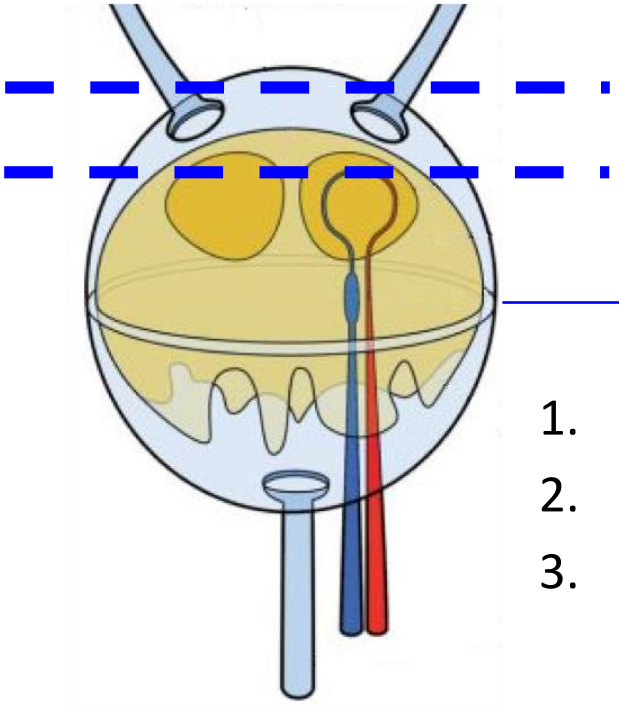
Salty microenvironments:
a need to bring material sciences into medicine

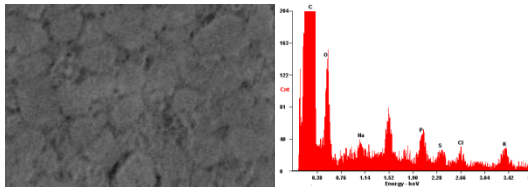
Stojan Perisic
Joachim Spatz

Embedding



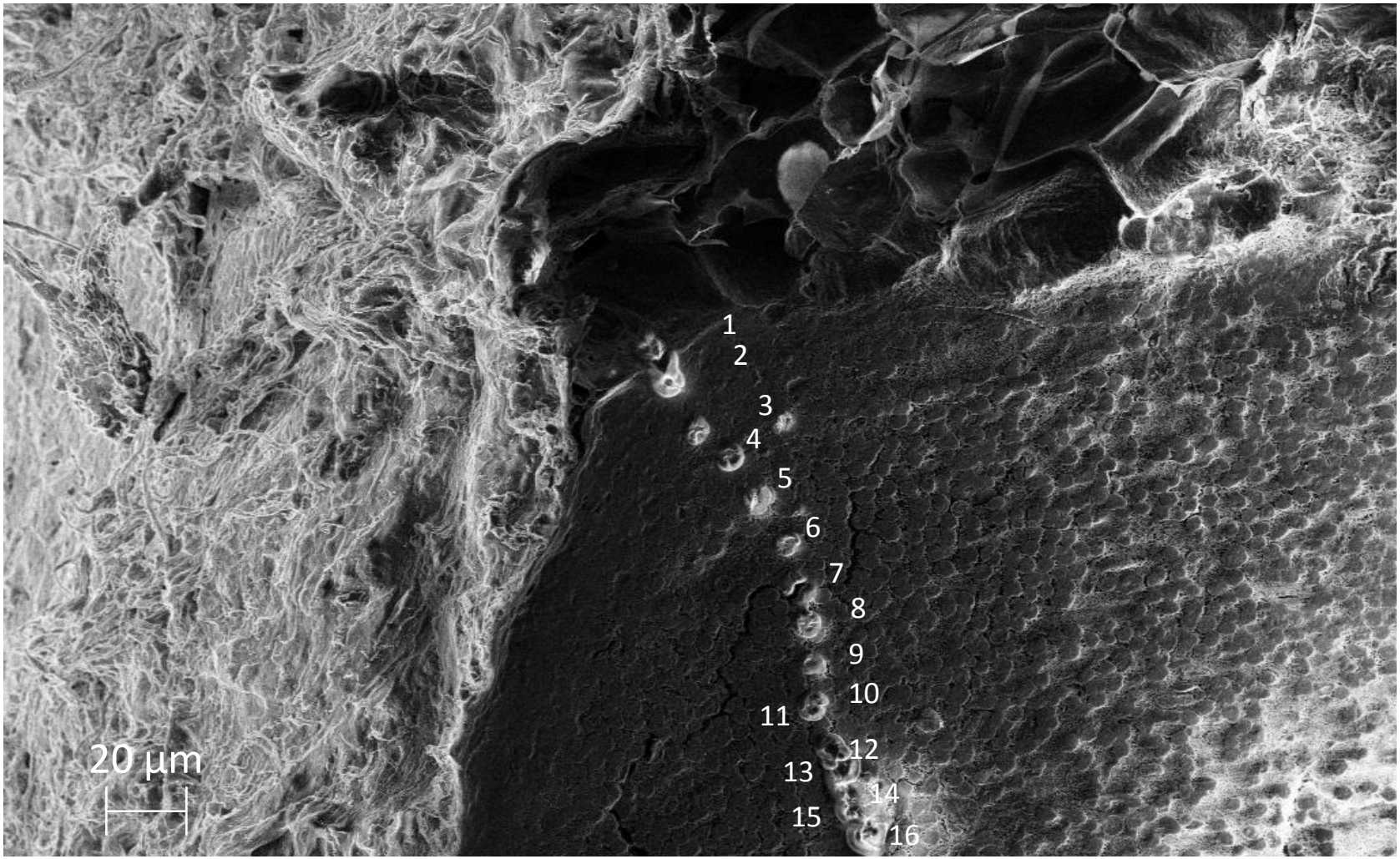
1. Planing
2. Freeze-drying
3. SEM+EDX

Rosendaal et al 2009, modified



work in progress

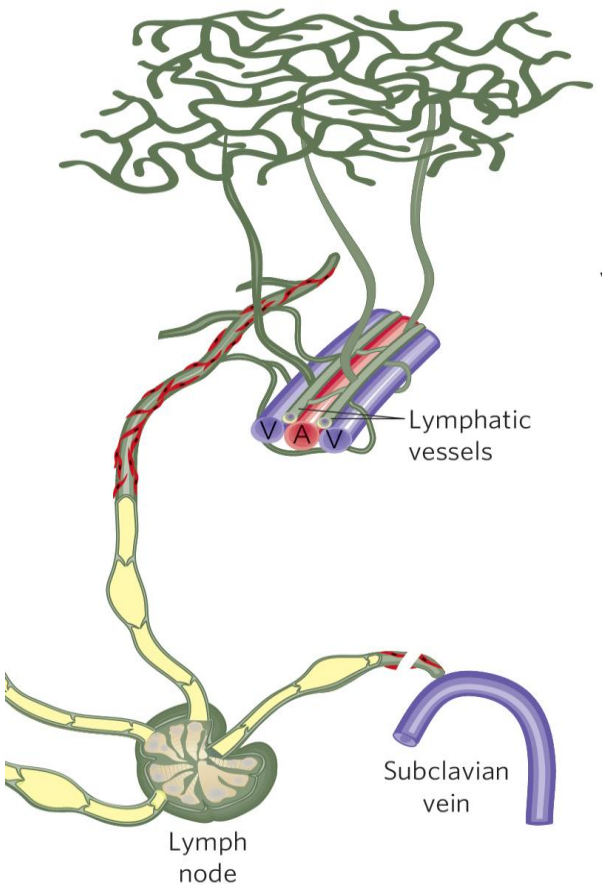
Salty microenvironments:
a need to bring material sciences into medicine



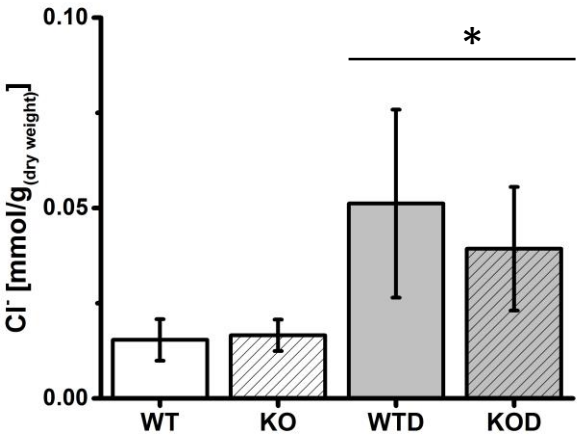
work in progress

B cells in salty microenvironments

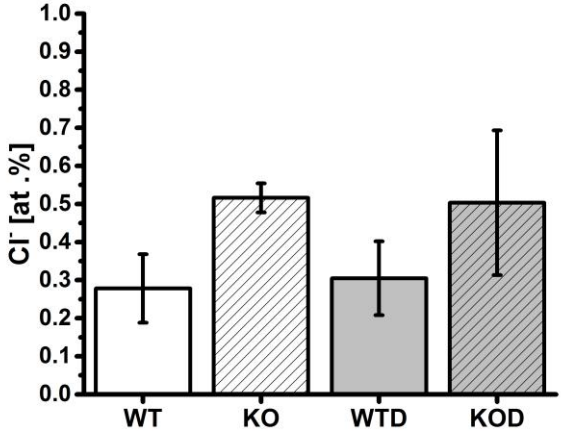
mb1^{cre}Nfat5^{flox} mice:



Skin



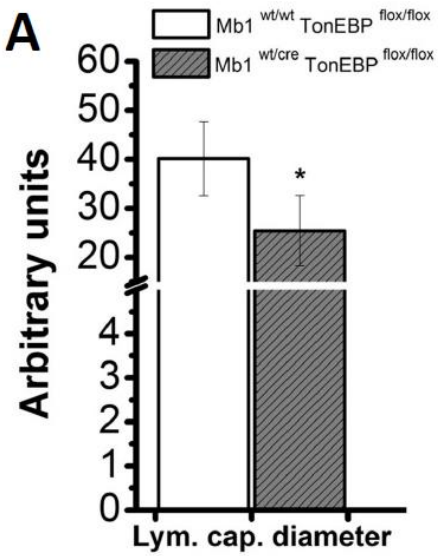
Lymph Node

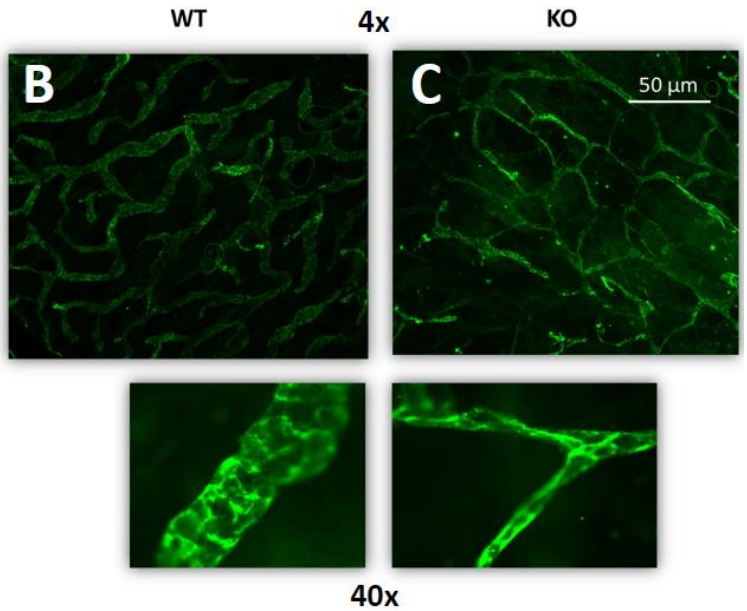


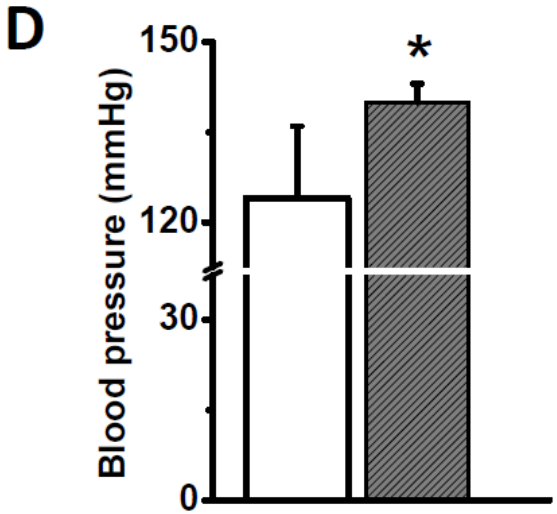
work in progress

B cells in salty microenvironments

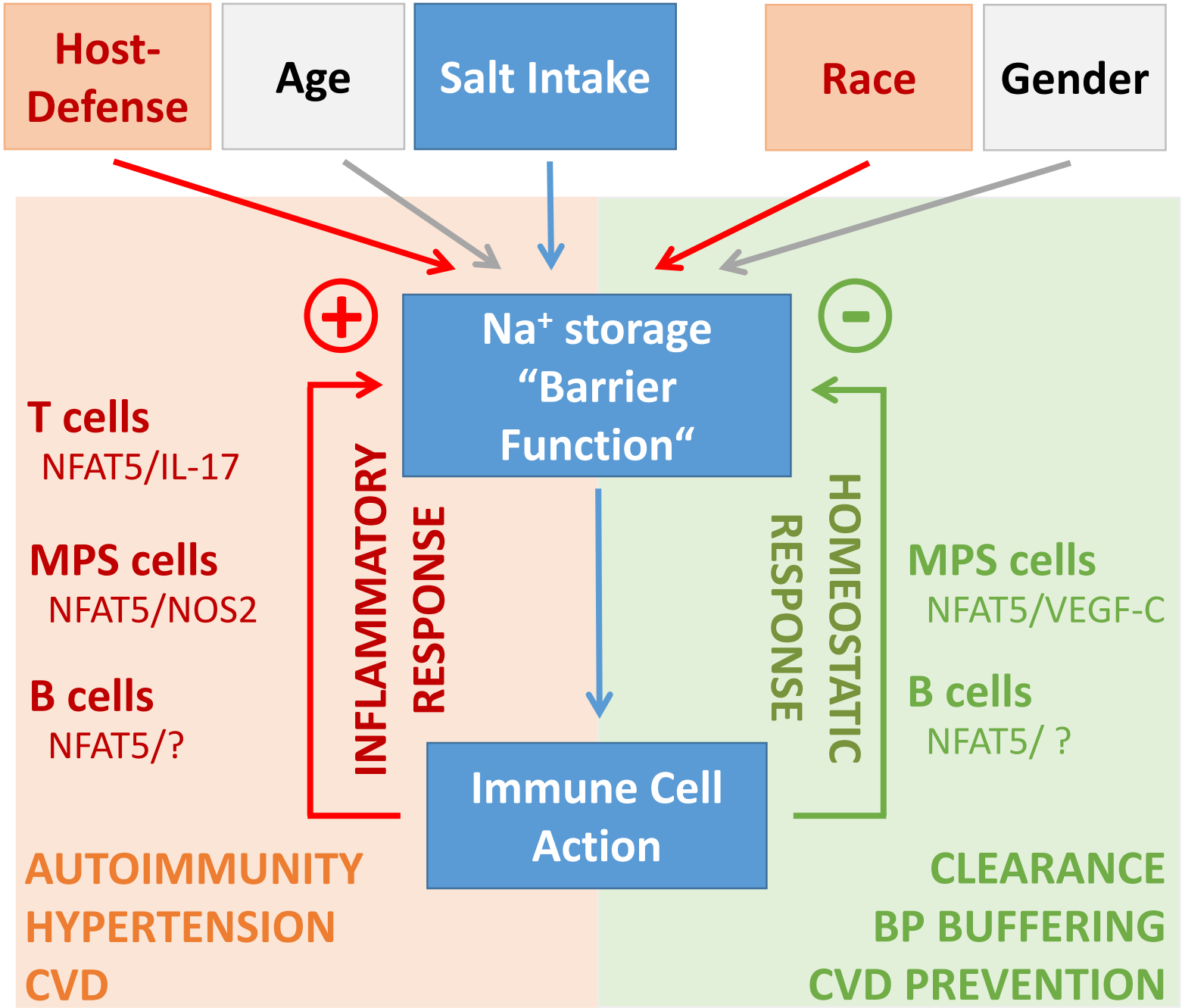
mb1^{cre}Nfat5^{flox} mice: salt-sensitive hypertension







work in progress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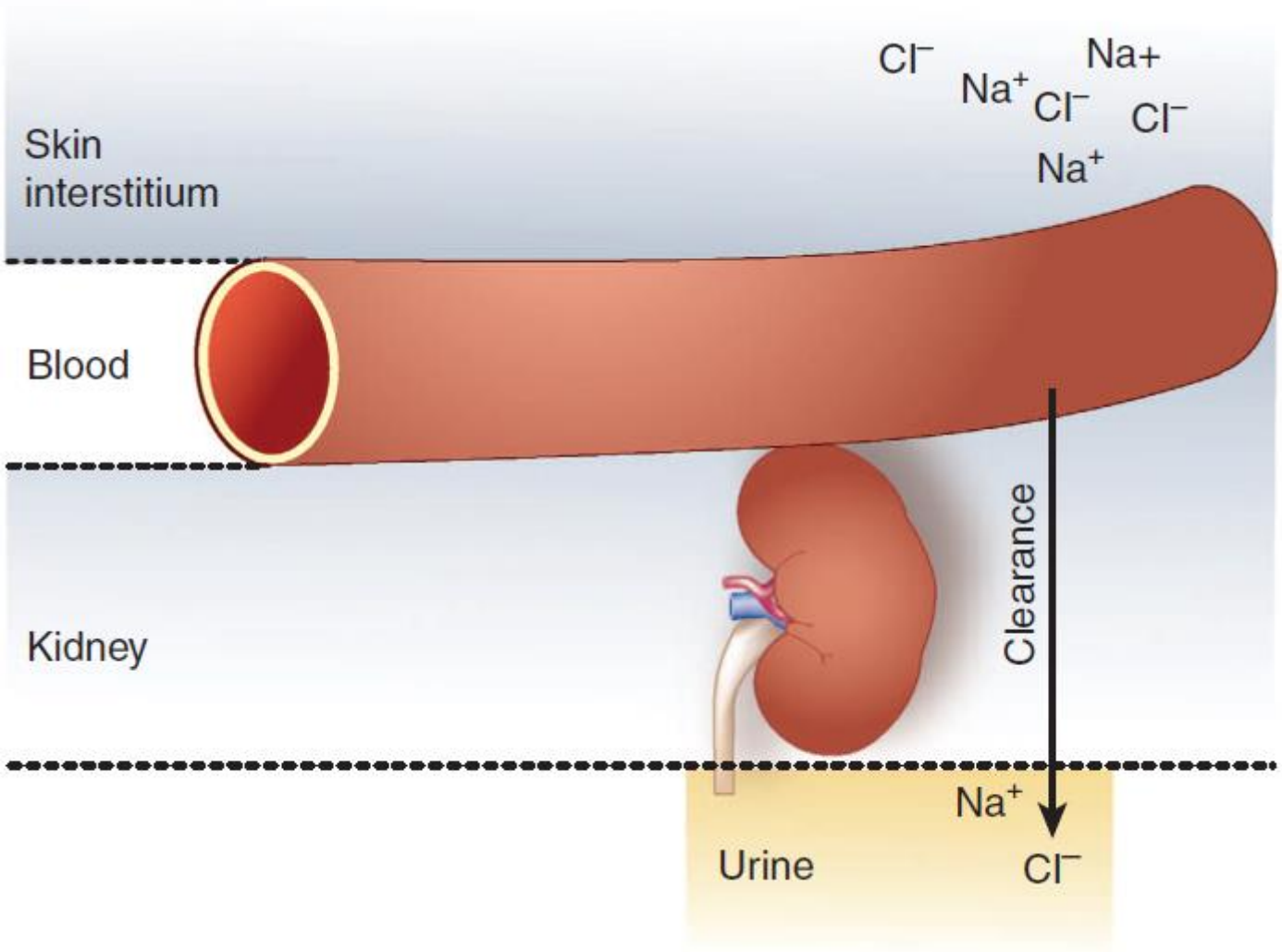
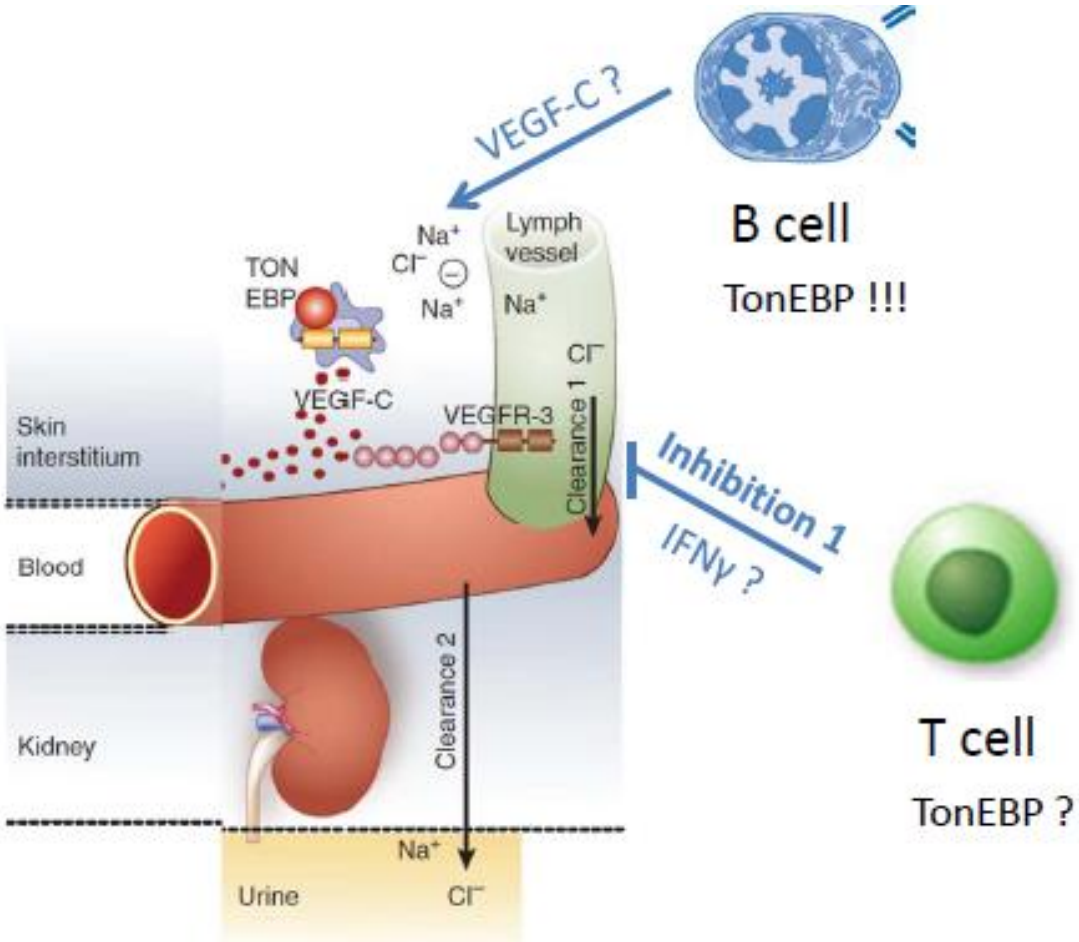
State of the art – and an alternative



Kidney International, 2014

State of the art – and an alternative



Kidney International, 2015