

Re: The human urinary system – comparative anatomy help request

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- *From:* charles <charles.uzzell@xxxxxxxxx>
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On Aug 14, 5:06 am, Marc Verhaegen <m_verhae...@xxxxxxxxx> wrote:

I'm giving a couple of tutorials to 1st year human anatomy students on Thursday about the kidney and the urinary system. I'm going to go through all the usual stuff of course. It's all laid out what I'm supposed to cover and I'm not going to deviate from the lesson plan very much but I just wondered if Marc or anyone here had any recommendations for AAT–related aspects that I might mention in the context of the session.

Hi Algis, DD & all,

Our kidneys can produce rel.diluted urine, but no strongly concentrated urine: max.urine concentration: beaver 550 milliosmol/liter, pig 1100, Hs 1400, dolphin 1700 (squid–eating dolphins a bit higher), cat 3200 etc.: from mammals who live in freshwater to sea mammals to land to desert inhabitants (I have no compar.figures on other primates, but I guess the same or a bit above Hs).

Most terr.mammals have 1 papil per kidney. Among primates, only Hs have more than 1 (10–15), although spider monkeys & capuchins sometimes have 2 or 3 papils/kidney, and chimps have their unique papil subdivided into 2 or 3 "sub"papils. If this division between papils is complete, we can speak of different kidneys = "renculi" (Lat.renculus = diminutive of "ren" kidney). Surnumerary kidneys are not rare in humans, but normally the human kidney surface is smooth, unlike most sea mammals (the only exception AFAIK are the semi–marine manatees).

Hs newborns have renculi, but shortly after birth the surface becomes smooth. Renculi are found in Cetacea (250–3000/kidney!), otters (esp.sea–otters), bears (pandas & polar bears) & Pinnipedia (c.200/kidney), okapis (but not giraffes), large herbivores (no real renculi, but lobulated surface = incompletely subdivided kidneys), dugongs (manatees & elephants have

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lobulated kidneys) & rhinos (which??), but not hippos.

Hs, beavers & swine have incompletely divided kidneys with smooth surface.

IOW: divided kidneys:

0) no division (most terr.mammals & primates),

1) subdivided papils (Pt),

2) different papils/kidneys (Hs, swine),

3) lobulated kidney surfaces (cow),

4) renculi (most marine mammals).

Clearly, divided kidneys & larger kidneys allow filtering of more water at the same time (in parallel). But why is this important in cows & whales, but not in hippos??

If renculi are an adaptation to a marine diet (eg, Marcel Williams), why renculi in okapis, rhinos, terr.otters & Hs fetuses? Why not in manatees (vs dugongs)?

Is a higher metabolism important? Otters have higher body Tps than hippos & sea-cows.

No doubt body size is important. But sea-otters have renculi. And why okapis (wetter foods?) & not giraffes?

Is the content of the diet (nitrogen...) important? eg, fish-shellfish-eaters > sea-cows. But why renculi in cows (grazer) & okapis (browser), but not hippos (grazer)?

Generally, larger mammals have more renculisation.

AFAICS renculisation means: A) "shallow" medulla + B) large cortex surface:

A) = short loops of Henle = less concentration needed = less (fresh)water?

B) = many glomeruli = large quantities of water = processing in parallel?

Marine mammals have (generally?) larger kidneys than equally large terr.mammals, but I don't know about beavers etc., or manatees vs dugons.

Hs kidneys weigh almost 150, chimps c.75 grams.

Hs kidneys are c.0.35 % of our body weight, dolphin 1.1 %, fin whale 0.44 %.

Marc & Marcel discussed the paper here, do a local search on "marine kidneys" here at AAT, chek the messages around the time of the paper's release, there's quite a bit to wade through, different types, fresh vs salt species... --DD

The anatomy of our kidneys (smooth surface, papils/kidney) suggests something like pigs...

The size seems to suggest (some) aquatic, possibly marine foods, or at least more drinking (not unexpected in an ex(semi)aq.).

The conc.capacity suggests good access to fresh water: obviously a savanna past is excluded (unless they lived at rivers or carried water, but carrying water is not very likely 5 Ma: chimps & other primates don't carry water.

Generally (form & function) the most resembling kidneys are seen in suids AFAIK: omnivory + plenty access to fresh water?

The differences with other primates (size, papils) surely need an explanation. Kidney lobulation (newborns) was one of the major arguments for Sera & Westenhoefer for humans being ex(semi)aquatic.

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1) How does urine composition and fine kidney anatomy (e.g. length of the loops of Henle) in humans compare to chimps?

Cortex thickness & medullar thickness are important in concentration, but also in other respects. Savanna & desert mammals have rel.thick cortex & medulla (loops of Henle are in the medulla): very long papil IIRC. The longer the loops of Henle, the more processing & filtering in series (= limited water).

I have Marcel's paper which only really says that human kidneys are much larger than chimps' but nothing on the fine anatomy or urine concentration.
2) How do they compare with savannah/marine/fresh water aquatic mamamals? Algis Kuliukas

No clear answers yet AFAIK: we need much more compar.data: exact composition of diet & drinking volume (sea mammals don't drink & don't need cooling water), abs.& rel.sizes, kidneys & papil division, cortex & medulla thicknesses etc., incl.non-human fetuses (milk composition...).

--Marc

Verhaegen <http://groups.yahoo.com/group/AAT> <http://users.ugent.be/~mvaneech/outthere.htm>

Hello Marc.... and Algis and etc.... Hope you had a good vacation.

I'm afraid that I can't help much with the question, but I am always willing to give a "shameless plug" for organ donation. I gave my sister a kidney in 1994:

http://www.transweb.org/people/live_don/experien/uzzell.htm

I do believe that your comparative work on the kidneys in various animals is productive, and will help with your needed evidence for the AAT. Keep on working on this one. You may want to also study how the kidneys process meat, and/or, if they are NOT working, how too much protein is excreted.

They removed my left kidney because the right one is not as likely to be injured if I get in a car accident. I suppose that in say, the UK, where they drive on the left, the surgeons preferentially remove the right kidney.

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I am fine with just one kidney. The other one has apparently gotten slightly larger to handle the extra work. I have no dietary restrictions; the kidneys are so important that nature put in an extra one.

I presume the kidneys are under the last couple of ribs for protection. Although it is debateable how much protection any particular organ is under any particular circumstances. ie., the brain...

regards,
charles

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