The Correlation Between Structure and Function of the Heart of Snakes and Lizards

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The heart of lizards and snakes (squamates) consists of two separate atria. receiving oxygen-poor systemic venous blood and oxygen-rich blood from the lungs, and a single ventricle. A muscular ridge (MR), however, divides the ventricle into the major compartments (cavum pulmonale and cavum dorsale), assisted by one or more apical septa. The MR arises from the ventricular wall, but has a free lateral opening. However, during ventricular contraction this opening can be effective closed by the MR abutting to the bulbuslamelle on the opposite side of the ventricle. The MR and bulbuslamelle are particularly large and well developed in varanid lizards and pythons, which enable the ventricles of these reptiles to have a high pressure in systemic circulation (approximately 60-100 mmHg), while keeping a low pressure in the pulmonary circulation (around 20 mmHg). Thus, it seems that interspecific differences in the degree of ventricular septation determine the degree of shunting between the pulmonary and systemic circulations. We will present and discuss the ventricular anatomy of different species of snakes and reptiles. Using NMR scanning and ultrasound, we have shown that the atrio-ventricular valves direct blood flows from the left and the right atria into the cavum dorsale and the cavum pulmonale. respectively, which can explain the pronounced blood flow separation that has been documented from measurements of blood gases. These findings will be discussed in relation to measurements of blood flow and shunt patterns during various types of behavior and metabolic states of the relevant species.

Effects of Body Elongation on the Patterning of the Abdominal

Viscera in Polypteriformes (Actinopterygii)

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A highly elongate body form has evolved independently multiple times within Actinopterygli. Axial elongation in fishes occurs via the addition of abdominal vertebrae, addition of caudal vertebrae, and/or by lengthening the vertebral centra. Most ray-finned fishes elongate by adding caudal vertebrae, but some groups elongate by the addition of abdominal vertebrae. One example of abdominal addition of vertebrae occurs within Polpyteriformes, where one genus has twice as many abdominal vertebrae as its sister genus. Previously, studies have focused on anteroposterior patterning of the vertebral column. In this study, we examined anterior-posterior patterning of the viscera in Polypterus senegalensis, Polypterus palmas, and Erpetoichthys calabaricus. We recorded the anterior and posterior positions of individual visceral organs relative to percent total length and vertebral number to determine whether organs were relatively longer and covered more segments, or whether organs maintained the same span, but were located at different segment numbers. In addition, we examined whether there were differences between males and females within the same species. We found that abdominal elongation involves both lengthening of some organs, as well as changes in the segmental positions of others. When the span of a given organ was longer, the number of vertebrae spanned doubled. The results of this study provide a basic understanding of the anteroposterior patterning of the viscera in Polypteriformes, and how changes occur when the number of abdominal segments is increased. In the future, this work will be extended to investigations of the visceral topography of other abdominally-elongate lineages of vertebrates,

The Developmental Basis for Adult Craniofacial Variation: A Morphometric Analysis of the "Short-faced" crf4 Mouse Mutant Stephen Wat, 1,2 Julia C. Boughner, Benedikt K. Hallgrimsson!;

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Phenotypic shortening of the basicranium and face is a hallmark of human evolution. Congenital facial malformations, notably palatal clefting, occur with high frequency in human populations where studied. The

etiology of clefting remains poorly understood, although we now appreciate that the high integration of craniofacial structures may factor into these birth defects. Compared to wild-type, the Crf4 mutant mouse was a previously uncharacterized strain with an apparently shorter head. Thus, this mutant was potentially a valuable model for understanding human craniofacial development and evolution. Here, we investigated Crf4 craniofacial developmental morphology. Our first aim was to statistically quantify craniofacial skeletal variation between Crf4 and wildtype mice. Our second aim was to test the hypothesis that between-strain morphological variation in adults was also manifest in embryos and/or neonates, 3D landmark data taken from micro-CT scanned Crf4 and wild-type embryos, neonates and adults were analyzed using a combination of Euclidean Distance Matrix Analysis, and Generalized Procrustes and Principal Components Analyses. Samples were age and size corrected. The Crf4 phenotype was characterized by shortened face, basicranium and cranial vault lengths, increased neurocranium height and globularity, and increased face and neurocranium widths. Morphological variation was statistically different between strains, comparable across all three age groups, and highly correlated with the allometric variation related to head size. Earlier midline fusion of the Crf4 nasal processes may contribute to the mutant phenotype. We were correct in that the developmental mechanism of the Crf4 phenotype is expressed at the embryonic stage of development,

A Single Ancient IGFL Allele Causes Small Size in Dogs

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The domestic dog exhibits greater diversity in body size than any terrestrial vertebrate. We use a novel three-part strategy to determine the genetic basis for size in dogs. First, through a genome-wide scan, we identified a major QTL on dog chromosome 15 associated with size variation in a single breed. Second, we examined genetic variation in the relevant 15 Mb interval in small and giant dog breeds, finding striking evidence for a selective sweep in a 70 kb region spanning insulin-like growth factor-1 (IGF1). A single IGF1 haplotype is common to all small breeds and nearly absent from giant breeds. Lastly, data from >3,200 dogs representing 143 breeds demonstrates that IGF1 accounts for a majority of the variance in average breed mass. These results suggest that the evolutionary mechanics of size variation in dogs is relatively simple and uniquely dependent on the appearance of a single ancient variant.

Evidence for Bird-like Air Sacs in Sauropods and Other Saurischian

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The presence of postcranial pneumaticity in sauropod and theropod dinosaurs has been assumed to indicate lung ventilation by air sacs. Pneumatic diverticula are widespread in vertebrates and can develop from any part of the respiratory system. On this basis, some authors have argued that postcranial pneumaticity in extinct archosaurs does not inform us about their lung morphology or mode of ventilation. However, the inference that saurischian dinosaurs had a bird-like respiratory system does not rest on the mere presence of pneumaticity. Rather, the evolutionary pattern of postcranial pneumatization provides strong evidence for bird-like air sacs in saurischians. Early saurischians have pneumatic spaces only in the cervical skeleton, Pneumatization by cervical air sacs is the most parsimonious explanation for this pattern. In more derived sauropods and theropods, pneumatization of the posterior dorsal, sacral, and caudal vertebrae indicates that abdominal air sacs were also present. The presence of abdominal air sacs in saurischians is also indicated by pneumatic hiatuses in a few taxa. Minimally, saurischians had a dorsally attached diverticular lung and air sacs both anterior and posterior to the lung, and thus had all of the pulmonary prerequisites for flow-through lung ventilation like that of birds. In birds, air sac ventilation mitigates the tracheal dead space associated with long necks, averts alkalosis during thermoregulatory panting, and facilitates efficient gas exchange. Sauropods were the largest and longest-necked of all land animals, and these capabilities of a bird-like respiratory system may have been pre-adaptive for the evolution of large body size and long necks.