Analysis of the FGF gene family provides insights into aquatic adaptation in cetaceans

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Why FGF

Fibroblast Growth Factor

FGF family:

FGFs:

FGF1

FGF2

•

FGF23

① Lung

- Development
- Disease (COPD, RDS, pulmonary fibrosis, cancer, etc)



- Inducing cardiomyocyte cycle reentry
- Cardiac development, diseases and repair

③ Urinary system

- · Nephron development
- · Ureteric branching and induction
- Diseases (Structural kidney and lower urinary tract, CKD, etc)
- Kidney injury and repair

4 Skeleton

- Development and homeostasis Genetic diseases (ACH, PS, etc)
- Repair/regeneration

⑤ Skeletal muscle

- Self-renewal of satellite cells
- Maintenance and regeneration

⑥ Blood vessel Lymph vessel

- Angiogenesis
- Lymphatic development
- Lymphangiogenesis
- Diseases related to EndMT, ischemic diseases, lymphedema
- Regeneration



7 Brain

- · Cerebral cortex development
- · Hindbrain development
- · Synaptic transmission
- Neural plasticity

® Skin/appendage

- · Skin surface expansion
- Skin protection from UV light damage
- Advancement of hair follicles and hair growth
- · Sebaceous gland proliferation
- Outgrowth of the glands (Salivary, lacrymal, mammary gland, etc)

3 7 9 Metabolism

- · Bile acids metabolism
- · Fatty acid metabolism
- · Glucose metabolism
- Mineral metabolism (phosphate, sodium and calcium)

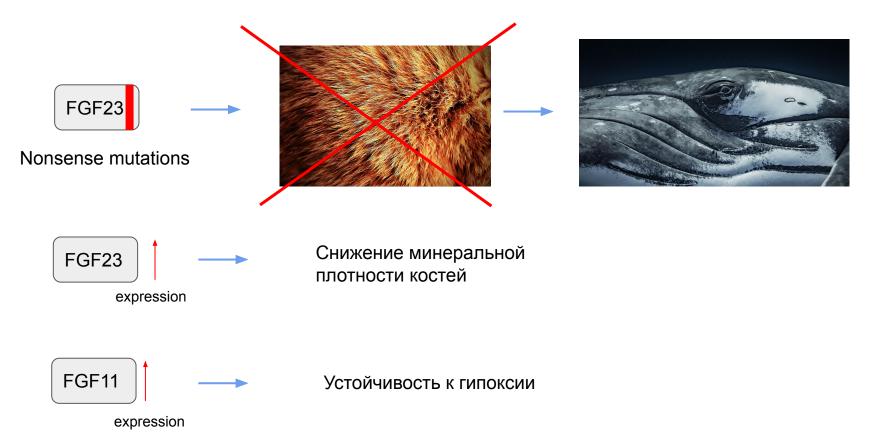
10 Inflammation

- Accentuating or suppressing
 Inflammation in different diseases
- such as COPD,CKD, etc.



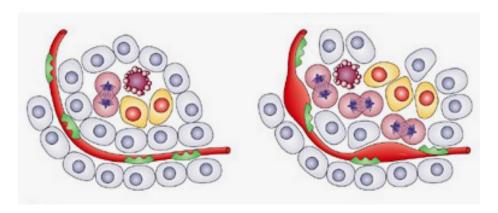
- Tumor growth
- · Invasion and migration tumors
- Tumor angiogenesis





Pic.2 Loss body hair due FGF23 mutations

- FGF1
- FGF2
- FGF3
- FGF4
- FGF5
- FGF6
- FGF7
- FGF8
- FGF9



Pic.4 Tumor development

Associacion with resistance to targeted therapy in cancer and cancer risks

FGF23 expression

Снижение минеральной плотности костей



Устойчивость к гипоксии



Pic.3 FGF11, FGF23 roles

Methods







human

ClustalW in MEGA6

PRANK program⁵² for the multiple sequence alignment

PolyPhen-2 PROVEAN v1.1 SIFT

Results

FGF23 Higher number of HREs in the

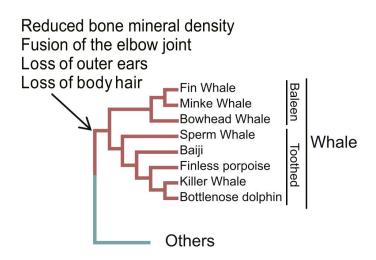
FGF23 promoter

FGF10 Changes are linked with the evolution of the lung (FGF10), or FGF19 kidney (FGF20), or with the metabolic changes (FGF19 and

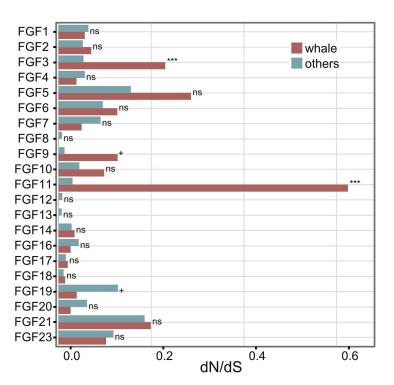
FGF21) required for aquatic life in

cetaceans.

Evolutionary analysis of FGF genes



Pic.3 The species tree based on previous studies



Pic.4 The dN/dS ratio of whale branches (orange) and the other mammalian branches (turquoise) for each FGF gene. The ns, +, and *** denotes the significance level with p>0.1, p<0.1, and p<0.001, respectively.