**Supplementary file 1a**

The expression pattern of *Nodal* gene in representative deuterostomes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Taxa** | **Species** | **Gene name/alias** | **Maternal** | **Zygotic** | **unilateral** | **References** |
| **Echinoderms** | *Strongylocentrotus purpuratus* | *Nodal* | no | yes | Yes | (*Lapraz et al., 2006*) |
| **Hemichordates** | *Ptychodera flava* | *Nodal* | no | yes | n.d. | (*Rottinger et al., 2015*) |
| **Cephalochordates** | *Branchiostoma floridae* | *Nodal* | yes | yes | yes | (*Onai et al., 2010*)(*Soukup et al., 2015*) |
| **Urochordates** | *Ciona intestinalis* | *Nodal* | no | yes | yes | (*Hudson and Yasuo, 2005*)(*Yoshida and Saiga, 2008*) |
| **Actinopterygians** | *Polypterus senegalus*(bichir) | *Sqt*  | no | yes | n.d. | (*Takeuchi et al., 2009*) |
| *Cyc* | no | yes | n.d. | (*Takeuchi et al., 2009*) |
| *Danio rerio*(teleost) | *Ndr1*/*Squint*/*Sqt* | yes | yes | no | (*Rebagliati et al., 1998*) |
| *Ndr2*/*Cyclops*/*Cyc* | no | yes | yes | (*Rebagliati et al., 1998*) |
| *Ndr3*/*Southpaw*/*Spw* | no | yes | yes | (*Long et al., 2003*) |
| **Frogs** | *Xenopus laevis* | *Xnr1* | no | yes | yes | (*Jones et al., 1995*)(*Lowe et al., 1996*) |
| *Xnr2* | no | yes | no | (*Jones et al., 1995*) |
| *Xnr3* | no | yes | no | (*Smith et al., 1995*) |
| *Xnr4* | no | yes | no | (*Joseph and Melton, 1997*) |
| *Xnr5* | no | yes | no | (*Takahashi et al., 2000*)(*Tadjuidje et al., 2016*) |
| *Xnr6* | no | yes | no | (*Takahashi et al., 2000*) |
| **Mammals** | *Mus musculus* | *Nodal* | n.d. | yes | yes | (*Zhou et al., 1993*)(*Lowe et al., 1996*) |
| **Birds** | *Gallus gallus* | *cNR1* | n.d. | yes | yes | (*Levin et al., 1995*)(*Chapman et al., 2002*) |

n.d., not determined. Only one copy of *Nodal* gene presents in invertebrate lineages. The phylogeny of vertebrate *Nodal* paralogues was analyzed previously (*Opazo et al., 2019*). At early stage, all analyzed deuterostome *Nodal* genesare not maternally supplied except the *Nodal* of cephalochordate amphioxus and *Ndr1*/*Squint*/*Sqt* of zebrafish. Both *Sqt* and *Cyc* in bichir (a stem group of actinopterygii) are expressed zygotically only at early blastula, suggesting that the maternal expression of *Sqt* in zebrafish might be a lineage-specific diversification in teleost (a derived group of actinopterygii) (*Takeuchi et al., 2009*). In addition, the maternal *Sqt* RNA functions independently of Nodal signaling but as a noncoding scaffold (*Lim et al., 2012*). At neurula stage of chordate, at least one *Nodal* gene, which is involved in L-R axis patterning, is expressed unilaterally (left side). Similarly, in echinoderm larva, *Nodal* is expressed unilaterally (right side).

**Supplementary file 1b**

The expression pattern of *Gdf1/3* andits paralogs in representative deuterostomes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Taxa** | **Species** | **Gene name/alias** | **Maternal** | **Zygotic** | **Unilateral** | **References** |
| **Echinoderms** | *Strongylocentrotus purpuratus* | *Univin* | yes | yes | no | (*Lapraz et al., 2006*)(*Bessodes et al., 2012*) |
| **Cephalochordate** | *Branchiostoma floridae* | *GDF1/3-like1*/*Vg1* | yes | yes | yes | (*Onai et al., 2010*)(*Soukup et al., 2015*) |
| **Actinopterygians** | *Danio rerio* | *Gdf3/Vg1*/*Dvr1* | yes | yes | no | (*Pelliccia et al., 2017*)  |
| **Frogs** | *Xenopus laevis* | *Vg1*/*Gdf1A* | yes | n.d. | n.d. | (*Weeks and Melton, 1987*)(*Opazo et al., 2019*) |
|  | *Derrière*/*Gdf3A* | no | yes | no | (*Sun et al., 1999*)(*Hanafusa et al., 2000*)(*Opazo et al., 2019*) |
| **Mammals** | *Mus musculus* | *Gdf1*/*Gdf1M* | n.d. | yes | no | (*Wall et al., 2000*)(*Rankin et al., 2000*) |
|  | *Gdf3* /*Gdf3M* | n.d. | yes | no | (*Chen et al., 2006*) |
| **Birds** | *Gallus gallus* | *cVg1* | n.d. | yes | no | (*Seleiro et al., 1996*)(*Somi et al., 2003*) |

n.d., not determined. At least one *Gdf1/3* gene in deuterostome lineages analyzed is expressed maternally. The *Gdf1/3* gene was duplicated independently in anura and mammalian within their own lineage (*Opazo and Zavala, 2018; Opazo et al., 2019*). The A and M subscripts were used for the genes in anura (frogs) and mammalian respectively (*Opazo et al., 2019*). At neurula stage of vertebrates, all *Gdf1/3* genes are expressed bilaterally. In echinoderm larva, the *Gdf1/3* gene is expressed bilaterally also (though left-right asymmetrically) (*Bessodes et al., 2012*). However, in amphioxus, one of *Gdf1/3* genes analyzed is expressed in the left side only. Note that our new data of WISH and reexamination of transcriptome data could not detect any maternal expression of either of the two *Gdf1/3* copies in Florida amphioxus.

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