DEVELOPMENT OF GONADS IN PASSERINE BIRDS

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INTRODUCTION

Bird gonads exhibit significant asymmetry that distinguishes them from other animals. The initial stage of gonadogenesis, which encompasses the formation of gonadal ridges, has been overlooked in research. Our previous studies have revealed notable differences in gonad development in **the zebra finch** (*Taeniopygia guttata*) when compared to other species. To determine whether the unique characteristics of zebra finch gonadogenesis are also present in other passerines, we also included related species: **the great tit** (*Parus major*) and **the blue tit** (*Cyanistes caeruleus*).

MATERIALS AND METHODS

The embryos of zebra finches, great tit and blue tit were staged according to Hamburger-Hamilton (HH) tables. The gonads were fixed in Bouin's solution, embedded in paraffin, and stained using a trichromatic method according to Dubreuill. Sex was genotyped using PCR with *CHD-Z* and *CHD-W* specific starters.

RESULTS

In all the bird species we examined, the left gonadal ridge consistently exhibited greater thickness than the right (**Figures 1-4**). Notably, in zebra finches, we observed a significant accumulation of germ cells within the left gonadal ridge, which was distinct from our observations in great tits and blue tits (**Figures 3-4**). Our research findings revealed a consistent trend in the development of testicular features, marked by a reduction in the cortex and an increase in the medulla. Subtle signs of asymmetry were evident in the surface epithelium, where the right testis exhibited a thinner epithelial layer compared to the left one (**Figures 5-7**). Likewise, a common pattern emerged in the development of ovaries across the studied bird species, characterized by an expansion of the cortex and a reduction in the medulla. Clear asymmetry persisted in the ovaries, with the left ovary displaying a thicker cortical layer compared to the diminished right ovary (**Figure 8**). Furthermore, we detected an anomaly in the left testis of zebra finches. It exhibited a hermaphroditic structure, characterized by seminiferous tubules and a cortex closely resembling that of the ovary (**Figures 9-10**).

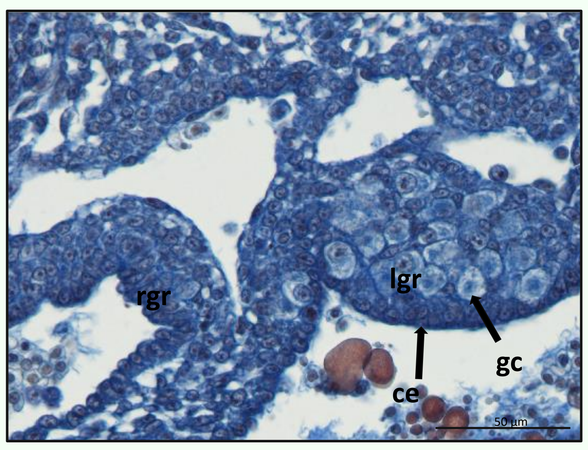


Fig 1. The gonadal rigdes (left and right) of the zebra finch embryo

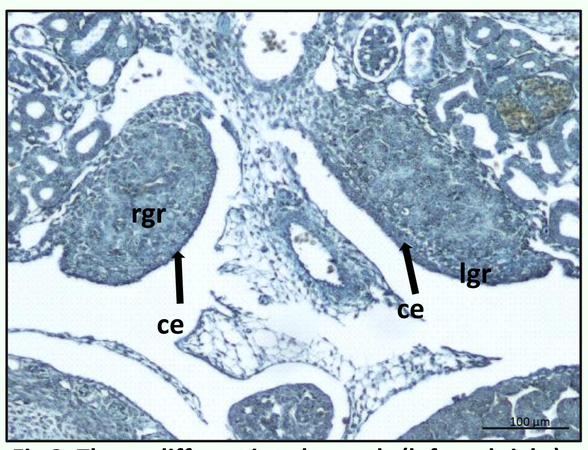


Fig 2. The undifferentiated gonads (left and right) of the blue tit embryo

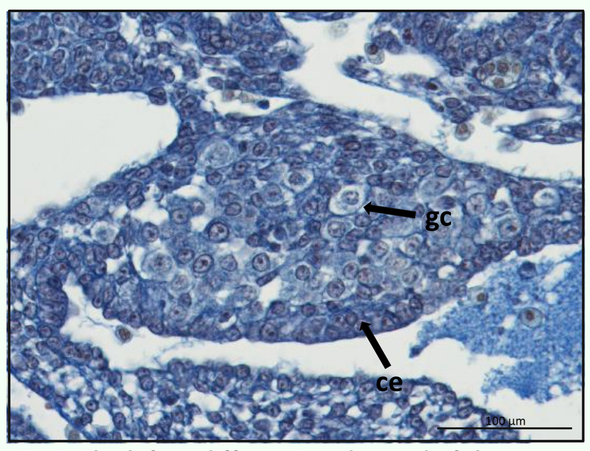


Fig 3. The left undifferentiated gonad of the zebra finch embryo

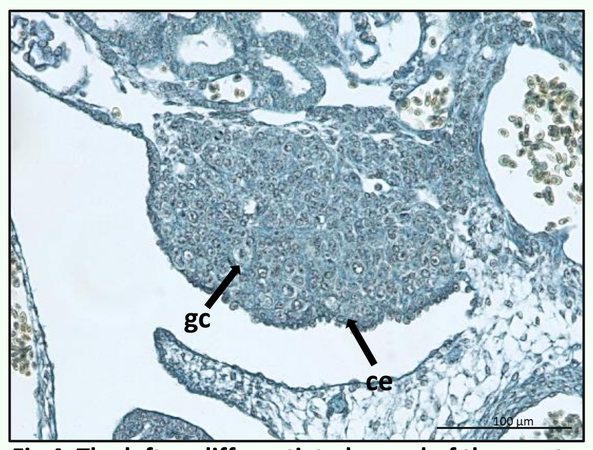


Fig 4. The left undifferentiated gonad of the great tit embryo

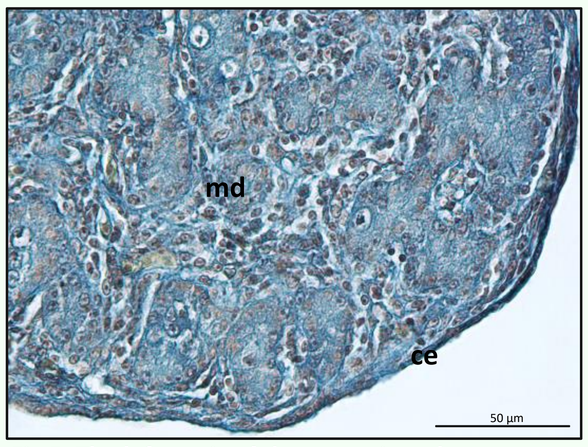


Fig 5. The left testis of the great tit embryo

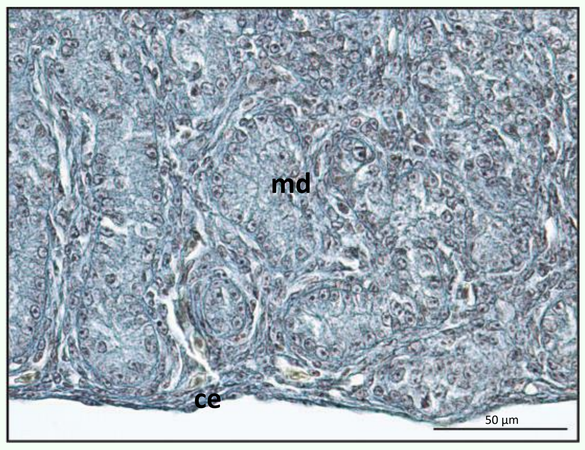


Fig 6. The right testis of the great tit embryo

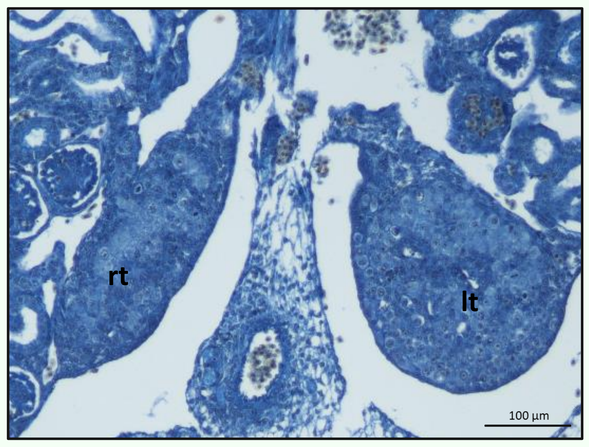


Fig 7. The testes of the zebra finch embryo

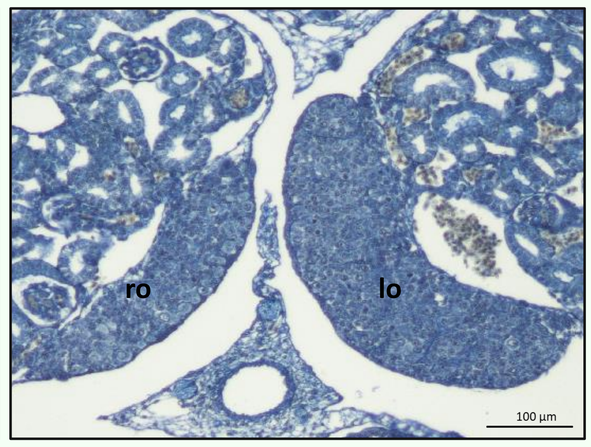


Fig 8. The ovaries of the zebra finch embryo

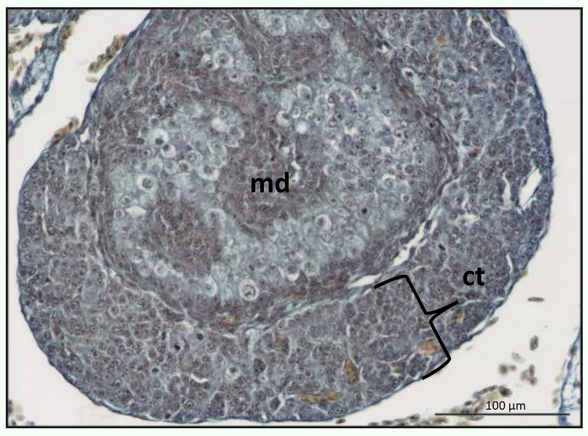
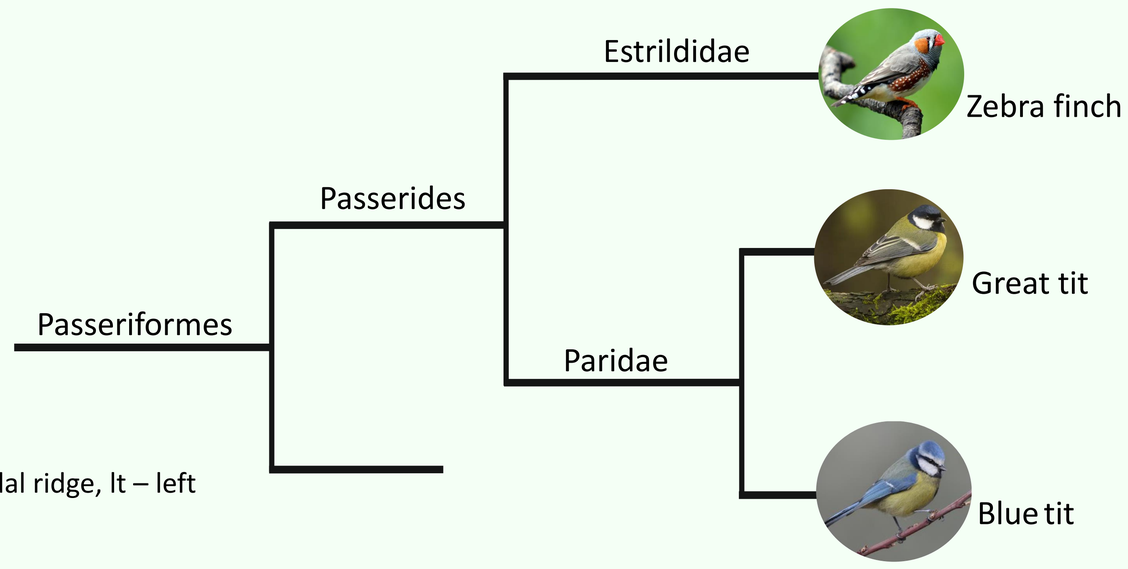


Fig 9. The left testis of the zebra finch embryo with the thick cortex

Fig 10. The right testis of the zebra finch embryo



Abbreviations: ce – coelomic epithelium, ct – cortex, gc – germ cell, lo – left ovary, lgr – left gonadal ridge, lt – left testis, md – medulla, rgr – right gonadal ridge, ro – right ovary, rt – right testis

DISCUSSION

Our research findings reveal that across all studied bird species, asymmetry becomes evident right from the start of gonadal ridge formation. Specifically, the left ridge is larger and exhibits a greater number of germ cells. The initial indication of gonadal sexual differentiation involves a decrease in germ cell count within the cortex and a simultaneous increase in the medulla of ZZ gonads, in ZW gonads, there is an augmentation in both cortex size and germ cell population. Remarkably, the zebra finch stands out due to distinctive gonad development characteristics. The presence of a substantial germ cell count challenges the conventional separation into gonadal cortex and medulla. Consequently, the trajectory of gonad development in zebra finches differs from that of other species, highlighting the need for further exploration into the underlying mechanisms and evolutionary implications. The previously described unique features of zebra finch gonadogenesis were not found in blue or great tits, what emphasize its special trajectory of development.

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