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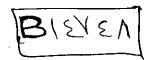


بالرسالة صفحات

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Zagazig University
Benha branch
Faculty of Science,
Zoology Department

STUDIES ON THE DEVELOPMENT OF THE NEURAL CREST IN SOME FISHES

A THESIS

Submitted in Partial Fulfilment of the Requirement for the Degree of Master of Science in Zoology

Presented By AHMED HESHAM KHALEFA EL-HASHASH (B. Sc. Zoology)

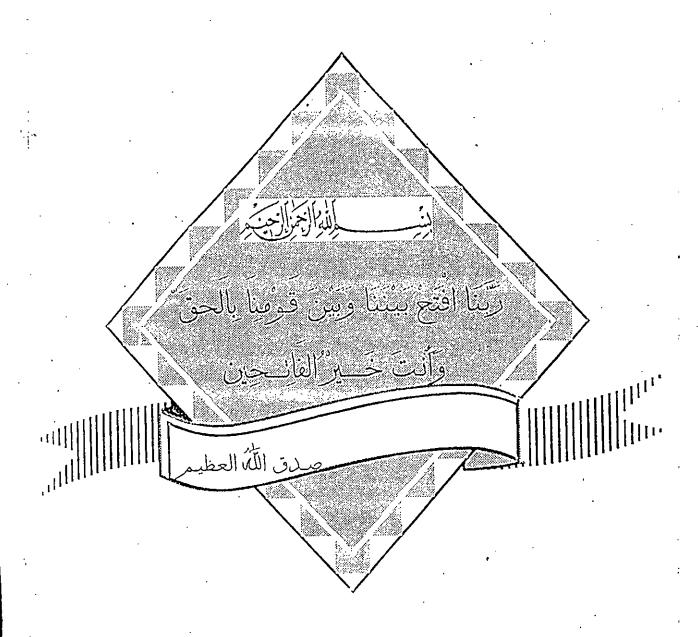
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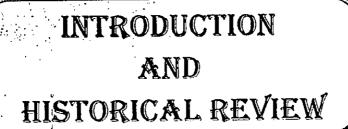
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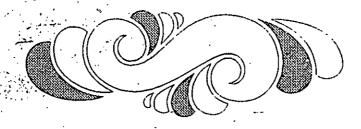
This work has been done at the Zoology Department, Zagazig University. Benha Branch, under the supervision of *PROF. DR. SABRY S. EL-SERAFY*, (Head of Zoology Department, Faculty of Science, Zagazig University, Benha Branch) and *DR. RAGAA M. EL-BALSHY*, (Department of Zoology, Faculty of Science, Zagazig University, Benha Branch). I wish to take this opportunity to express my deep gratitude and indebtedness to them for their constant assistance, unfailing guidance and facilities they kindly offered while doing this work. Grateful mention is also due to them for critical reading of the manuscript and offering valuable comments and suggestions, besides their constructive criticism and their interest throughout the work.

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INTRODUCTION AND HISTORICAL REVIEW

1- Neural Crest Formation and Migration:

The neural crest cells are firstly appearing as a band of cells or a meshwork of synchronously pulsating cells. These cells are perpendicular to the roof of the neural tube.

The neural crest cells formation and migration are fundamental events during embryogenesis. The crest cells leave the margins of the developing neural tube in large numbers to populate deeper sites of the embryo.

Ravenand Kloos (1945), Hörstadius and Sellman (1946), Seno and Nieuwkoop (1958), Brun (1985) and Tan (1986) reported that the neural crest is determined as a distinct tissue from the rest of the neural plate during induction, as a result of induction from the lateral aspects of the archenteron roof. The previous authors added that the neural crest cells can be defined partly topographically at the lateral margins of the neural folds, and partly based on their future migratory and differentiation capacities.

Weston (1963), Weston and Butler (1966), Johnston (1966).

Noden (1975), Löfberg et al. (1980), Epperlein (1982), Thiery,

et al. (1982), Erickson and Weston (1983) and Sadaghiani and

Vielkind (1989) studied the migration of the neural crest cells in the neural

trunk regions of Amphibia, Aves and mammals as well as

xiphophorian fishes. They demonstrated that the neural crest cells are

dispersed from the dorsal surface of the neural tube in two directions;

either dorso - laterally under the ectoderm or ventrally alongside the neural

tube. The dorso - lateral stream is composed primarily of presumptive melanoblasts. On the other hand, the ventral stream migrates between the neural tube and somites to provide the foundation for cells of the sensory ganglia, dorsal root ganglia, sympathetic ganglia, adrenal medulla and aortic plexus.

Johnston (1966), Noden (1975), Johnston et al. (1979), Duband and Thiery (1982), Jacobson and Meier (1984) and Jaskoll et al. (1991) described the migratory behaviour of the cranial neural crest cells of Amphibia and Aves. They reported that the neural crest cells migrate mainly in lateral pathway found between the surface of the ectoderm and underlying mesenchyme, although, small numbers of the neural crest cells migrate also ventrally between the brain and endomesenchyme. Both laterally and ventrally migrating neural crest cells eventually give rise to branchial arches, craniofacial skeletal and connective tissues. However, Sadaghiani and Vielkind (1989) found that the neural crest cells migrate equally in both lateral and ventral migratory pathways, in the head region of xiphophorian fishes.

Bancroft and Bellairs (1976), Ebendal (1977), Löfberg and Ahlfors (1978), Tosney (1978), Tan (1986) and Jaskoll et al. (1991) mentioned that there are certain recognizable changes which are associated with the stages leading up to emigration of the neural crest cells. In trunk region of chick embryo, up to four different phases have been identified: (i) appearance, (ii) condensation, (iii) early migration and (iv) advanced migration. They concluded that as the neural folds fuse to form the brain and spinal cord, the neural crest firsty appears as a band of elongated cells which are loosely interconnected, separated by extracellular spaces, and

are found perpendicular to the roof of the neural tube. However, during condensation the neural crest cells become flattened, orient tangentially to the long axis of the neural tube, and there is a reduction in their extracellular spaces. Moreover, as migration begins the neural crest cells often have filopodia and make lateral connections with adjacent cells, but they do not come in contact with the basement membranes of either the neural tube or surface epithelium. Furthermore, as migration advances the migratory neural crest cells appear to form a unicellular layer over the somites, while other cells are dispersed between the neural tube and somites.

Newgreen and Gibbins (1982) identified four possible factors which may initiate the neural crest cell migration and operation in varyling axial levels in the animal species studied. These factors are the conductive extracellular matrix environment, basement membrane breakdown, neural crest cell competence, and the loosening of adhesive forces which bind the neural crest cells to the rest of the neural ectoderm.

Löfberg et al. (1985) mentioned that in the axolotl (Amphibia), the controlling factor which initiates the neural crest cell migration appears to be the sub-epidermal extracellular matrix composition which is able to stimulate precocious cell migration among immature neural crest cells.

Valinsky and LeDouarin (1985) showed that the cranial neural crest cells of the quail (Aves) appear to synthesize large amount of plasminogen activator, an enzyme with proteolytic activity, during their initial migration from the cranial neural tube. They suggested that this enzyme acts as a possible mechanism for the digestion of intervening basement membranes

and extracellular glycoproteins. Thus, it creates spear-head for emigrating cells.

2- Control of the Neural Crest Cell Migration:

The neural crest cells are in constant proximity with other cells and extracellular matrix (ECM). Thus, the control of the neural crest cell migration is probably due to the roles of each component of the surround, ing microenvironment.

Le Douarin and Teillet (1974), Noden (1975 & 1978 a,b), Spornand Roberts (1988), Weston (1986), Bagnara (1987), Ciment (1990) and Morrisson - Graham et al. (1990) provided a compelling evidence that the premigratory neural crest cells are not programmed to follow region specific routes. Instead, the substances in the embryonic environment play a critical role in directing the migration of the neural crest cells.

Newgreen and Erickson (1986) classified the theories or mechanisms that have been proposed to explain directional movement of the neural crest cells into two main categories; impetus for directional migration and determination of migration pathways, and cell properities influencing migration.

2.1.Impetus for Directional Migration and Determination of Migration Pathways of Neural Crest Cells.

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The factors responsible for the particular patterns of the neural crest cell migration are the cell masses and surfaces, basal laminae, and extracellular spaces as well as extracellular matrix.

Manasek (1975), Noden (1975), Allan and Newgreen (1980), Newgreen and Thiery (1980), Thiery et al. (1982) and Brauer et al. (1985) proposed that the cell mass of adjacent tissue is not a causal factor to prevent the early migrated crest cells from penetration and migration within these tissues (e.g. mesenchymal cells), where the migrated neural crest cells move within the mesenchyme of the gut but do not initially pentrate within an open and looselypacked cranial endomesenchyme and caudal sclerotome. The above mentioned authors suggested that the interior of the cranial mesenchymal masses is relatively unfavorable for migration probably due to the reduction of intercellular fibronectin [favorable matrix component], and the increasing of sulfated glycosaminoglycans [unfavorable matrix component].

Bancroftand Bellairs (1976), Tosney (1978) and Newgreen et al. (1982) observed that the neural crest cells contact the basal laminae in some regions of the embryo [e.g. dorsal surface of the neural tube]. Moreover, the space bordered by basal lamina constitutes the zone within which the neural crest cells first migrate. These authors concluded that the basal laminae facilitate the early neural crest cell migration, probably by acting as impenetrable barriers, or by providing a substratum on which the neural crest cells spread preferentially.

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Löfberg et al. (1980), Newgreen and Thiery (1980), Weston et al. (1984), Rogers et al. (1986), Sternberg and Kimber (1986), Tuckerand Erickson (1986 a,b), Duband and Thiery (1987) and Epperlein et al. (1988) reported that a number of extracellular matrix components are located in regions traversed by the neural crest cells and probably play an