THE NEURAL CREST: A STUDY ON CELL DEGENERATION AND THE IMPROBABILITY OF CELL MIGRATION IN MOUSE EMBRYOS

by

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SUMMARY

Mouse embryos (CPB-S strain) aged 6.0–8.3 days post coitum (p.c.) were investigated in 10-µm and 1-µm series by light microscopy with respect to: (a) the occurrence of degenerating cells in the neural crest, and (b) the stage of development in which the neural crest cells start to lose their epithelial arrangement.

A high frequency of cell degeneration was found in all embryos examined, starting with the 6.6-day-p.c. stage, i.e., prior to the ectodermal disruption of the neural crest in the 7.3-day-p.c. stage, and continuing through all of the later stages included in the study. In the 7.3-day-p.c. stage the neural plate has not developed yet and the neural crest is present between the neurectoderm and the future surface ectoderm situated just lateral to the notochordal plate. During the transformation of the neurectoderm, via the neural plate and the neural groove, into the neural tube, the neural crest is shifted first laterally and then dorsally and medially, and drops cells. These cells proliferate immediately and eventually differentiate. In this developmental model there is no need for migration of cells to explain the outgrowth of e.g. facial swellings.

INTRODUCTION

The concept that cells migrate during the development of vertebrate embryos is generally accepted. In this study only one aspect of cell migration is considered, i.e., the active movement of cells or sheets of cells relative to the surrounding tissues. Movements of cells within an epithelium or displacement caused by proliferation are not taken into account.

The facial musculature in man is thought to develop from migrating mesodermal cells originating from the core of the second branchial arch (e.g. GASSER, 1967). However, from studies on the development of the facial muscles in combination with the transformations occurring in the head-neck area, it was concluded that these muscles develop locally (VERMEIJ-KEERS, 1967).

In the literature on the patho-embryology of facial defects in man, migration of another group of cells is encountered in the head-neck area (e.g. JOHNSTON, 1975; LE LIÈVRE & LE DOUARIN, 1975). This implies that not only the sensory ganglia but also most of the mes-
enchyme of the swellings in the face and neck is derived from migrated cells of the cephalic neural crest. According to Johnston (1975), the neural crest—which is ectodermal in origin—is localized at the junction between the neural plate or neural folds and the surface ectoderm; the cephalic crest cells begin their migration between the initiation of the neural fold elevation and the time at which the neural folds make contact and begin to fuse.

Johnston (1966, 1975), Noden (1975), Le Lièvre & Le Douarin (1975), and Le Douarin (1975) describe migration of neural crest cells in the head-neck region on the basis of experimental work performed in avian embryos in the 5-7 somite stages; almost all of the crest cells are thought to migrate between the mesoderm and the surface ectoderm.

The results of these investigations correspond with each other to a high degree. For example, Johnston (1975) and Le Douarin (1975) both demonstrated some neural crest cells in the core (muscle plate) of the second branchial arch, and extrapolated their findings, without any restriction, to mammalian embryos, e.g. the human embryo.

If both pathways of cell migration in the head-neck area were combined some neural crest cells would move first into the core of the second branchial arch and these would have to migrate further, i.e., into the face to form the facial muscles.

Consistent with the theory of local development of the facial muscles, it is assumed that if the neural crest cells lose their epithelial arrangement very early in development, when the ectoderm faces the endoderm, there need not be any migration at all.

In the literature little attention is paid to the question of how the neural crest cells lose their epithelial arrangement. Therefore, in this study on mouse embryos the neural crest was investigated, starting from a neural groove stage and going backwards in development to the very early period of the presomite stages, during which the ectoderm faces the endoderm.

The local situation within the ectoderm was also studied in an attempt to describe the disruption of the epithelium in the neural crest.

**MATERIAL AND METHODS**

Mouse embryos of the CPB-S strain were used for light-microscopical investigations. The study was performed in 46 embryos aged 6.0–8.3 days post coitum (p.c.), sectioned in a 10-μm series, and in 1-μm sections of a series of 24 embryos aged 6.2–7.9 days p.c. The developmental stages were determined by calculation (Goebbloed, 1972). The plane of sectioning varied (sagittal, transverse, and frontal).