COMPARATIVE MORPHOLOGICAL STUDY OF HOMO- AND HETEROTOPIC NEURAL TRANSPLANTS

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Neural transplantation provides an approach to problems in the practice of medicine, as well as to basic questions relating to mechanism of histogenetic processes, synaptogenesis, and the pathogenesis of a number of neuropsychiatric illnesses. An adequate, and in many respects unique, model for studies of the mechanisms of nerve tissue histogenesis is provided by transplantation of embryonic rudiments of the nervous system into ectopic sites in adult animals, which allows studies of the roles of the microenvironment and innervation in the fulfillment of histoblastic potential. Transplantation of embryonic neocortex rudiments into different parts of the brain [4, 5, 13], spinal cord [8, 12, 14], peripheral nerves [10, 11, 19], anterior chamber of the eye [7, 17], testicle [2], and salivary glands [9] has been shown to result in realization of the histoblastic potential of the transplanted tissue; the cellular elements differentiate into mature neurons and glial cells. However, comparative analysis of the development of cellular elements transplanted into different parts of the body has not yet been performed, and the characteristics of histogenesis in homo- and heterotopic transplants have not been determined.

The aim of the present work was to compare the dynamics of the development of autotransplants of rat embryo neocortex into the brain and peripheral nerves of adult animals.

MATERIALS AND METHODS

Studies were carried out on 40 male Wistar rats (200-250 g). Embryonic material was transplanted into the brain (experiment I) and sciatic nerve (experiment II) under anesthesia (Calypsol 200 mg/kg i.p.). Donors were Wistar rat embryos of 15 days of development. The dorsolateral wall of the anterior cerebral ventricle, containing deposits of neocortex, was collected, and was placed for no more than 2 h in medium 199 (Moscow) containing streptomycin sulfate (0.01 g per 10 mg of medium); prior to transplantation, embryonic material was cut into pieces of 0.5 x 1 mm. In experiment I, the head was shaved over the projection of the right cerebral hemisphere and the skin was incised, and an opening was made in the skull using a dental drill in the region of the tuberosity over the right ventricle. Embryonic material was transplanted using a glass cannula passed through the dura mater. In experiment II, hair was removed over the upper third of the thigh, the skin and underlying muscles were incised, the nerve was freed from loose connective tissue, and was clamped for 30 sec. Fibers from one of the nerve stems were cut, and a glass cannula was used to introduce embryonic material under the perineurium. Animals were kept in standard animal-house conditions, and were sacrificed by overdosage with ether vapors at 1, 3, 7, 10, and 30 days after surgery. For histological studies, brains were fixed in Bouin's fluid, and paraffin sections of thickness 5 μm were stained with hematoxylin and eosin and Nissl's toluidine blue. The ratio of neurons to the total number of transplant cells was measured, using 4000-5000 cells. Results were analyzed statistically using Student's t test.

Electron microscopic studies of transplants were performed at 30 days. Specimens were fixed in 2.5% glutaraldehyde in 0.1 M phosphate buffer pH 7.3, and were washed with buffer, treated with 2% osmium tetroxide in 0.05 M cacodylate buffer for 1 h, dehydrated with a series of ethanol solutions of increasing concentrations and propylene oxide, and were embedded in Epon. Ultrathin sections were prepared using an LKB microtome, and were contrasted with uranyl acetate and lead citrate, and examined with a JEM-1-B electron microscope with an accelerating voltage of 75 kV.
RESULTS AND DISCUSSION

The starting material used for transplantation, i.e., the wall of the anterior cerebral ventricle of 15-day rat embryos, consists of three layers: the ventricular, the mantle layer, and the marginal. The ventricular layer contains neuroepithelial cells, many of which are undergoing mitotic division. The mantle layer consists of poorly differentiated migratory neuroblasts, which are distributed more loosely than the cellular elements of the ventricular layer. The marginal layer consists of presumptive cerebral white matter, and contains processes from matrix cells and neuroblasts.