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Improved Survival Rate and Reduced Spinal Cord Parenchymal Destruction of Rats Subjected to Complete Spinal Cord Transection and Heterotopic Tissue Transplantation

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Complete experimental spinal cord (SC) laceration, besides paraplegia, involves various somatic and autonomic dysfunctions which can cause death within days or a few weeks after lesioning (Das, 1989). After SC injury, the neural damage occurs beyond the lesioned site, involving the neighboring tissue through multiple secondary metabolic (Kao, 1977; Balentine, 1988), excitotoxic (Faden, 1988), and vascular (Goodman, 1979) alterations, which ultimately lead to destruction or atrophy of neurons far from the injured zone (Feringa, 1988). Recently we reported (submitted for publication) on the neuroprotective effect of fetal SC grafts transplanted to the SC of adult rats after complete laceration.

We evaluated the effects of heterotopic grafts using the same model of SC injury to the lower thoracic region (T7-T8 level). Five groups of 6 rats each were formed: group 1, not transplanted (control group); group 2, homotopically transplanted with allogeneic fetal SC E-15; groups 3, 4, and 5, autotransplanted with adipose tissue, peripheral nerve, and salivary gland, respectively. The space between the 2 SC stumps was filled immediately with the corresponding tissue implant. Clinically, rats were evaluated for rate of survival, time of reflex return, and percentage body weight loss. To evaluate implant survival and parenchymal destruction, rats were sacrificed 12 days after surgery. Three representative SC slides of each rat were photographed to carry out the morphometric analysis by a stereological method: the simple square lattice test system (the destroyed parenchymal area was drawn on millimetric paper; the number of 5 mm crosses in this area was measured).

TABLE

Morphometric evaluation of SC parenchymal destruction

Group	Number of crosses	
	Mean	SD
1 Control	114.6	42.7
2 Fetal	63.8	42.8
3 Adipose	50.3	16.0
4 P nerve	60.8	21.1
5 Salivary g	68.7	50.9

Regardless of the grafted tissue, rats with transplants showed a better survival rate; the Mantel-Haenszel test, used to compare the probability of survival of transplanted and non-transplanted rats, showed statistically significant differences ($p<0.05$) between the two groups. Except for the peripheral nerve implant group, where the time of reflex return was significantly late, no differences were observed among the other groups. This could be explained by a possibly transitory release of acetylcholine from the nerve implant, with an inhibitory effect on the segmentary motor neurons. In the 12 days after surgery there were no significant differences in body weight loss among groups. Grafts from all experimental groups survived, though none became integrated with the host SC. The amount of surviving implant tissue was different among groups: a small amount of fetal SC survived and appeared as "small island(s)", showing immature neurons; enough adipose tissue survived to fill the gap created by the laceration injury; peripheral nerve tissue appeared to be filling the gap; the salivary gland implant showed

several "patches" of surviving tissue, with a well conserved acinar structure. The measured parenchymal SC destruction was significantly higher in the control group (without transplant), compared to each one of the transplanted groups (Mann Whitney test, $p<0.05$ in all cases), and among groups (Kruskal-Wallis test). The neuroprotective effect to the host SC of the grafts placed in the lesioned area immediately after complete SC laceration could reflect their capacity to serve as a buffer zone for neurotoxic substances released after injury.