Kaohsiung Journal of Medical Sciences (2016) xx, 1–9

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journal homepage: http://www.kjms-online.com

ORIGINAL ARTICLE

Effect of platelet-rich plasma on reconstruction with nerve autografts

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Received 20 September 2016; accepted 14 November 2016

KEYWORDS
Microsurgery;
Nerve regeneration;
Platelet-rich plasma

Abstract Despite advances in understanding of peripheral nerve injuries and regeneration and advances in surgical techniques, successful outcomes cannot be guaranteed after reconstructive surgery. Platelet-rich plasma (PRP) has been reported to have positive effects on nerve regeneration, as well as on tissue healing. The present study was designed to evaluate the effect of PRP on nerve-grafted defects. Sprague–Dawley rats were divided into four surgery groups ($n = 7$ in each). A 1-cm long nerve defect was created in the upper thigh and then reconstructed using a nerve autograft in all groups. The wet muscle weights, electromyographic findings, and histomorphologic changes were evaluated 10 weeks later. As shown by both the electromyographic ($p < 0.001$) and histomorphologic findings ($p < 0.001$), PRP had more positive effects on nerve gap reconstruction in Group 3 then Group 4 as compared to the control groups. The present study is novel in that it evaluated the regeneration effect of PRP on a large nerve defect reconstructed with a nerve graft rather than primary repair. The results are encouraging for further experimental studies on the role of PRP in nerve healing.

Conflicts of interest: All authors declare no conflicts of interest.

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http://dx.doi.org/10.1016/j.kjms.2016.11.005

Please cite this article in press as: Teymur H, et al., Effect of platelet-rich plasma on reconstruction with nerve autografts, Kaohsiung Journal of Medical Sciences (2016), http://dx.doi.org/10.1016/j.kjms.2016.11.005

Introduction

Although there are several available methods to repair nerve defects, reconstruction using nerve grafts remains the gold standard and produces the most successful results [1–6]. However, even when nerve grafts are used for reconstruction of nerve defects, recovery rates may not be satisfactory [7]. Therefore, the potential of additional treatments, including growth factors, hormones, and mediators, has been tested in nerve regeneration studies to strengthen the current gold standard method [7].

Grafts survival depends on surface diffusion in the early stages, with thinner grafts more likely to survive than thicker grafts due to better diffusion ability. As reported previously, thick nerve grafts can result in central necrosis due to a lack of diffusion [8]. To address this issue, in the present study, we performed a modification in two groups, which increased the surface area of standard nerve grafts. This modification was partial resection of the grafts epineural layer.

Platelet-rich plasma (PRP) is easy to obtain and relatively cheap. It also has a low risk of immunological side effects as it can be obtained autogenously. The platelets in PRP are rich in growth factors. In clinical use, PRP is derived from the patient's own blood. The growth factors inside the granules of platelets are secreted locally after the activation of PRP, with a long effecting time [9].

In addition to its positive effects on the healing of many types of tissues, recent studies reported that PRP had positive effects on nerve regeneration [10–13]. These effects were attributed to the growth factors (platelet derived growth factor, fibroblast growth factor, vascular endothelial growth factor, and insulin like growth factor I) that PRP contains [14–17]. Studies in literature commonly have focused on the development of alternatives to nerve grafts.

The present study was designed to evaluate the effect of PRP on nerve graft reconstruction of a nerve defect. This is a novel study in that it evaluated the regeneration of a long nerve graft segment treated with PRP.

Methods

Animals and laboratory

All experiments and protocols described in the present study were performed in accordance with the Guide for the Care and Use of Laboratory Animals, as adopted by National Institutes of Health (USA) and also approved by the Medical Faculty Experimental Ethics Committee of Dokuz Eylül University (Izmir, Turkey; Ethical Committee Number: 87/2012). Thirty-eight Sprague–Dawley rats were used in this study. The rats were kept under a 12-hour light/dark cycle (light from 07.00 to 19.00), in quiet rooms, with 22–24°C ambient temperature and provided free access to standard rat nutrients and purified drinking water *ad libitum*.

Surgical groups

The present study consisted of four experimental groups (2 surgery-only groups and 2 surgery plus PRP groups), with seven rats in each group. Another 10 rats were sacrificed, and whole blood was taken to obtain PRP. In Group 1 (Control group), a standard nerve graft was used for reconstruction. In Group 2, a partially peeled nerve graft was used for nerve reconstruction. In this group, only the central part of the graft epineurium (~6 mm) was resected to increase graft surface area. In Group 3, a standard nerve graft was used for reconstruction, and PRP was then applied around the reconstruction area. In Group 4, a partially peeled nerve graft was used for nerve reconstruction, and PRP was then applied around the reconstruction area. The make-up of the groups is described in Figure 1.

In all the groups, only the left sciatic nerves were operated upon, with 1-cm long nerve segments resected as nerve autografts and then used in the nerve reconstructions of the same nerve defect. Similarly, in all the rat groups, the grafts were not rotated or turned upside down but

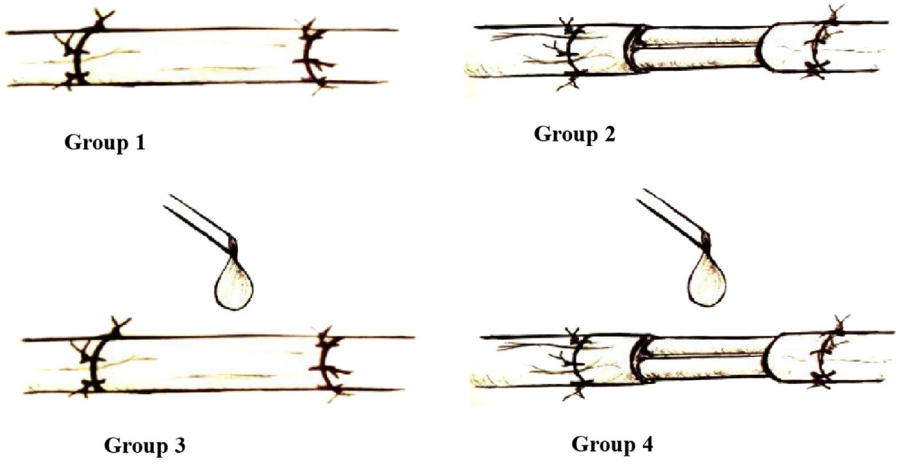

Figure 1. Schematic views of experimental groups. Group 1: 1 cm long nerve graft is used in original position for defect reconstruction with six epineural sutures on each anastomosis. Group 2: 1 cm long nerve graft is used in original position for defect reconstruction with 6 epineural sutures on each anastomosis. Additionally, from the mid-area of graft, about 6 mm long epineural sheet is resected. Group 3: Same surgery procedure as Group 1 and 0.5 mL PRP applied around graft. Group 4: Same surgery procedure as Group 2 and 0.5 mL PRP applied around graft.

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