

Evaluation of collateral microcirculation induced by limb ischemia using synchrotron radiation microangiography

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Introduction

Therapeutic angiogenesis has emerged as a new therapeutic tool for intractable ischemia using angiogenic genes and endothelial progenitor cells. Therapeutic angiogenesis consists of angiogenesis (small vascular formations of less than 50 μm) and arteriogenesis (collateral circulation of less than 200 μm). Since conventional angiography cannot identify small vessels of less than 200 μm , a new angiographic system using synchrotron radiation (SR) has been established, and has been to identify vessels down to 50 μm . With this method, the time course of microcirculation (angiogenesis) for limb ischemia was investigated, since it had not been evaluated angiographically due to limitations of resolution.

Method

The left femoral artery and its branches were ligated and completely excised in male Wistar rats ($n=30$). Rats were divided into five groups according to the times from ligation: one day (control), one week, two weeks, four weeks, and eight weeks. SR angiography was performed under the following conditions: photon energy; 33.3 KeV, exposure time; 150 ms, resolution 26 $\mu\text{m}/\text{pixel}$, visual field 26 x 26 mm. The development of collateral microcirculation was evaluated by the angiographic score (AGS). A composite of 4 mm^2 grids printed on a transparent sheet was placed over the median thigh area of each image to calculate the AGS.

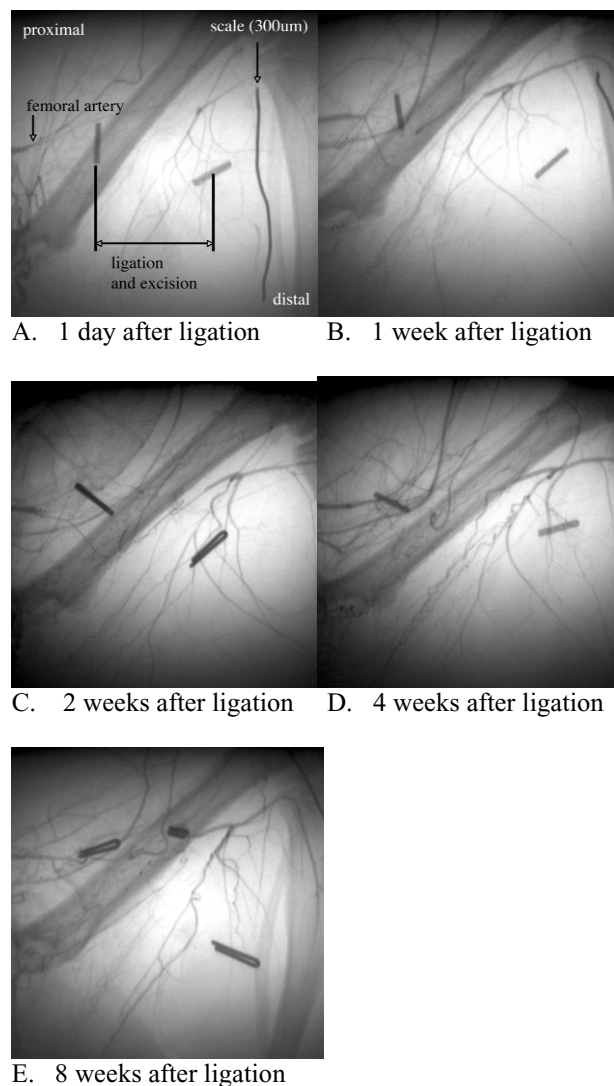
Results

The AGS were as follows: 1.3 ± 0.3 at 1 day, 1.8 ± 0.3 at 1 week, 2.1 ± 0.3 at 2 weeks, 2.6 ± 0.2 at 4 weeks, and 2.7 ± 0.5 at 8 weeks after ligation (1 day vs. 1 week: $P < 0.05$, 1 day vs. 2 weeks: $P < 0.05$, 2 vs. 4 weeks: $P < 0.05$). The formation of collateral microcirculation persisted up to four weeks and no change was observed during eight weeks follow up (Fig-1 A-E).

Conclusion

It was found that the development of collateral microcirculation is completed by up to four weeks in rat's ischemic limbs. Therapeutic angiogenesis could be visualized by SR angiography.

Fig-1. Microangiography of the rat hindlimb



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