Assessment of Lymphaticovenous Drainage through Vascularized Lymph Node Flaps Using Real-Time High-Resolution Fluorescent Imaging

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Disclosures: None

PURPOSE: Vascularized lymph node (VLN) transfer is a promising treatment option for patients suffering from lymphedema.[1] Despite positive preliminary outcomes, several questions remain unanswered, including mechanism of action and optimal flap design.[2-4] The purpose of this study was to: 1) evaluate the mechanism of lymph drainage through the VLN flap, and 2) investigate if the number of VLNs impacts lymph transit time through the flap.

MATERIALS AND METHODS: Twenty-seven axillary VLN flaps were elevated in 14 male Sprague-Dawley rats (450- 500g) and divided into 3 groups (n=9 each) based on the number of lymph nodes present: Group 1 (0 VLNs), Group 2 (2 VLNs), and Group 3 (4 VLNs). Indocyanine green (n=8/group) and Alexa680-albumin (n=1/group) were injected into the edge of flaps and latency period between injection and fluorescence in the axillary vein was recorded. Stereomicroscopic fluorescent lymphography was performed to directly visualize lymphatic transit through the VLNs (Figure 1).

RESULTS: Fluorescence was detected in the axillary vein after 197±188, 109±97, and 73±57 seconds in Groups 1, 2, and 3, respectively. Increased lymph node number decreased lymph transit time as shown by the negative correlation between the number of VLNs in the flap and the latency period ($r = -0.39$; $p=0.03$). Mean flap weights were comparable in Group 1, 2, and 3 (275±54, 298±74, 309±60 mg; ANOVA $p=0.54$). Stereoscopic lymphography allowed direct visualization of lymphatic fluid transit first through afferent lymphatics into the lymph nodes, followed by movement through the hilum into vessels draining toward the flap pedicle vein (Figure 2).

CONCLUSION: Our results suggest that lymphatic fluid in VLN flaps drains into the venous system mainly by passing through the afferent lymphatics and lymph nodes. A secondary mechanism is the diffusion of fluid directly into the venous system via flap capillary lymphatics. This is shown by the delayed presence of fluorescence in the pedicle vein in flaps without VLNs. Increasing the number of lymph nodes in the flap directly improves flap lymphatic drainage capacity.

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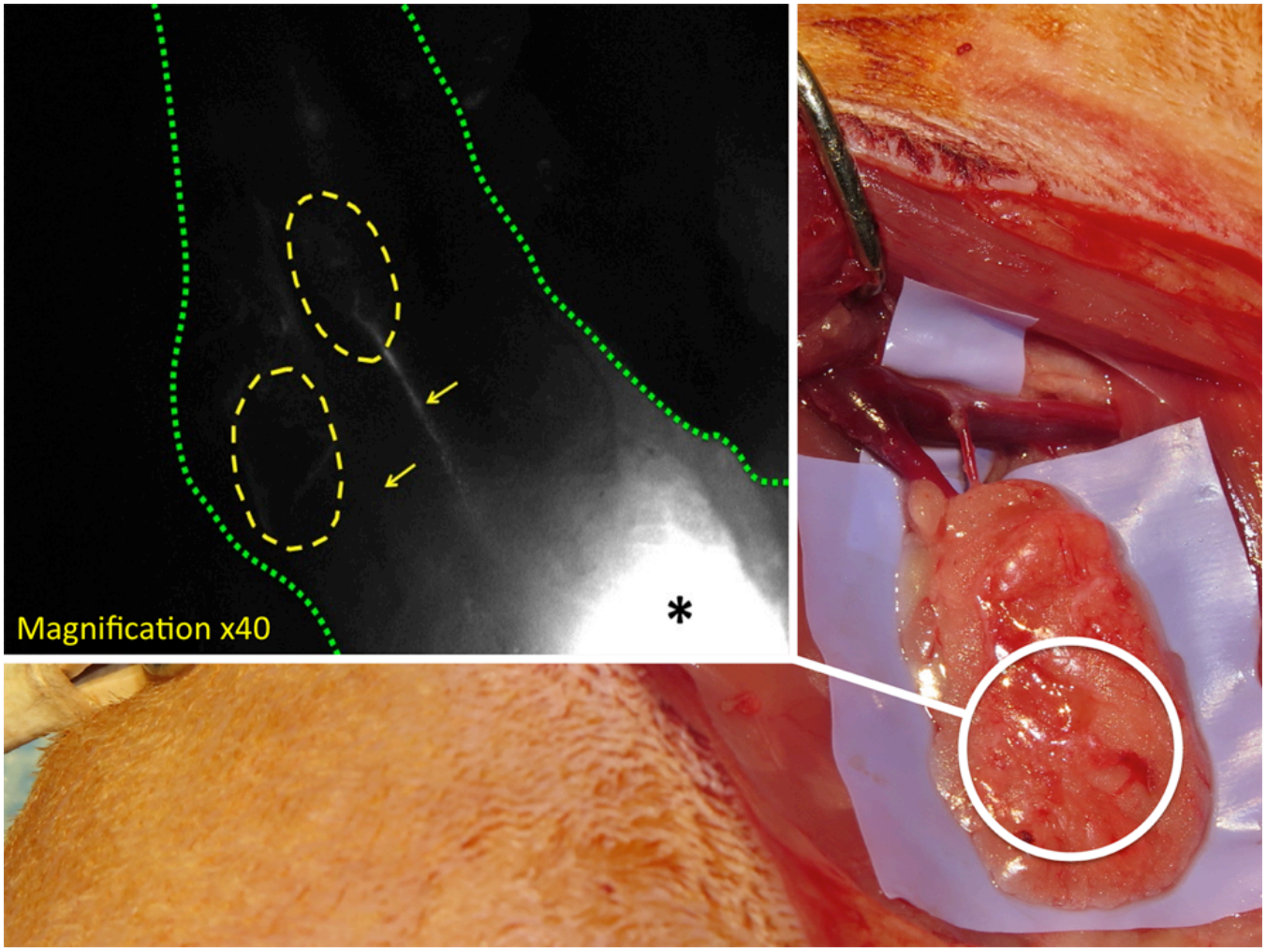
LEGENDS:

Figure 1. Stereomicroscopic lymphography displaying lymphatic fluid drainage through the rat axillary VLN flap. * – Alexa680-albumin injection site; Arrows: afferent lymphatics; Green dashed line – flap contour; Yellow dashed line – VLN contour.

Figure 2. Stereomicroscopic lymphography showing high magnification view of lymph node.


Magnification x40
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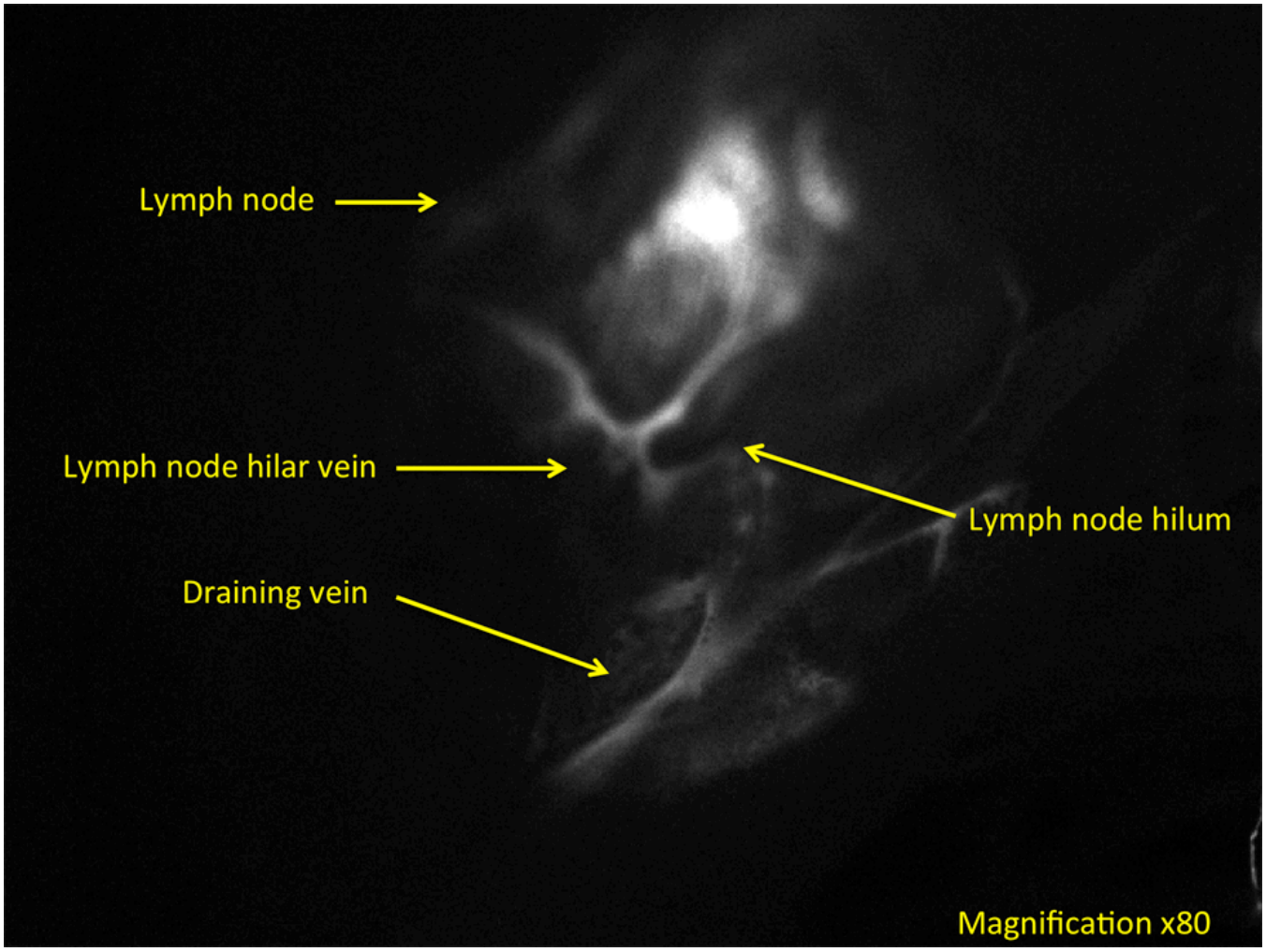
Lymph node
Lymph node hilar vein
Lymph node hilum
Draining vein
Magnification x80