Sentinel nodes in complex areas: innovating radioguided surgery
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Appendix

Lymphoscintigraphy of a breast tumor showing focal tracer accumulation along the falciform ligament of the liver

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ABSTRACT

99mTc-technetium-nanocolloid was injected intratumorally in a patient with a left breast carcinoma. Sequential planar images showed drainage to an axillary and a left parasternal sentinel node. The liver showed faint homogeneous tracer uptake but there was also focal tracer accumulation adjacent to the liver. SPECT/CT visualized the two sentinel nodes, but also intense tracer accumulation along the falciform ligament. Lymph from the breast can follow unpredictable pathways and may travel retrograde via the internal mammary chain towards lymphatic channels along the falciform ligament. This phenomenon might also explain incidental observations of umbilical metastasis in breast cancer.

Lymphatic mapping was performed in a 50-year old woman with a non-palpable cT2N0 carcinoma of the left breast. One deposit of 0.2ml of 138 MBq (3.7 mCi) 99mTc-technetium-nanocolloid was injected into the tumor guided by ultrasonography. Anterior and lateral sequential planar images were performed after fifteen minutes, two hours and four hours (A). No axillary drainage was visualized at fifteen minutes, although generalized faint liver uptake was present, as well as two spots of focal tracer accumulation within the contour of the liver on the anterior image. After two and four hours, this particular distribution of the radio-colloid in the upper abdomen was still present. Furthermore, an intense axillary sentinel node and weak left parasternal node were visualized (A).
Some diffuse liver uptake is sometimes seen in lymphatic mapping, due to diffusion of radio-labeled particles to the blood stream after injection, or after accidental intravenous injection.\textsuperscript{1} Focal tracer uptake in the upper abdomen during breast lymphoscintigraphy has not been described in the literature to our knowledge.

Following the late static image, hybrid single photon emission computed tomography – computed tomography (SPECT/CT; SymbiaT, Siemens, Erlangen, Germany) scanning was performed in order to localize both the sentinel nodes and the focal tracer accumulation in the abdomen (B). The left parasternal node was only visualized with maximal intensity of the SPECT (not shown in this figure) and was localized just cranial from the fourth rib in the third intercostal space. The axillary sentinel node and the two hotspots within the contour of the liver, at the level of the seventh costocartilage, are clearly visualized on three-dimensional reconstruction (B). Two-dimensional SPECT/CT fusion (C, D) showed both spots of focal tracer uptake in the upper abdomen to be localized along the falciform ligament adjacent to the liver parenchyma.

A dense network of collecting lymphatic capillaries and vessels along the falciform ligament ascends towards several node groups above the diaphragm, such as anterior diaphragmatic and retrosternal nodes.\textsuperscript{2, 3} This drainage system is part of the superficial lymphatic drainage pathway of the liver.\textsuperscript{3} Lymph flow obstruction due to heavy involvement of such a node may explain the rare observation of liver tumors presenting with metastasis in the breast.\textsuperscript{4-6} In some cases however, collecting trunks along the falciform ligament drain downwards towards hepatic hilar nodes or towards lymph nodes in the deep superior epigastric chain.\textsuperscript{3} Extensive early uptake along the falciform ligament in the current image might represent retrograde lymphatic flow from the breast via the internal mammary chain towards this ligament. Accumulation within lymph nodes or stasis in so-called lymphatic lakes may explain the persistent visualization for at least four hours after injection. This dominant flow probably bypassed the parasternal sentinel node, because the latter hot spot appeared much later.

At the end of the eighteenth century, Cruikshank and Mascagni described the internal lymphatic route from the dorsal part of the breast, perforating the intercostal muscles, and joining the lymphatic channels coming from liver and diaphragm.\textsuperscript{7} Other indirect evidence of lymphatic backflow in the falciform ligament, an embryologic remnant of the umbilical vein, is the rarely observed umbilical metastasis (Sister Mary Joseph’s nodule) of breast cancer.\textsuperscript{8} Lymphatic backflow might occur due to defect valves, obstruction or impaired lymphatic
The observation of lymph flow towards the falciform ligament in our patient might represent a rare variant of lymphatic drainage. A pathological cause for the retrograde flow appears to be less likely, because two axillary sentinel nodes and one parasternal sentinel node were harvested and both proved to be tumor-free. The hotspots at the falciform ligament were left untouched.

REFERENCES