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Lymphoscintigraphy: Preventive, Diagnostic and Prognostic Value

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Abstract: *Accurate diagnosis of lymphedema is essential to establish an appropriate treatment and reduce morbidity. Lymphoscintigraphy is confirmed as the "gold standard" procedure for the diagnosis of lymphedema. Due to its reproducibility and limited invasiveness, it is recommended for the diagnosis and assessment of treatment response in adults and pediatric patients. Furthermore, preoperative lymphoscintigraphy is recommended to confirm effective absorption and direction of radiotracer migration into sentinel nodes during lymphatic mapping for breast cancer and other monocentric neoplasms such as melanomas, carcinomas of the penis and vulva, oropharyngeal and, also, thyroid. In addition, preoperative lymphatic mapping can provide a useful visual aid to the relative position of the sentinel nodes within a lymph node basin.*

Keywords: *Lymphedema, lymphoscintigraphy, sentinel node mapping*

1. Introduction

Lymphedema is a common and chronic condition resulting from an impairment of the lymphatic drainage caused by congenital abnormalities, lymph injury or infection [1]. Chronic lymphedema is a progressive disease that significantly affects patients' quality of life [2, 3].

Therefore an early and accurate diagnosis of this condition is essential to establish an appropriate treatment and reduce morbidity. However, specific clinical and instrumental evaluation may be difficult to obtain in the early stages of disease diagnosis. In fact, it could be a clinically not very busy case, which however shows intense alterations on the instrumental lymphoscintigraphic examination [4].

Lymphoscintigraphy, first introduced in 1953 by Sherman and Ter-Pogossian [5], still represents the "gold standard" procedure for the diagnosis of lymphedema. Lymphoscintigraphy has largely replaced lymphography for evaluating the lymphatic system, being currently recommended as an initial diagnostic test by the International Society of Lymphology (ISL) with a grade 1 recommendation and by the American Venous Forum guidelines on a level of evidence B [6, 7].

As for the execution technique, numerous studies have documented the ability to improve both the sensitivity and the specificity of the lymphoscintigraphy performed with the planar two-dimensional technique, by means of hybrid SPECT/CT imaging, thus obtaining to mographic images for a better geographical identification of the lymph node stations [8,9].

2. Lymphoscintigraphy

The main indication of lymphoscintigraphy is the early detection of impairment of the lymphatic system in patients with clinical suspicion of primary and secondary lymphedema [10].

In addition to the initial assessment of the severity of the lymphatic flow disorder, serial lymphoscintigraphic examinations may be performed during follow-up to monitor response to treatment and disease progression [11]. In patients diagnosed with primary lymphedema, lymphoscintigraphic evaluation of immediate family members should also be considered to adopt adequate primary prevention measures [11].

With regard to radiation protection data [12], the main information relating to the effective dose to the critical organs by the administration of colloidal tracers labeled with Tc-99m are

derived from data obtained during the execution of the sentinel lymph node lymphoscintigraphy [13-15]. As reported in the manufacturer's notes provided with the commercial product, the effective dose resulting from a subcutaneous administration of 110 MBq of Tc-99m nanocolloids in an adult patient is 0.44 mSv, with an absorbed dose of 65 mGy for the lymph nodes and 1320 mGy at the injection site[16].

In pediatric patients, lymphoscintigraphy represents the main diagnostic tool of congenital lymphatic anomalies suspected clinically and in case of edema of the limbs and genitals, of chylothorax and chylous ascites [17,18].

Diagnostic information provided by lymphoscintigraphy includes the extent of lymph flow delay and its severity, the presence and site of lymphatic stasis and/or true lymphatic stops, the presence of dermal back flow and/or collateral flow, complete or incomplete visualization of lymphatic drainage basins [10,19].

Regarding primary prevention, in our experience, of the 41 cases of post-saphenectomy lymphedema due to aortocoronary bypass, 26 (57%) showed a reduced presence of inguinal lymph nodes, with normal contralateral groin. In these cases a preoperative evaluation with lymphoscintigraphy can allow a prevention of iatrogenic lymphedema [20].

In patients with post-traumatic lymphatic edema (57 cases) a reduced visualization of the lymph nodes of the limb root was observed in 24.2%, with the simultaneous presence of "dermal back flow" corresponding to the affected anatomical area. In these cases, the prognosis for complete recovery is less favorable[20].

One of the frequent clinical observation is that radiotherapy that affects the lymph nodes can damage lymph nodes and lymph vessels leading to the formation of a fibrous tissue that blocks the lymph flow. In addition to affecting the tumor mass, the lymph nodes can also be affected and this intervention is desirable when the lymph nodes are clinically involved in the disease, or if there is a fear of malignant spread of the tumor through the lymphatic circulation. Of course, only the diseased cells are attempted, but unfortunately, portions of healthy cells can also be irradiated. For example, in a large cohort of breast cancer patients undergoing prospective screening for lymphedema, peripheral lymphatic irradiation was found to significantly increase the risk of lymphedema, compared to breast / chest wall radiation alone[21]. Therefore, when considering the use of peripheral lymphatic irradiation, clinicians should weigh the potential benefit of peripheral lymphatic irradiation for disease control against the increased risk of lymphedema. Other authors have stated that over 60 years of age, a large dose of radiotherapy and/or a high dose of axillary cords, were significant risk factors for arm lymphedema. Sentinel lymph node biopsy, reduced number of dissected axillary lymph nodes, linear accelerator RT reduced late skin reactions. Menopause, obesity, diabetes mellitus, the stage of cancer and chemotherapy have not, however, affected arm lymphedema and skin delayed side effects[22].

In a study, the clinical manifestations of edema of the lower limbs (LEE) in patients with locally advanced cervical cancer treated with two different strategies were investigated. The authors conclude that cervical cancer patients undergoing radiotherapy after laparoscopic surgical staging experienced LEE and related symptoms more commonly than patients undergoing primary radiotherapy, suggesting that surgery rather than radiotherapy per se has greater effects on the lymphatic pathways [23].

But there are also those who suggest that the onset of primary lower extremity infedema (LLL) may not be related to the cancer treatment (s) but that these LLLs may represent the development of a latent primary disease prior to therapeutic interventions based on of a lymphoscintigraphy performed on 33 patients undergoing intra-abdominal lymphadenectomy for ovarian, uterine, cervical and prostate cancer, compared with lymphoscintigraphy performed in subjects with LLL [24].

But the role of lymphoscintigraphy is not confined only to the diagnosis of lymphatic drainage. Starting from cases of melanoma, Morton and the pathologist Cochran in 1992 developed the innovative concept of "lymph mapping through sentinel lymph node biopsy" [25]. They argued that the lymphatic drainage of a melanoma is directed directly to a specific lymph node, at a specific location, starting from the location of the primary lesion, albeit with some individual variability. This was called sentinel lymph node, as a detector of the disease state of the draining lymph nodes, in homage to the concept of lymphatic spread. This concept has been extended over time to numerous neoplastic forms, particularly with a unitary or

almost unitary origin. This has led to extensive applications of the technique, in particular in breast cancer, where it has revolutionized the concept of the severity of the pathology and subsequent diagnostic-therapeutic procedures [26,27].

3. CONCLUSIONS

In conclusion it must be considered the possibility offered to nuclear medicine to be a primary protagonist in the development of the diagnosis and therapy of complex pathologies, including a series of rare diseases [28]. Therefore, lymphoscintigraphy is confirmed as the "gold standard" procedure for the diagnosis of lymphedema. Due to its reproducibility and limited invasiveness, it is recommended for the diagnosis and assessment of treatment response in adults and pediatric patients. However, it should be stated that due to the essential role played by this procedure in the clinical management of primary and secondary lymphedema, an effort must be made for the standardization of this diagnostics in order to provide clinicians with a consistent and reliable technical methodology [11, 29].

Furthermore, preoperative lymphoscintigraphy is recommended to confirm effective absorption and direction of radiotracer migration into sentinel nodes during lymphatic mapping for breast cancer [30]. In addition, preoperative lymphatic mapping can provide a useful visual aid to the relative position of the sentinel nodes within a lymph node basin [31, 32].

REFERENCES

[1] Szuba A., Shin W.S., Strauss H.W. andRockson S. The third circulation: radionuclide lymphoscintigraphy in the evaluation of lymphedema. J Nucl Med.44:43 (2003)

[2] Taghian N.R., Miller C.L., Jammallo L.S., O'Toole J. and Skolny M.N. Lymphedema following breast cancer treatment and impact on quality of life: a review. Crit Rev OncolHematol. 92, 227 (2014)

[3] Finnane A., Hayes S.C., Obermair A. and Monika J. Quality of life of women with lowerlimb lymphedema following gynecological cancer. Expert Rev Pharmacoecon Outcomes Res. 11, 287 (2011)

[4] Mango L. Linfoscintigrafia: valore diagnostico, prognostico e preventivo. Atti V Congresso Nazionale ITALF Napoli , 10 (2019)

[5] Sherman A.I., and Ter-Pogossian M. Lymphnode concentration of radioactive colloidal gold following interstitial injection. Cancer. 6, 1238 (1953)

[6] International Society of Lymphology. The diagnosis and treatment of peripheral lymphedema: 2016 consensus document of the International Society of Lymphology. Lymphology. 49, 170 (2016)

[7] American Venous Forum. Handbook of venous and lymphatic disorders: guide-lines of the American Venous Forum. CRC Press; (2009)

[8] Mangano A.M., Addabbo W., Semprebene A., Ventroni G. and Mango L. Search Sentinel Lymph Node in Melanoma: SPECT/CT Added Value. A Case Report. J Cancer Res Forecast. 1(1), 1001 (2018)

[9] Jiang Y., Hou G., and Cheng,W. 99mTc-SC lymphoscintigraphy and SPECT/CT findings in a case report of Gorham-Stout disease presenting with chylothorax and bone pain. Medicine, 98(14), e15023 (2019)

[10] Mango L., Ventroni G. and Michelini S. Lymphoscintigraphy and clinic. Res Rev Insights. 1(1), 1 (2017)

[11] Maccauro M., Villa G., Manzara A., Follacchio G.A., Manca G., et al. Lymphoscintigraphy for the evaluation of limb lymphatic flow disorders: Report of technical procedural standards from an Italian Nuclear Medicine expert panel. Rev Esp Med Nucl Imagen Mol. 38(5), 335 (2019)

[12] Mango L. Quality assurance and patient safety in nuclear medicine. International Journal of Radiology Research 2(1), 11 (2020)

[13] Law M., Cheng K.C., Wu P.M., Ho W.Y. and Chow L.W.C. Patient effective dose from sentinel lymph node lymphoscintigraphy in breast cancer: a study using a female humanoid phantom and thermoluminescent dosimeters. Br J Radiol. 76,818 (2013)

[14] Pandit-Taskar N., Dauer L.T., Montgomery L., St. Germain J., Zanzonico P.B. et al. Organ and fetal absorbed dose estimates from99mTc-sulfur colloid lymphoscintigraphy and sentinel node localization in breast cancer patients. J Nucl Med. 47, 1202 (2006)

[15] Cremonesi M., Ferrari M., Sacco E., RosiA., De Cicco C.et al. Radiation protection in radio guided surgery of breast cancer. Nucl Med Commun. 20, 919 (1999)

[16] GE Healthcare S.r.l. Italian Drug Agency A.I.C. n. 038981015

[17] Watt H., Singh-Grewal D., Wargon O., Adams S. Paediatric lymphoedema: A retrospective chart review of 86 cases. J Paediatr Child Health 53:, 38 (2017)

[18] ElHabnouni C., Tauveron V., Leducq S., Geremia S., Allain P. et al. Short-term Effect and Acceptability of Manual Lymphatic Drainage for Paediatric Limb Lymphoedema: A Prospective Study. ActaDermVenereol 100(6-7), 1 (2020)

[19] Mango L., Michelini S., Failla A., Moneta G. Lymphoscintigraphy and clinicalevidence. Eur. J. Lymphology 15, 27 (2005)

[20] Michelini S., Failla A., Moneta G., Mango L. and Iannacoli M. Iatrogenic secondary lymphedema: a reality to be avoided. Eur. J. Lymphology 9, 99 (2001)

[21] Warren L.E.G., Miller C.S., Horick N., Melissa N., Skolny M.N., Jammallo L.S. et al. The Impact of Radiation Therapy on the Risk of Lymphedema After Treatment for Breast Cancer: A Prospective Cohort Study. Int J RadiatOncolBiol Phys, 88(3), 565 (2014)

[22] Sağinç H., Özsaran Z., Baltalarli B. and Yildirim O. Assessment of Arm Lymphedema and Late Skin Side Effects in Breast Cancer Patients Who Received Postoperative Adjuvant Radiotherapy. TurkiyeKlinikleri J Med Sci 38(2), 99 (2018)

[23] Kim S.I., Lim M.C., Lee J.S., Kim Y., Seo S.S., et al. Comparison of lower extremity edema in locally advanced cervical cancer: pretreatment laparoscopic surgical staging with tailored radiotherapy versus primary radiotherapy. Ann. Surg. Oncol. 23(1),203 (2016)

[24] Roman M.M., Barbieux R., Nogaret J.M. and Bourgeois P. Use of lymphoscintigraphy to differentiate primary versus secondary lower extremity lymphedema after surgical lymphadenectomy: a retrospective analysis. World J SurgOncol16, 75 (2018)

[25] Morton D.L., Wen D.R., Wong J.H.,Economou J.S., Cagle L.A., et al. Technical details of intraoperative lymphatic mapping for early stage melanoma. Arch Surg 127, 392 (1992)

[26] Gucciardo G., Schiavo R., Grillo L.R., Mencacci R., Mango L. et al. The success rate of identification of the sentinel lymph node in breast cancer: our training series. Tumori86, 312 (2000)

[27] Giuliano A.E. The evolution of sentinel node biopsy for breast cancer: Personal experience. Breast J. 26(1), 1721 (2020)

[28] Mango L. Nuclear Medicine in the Third Millennium. J Nucle Med Clinic Imag. 1(1). 001 (2019)

[29] Sarica M., Gordon K., van Zanten M., Heenan S.D., Mortimer P.S., et al. Lymphoscintigraphic Abnormalities Associated with Milroy Disease and Lymphedema-Distichiasis Syndrome. Lymphat Res Biol. 17(6), 610 (2019)

[30] Mariani G., Erba P., Villa G., Gipponi M., Manca G., et al. Lymphoscintigraphic and intraoperative detection of the sentinel lymph node in breast cancer patients: The nuclear medicine perspective. J SurgOncol 85, 112 (2004)

[31] Mango L. and Ventroni G. Sentinel node mapping in breast cancer: drainage to multiple axillary nodes after intradermal injection (Planar Imaging). In: G. Mariani et al. eds, Atlas of Lymphoscintigraphy and Sentinel node Mapping. Springer 2013 pp.139.

[32] Kenneth A.K. and Rosenberg R.J. Preoperative lymphoscintigraphy during lymphatic mapping for breast cancer: improved sentinel node imaging using subareolar injection of technetium 99m sulfur colloid. J. Am. Coll. Surg. 191, 479 (2000)

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