Role of DWI assessing nodal involvement and response to neoadjuvant chemotherapy in advanced breast cancer

Poster No.: B-0117
Congress: ECR 2015
Type: Scientific Paper
Authors: C. Buccheri, E. Bufi, A. Bonatesta, R. Fubelli, M. Tumino, F. Padovano, F. Patrolecco, P. Belli, L. Bonomo; Rome/IT
Keywords: Breast, Lymph nodes, MR-Diffusion/Perfusion, Staging, Cancer, Metastases
DOI: 10.1594/ecr2015/B-0117

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

Breast MRI is the gold standard technique for the assessment of response to neoadjuvant chemotherapy in advanced breast cancer, since it best evaluates residual disease and assists in planning surgical treatment [1-3]. In regard to restaging of the axilla after chemotherapy, breast MRI has shown 59% sensitivity, 61% specificity, 43% PPV and 75% NPV when morphologic criteria are considered, thus resulting inadequate to preclude surgical axillary staging. [4,5] According to the results of recent surgical trials [6], axillary node dissection can be omitted under certain preconditions (tumour smaller than 5 cm, cN0, M0, planned breast whole irradiation for breast conservative surgery) in patients with affected sentinel lymph nodes without altering local recurrence rate significantly. Thus, the role of radiologists in staging of the axilla would consist in identifying the presence of axillary metastases with a positive predictive value high enough to be useful to the surgeon in deciding when to proceed directly to axillary lymph node dissection. [7] Applicability of the results of this trial are on debate [8, 9] and still not considered in the setting of neoadjuvant chemotherapy. [10] In this particular setting, since studies in literature have demonstrated a reduction in diagnostic performance of sentinel lymph node biopsy [11,12], a diagnostic technique which reflects microscopic changes as DWI, could be a support in decision making. Utility of DWI imaging has been demonstrated for assessment of response to chemotherapy in primary breast lesions [13]. Although many works in literature have explored the utility of DWI assessing nodal status in pathologic axilla at the time of diagnosis, reporting different cut-off values of ADC and a good overall diagnostic performance [14-18], to our knowledge possible role of DWI in restadiation of axillary lymph nodes after neoadjuvant chemotherapy has not been investigated yet. Aim of this study is to assess variations in mean ADC values and in number (N) of axillary nodes in DWI images during neoadjuvant chemotherapy, taking into account all the visible lymph nodes in both healthy and pathologic axilla, and possible relation of these values with nodal disease status.
**Methods and materials**

MRI examinations of 27 patients diagnosed with locally invasive breast cancer addressed to neoadjuvant chemotherapy were retrospectively reviewed. MRI examinations were performed at the time of diagnosis and after the end of neoadjuvant treatment, as indicated in the RECIST 1.1 guidelines [19]. All of the Patients underwent breast surgery with complete axillary lymph nodes dissection, thus histopathologic diagnosis of nodal status of the whole pathologic axilla was achieved. MRI examinations were acquired with a 1.5T magnet, and DWI images were obtained at b values of 1000 and 0, in order to obtain ADC maps. Lymph nodes in pathologic axilla and in contralateral healthy axilla were detected as focal areas of hyperintensity in DWI; in order to differentiate lymph nodes from other structures, such as vessels, we took T1w post-contrast images as reference. Multiple ROI surrounding each lymph node were placed both in pathologic and in healthy axilla, in order to obtain ADC values. Mean values of calculated ADCs were obtained for each axilla at the time of diagnosis (0) and after chemotherapy (1). Obtained mean ADC values and number of lymph nodes (N) in pathological axilla (PA) (further stratified between "responders" and "non responders") and in the healthy one (HA), at time 0 and time 1 were compared using the t-test.
Results

ADC mean value was 0.8408 ± 0.218 × 10⁻³ mm²/s at time 0 and 0.888 ± 0.203 × 10⁻³ mm²/s at time 1 in pathologic axilla, this small difference being not statistically significant (p= 0.314) (Fig.1); there was not significant difference as well between ADC mean values in healthy axilla at time 0 and time 1 (0.840 ± 0.232 × 10⁻³ mm²/s and 0.846 ± 0.24 × 10⁻³ mm²/s respectively, p= 0.9) (Fig. 2). Small decrease in number of lymph nodes detected in pathologic axilla was registered between time 0 (5.35 ± 2.95) and time 1 (4.65 ± 2.77), although this difference was not statistically significant (p=0.274), while this value remained almost constant in healthy axilla (3.42 ± 2.41 at time 0 and 3.58 ± 2.84 at time 1 ,p= 0.76) (Fig.3). In pathologic axilla there was a small, not statistically significant difference in ADC mean values between "responders" (0.908 ± 0.21×10⁻³ mm²/s) and "non responders" (0.871 ± 0.22×10⁻³ mm²/s) at time 0 (p=0.26) (Fig.4), this difference becoming higher and statistically significant after chemotherapy (0.995 ± 0.19×10⁻³ mm²/s in responders and 0.826 ± 0.19×10⁻³ mm²/s in non responders, p= 0.049)(Fig.5). (Fig.6 - Fig.14 Patient n.1,"non responder"; Fig.15 - Fig.23 Patient n.2, "responder").
Fig. 1: Bar chart showing mean ADC value and standard deviation in pathologic axilla at time 0 (0.8408 ± 0.218) and time 1 (0.888 ± 0.203), (p= 0.314).

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 2: Bar chart showing mean ADC value and standard deviation in healthy axilla (HA) at time 0 (0.84 ± 0.232) and time 1 (0.846 ± 0.24), (p= 0.9).

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 3: Bar chart showing mean and standard deviation of N (number of lymph nodes) in PA and HA at time 0 and time 1. Small decrease in number of lymph nodes detected in pathologic axilla was registered between time 0 (5.35 ± 2.95) and time 1 (4.65 ± 2.77), (p=0.274). No significant variations were registered in healthy axilla (3.42 ± 2.41 at time 0 and 3.58 ± 2.84 at time 1, p= 0.76).

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 4: Bar chart showing mean ADC value and standard deviation in pathologic axilla (PA) stratified between “responders” (0.908 ± 0.21) and “non responders” (0.871 ± 0.22) at time 0, (p=0.26).

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 5: Bar chart showing mean ADC value and standard deviation in pathologic axilla (PA) stratified between "responders" (0.995 ± 0.19) and "non responders"(0.826 ± 0.19) at time 1, (p= 0.049).

© Dipartimento di Radiologia,Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
**Fig. 6:** DWI images and ADC maps of Patient n.1, non responder, at time 0. Lymph nodes from 1 to 5 in left axilla (pathologic axilla) show mean ADC value of $0.84\times10^3$ mm$^2$/s; lymph nodes 6 and 7 in right axilla (healthy axilla) show mean ADC value of $1.01\times10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 7: DWI images and ADC maps of Patient n.1, non responder, at time 0. Lymph nodes from 1 to 5 in left axilla (pathologic axilla) show mean ADC value of $0.84 \times 10^3$ mm$^2$/s; lymph nodes 6 and 7 in right axilla (healthy axilla) show mean ADC value of $1.01 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
**Fig. 8:** DWI images and ADC maps of Patient n.1, non responder, at time 0. Lymph nodes from 1 to 5 in left axilla (pathologic axilla) show mean ADC value of $0.84 \times 10^3$ mm$^2$/s; lymph nodes 6 and 7 in right axilla (healthy axilla) show mean ADC value of $1.01 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
**Fig. 9:** DWI images and ADC maps of Patient n.1, non responder, at time 1. Lymph nodes from 1 to 7 in left axilla (pathologic axilla) show mean ADC value of $0.77 \times 10^3$ mm$^2$/s; mean ADC value of lymph nodes in healthy axilla (8 to 12) is $0.86 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 10: DWI images and ADC maps of Patient n.1, non responder, at time 1. Lymph nodes from 1 to 7 in left axilla (pathologic axilla) show mean ADC value of 0.77×10^{-3} mm²/s; mean ADC value of lymph nodes in healthy axilla (8 to 12) is 0.86×10^{-3} mm²/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 11: DWI images and ADC maps of Patient n.1, non responder, at time 1. Lymph nodes from 1 to 7 in left axilla (pathologic axilla) show mean ADC value of 0.77×10⁻³ mm²/s; mean ADC value of lymph nodes in healthy axilla (8 to 12) is 0.86×10⁻³ mm²/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 12: DWI images and ADC maps of Patient n.1, non responder, at time 1. Lymph nodes from 1 to 7 in left axilla (pathologic axilla) show mean ADC value of $0.77 \times 10^3$ mm$^2$/s; mean ADC value of lymph nodes in healthy axilla (8 to 12) is $0.86 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 13: DWI images and ADC maps of Patient n.1, non responder, at time 1. Lymph nodes from 1 to 7 in left axilla (pathologic axilla) show mean ADC value of $0.77 \times 10^{-3}$ mm$^2$/s; mean ADC value of lymph nodes in healthy axilla (8 to 12) is $0.86 \times 10^{-3}$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
**Fig. 14:** DWI images and ADC maps of Patient n.1, non responder, at time 1. Lymph nodes from 1 to 7 in left axilla (pathologic axilla) show mean ADC value of $0.77 \times 10^3$ mm$^2$/s; mean ADC value of lymph nodes in healthy axilla (8 to 12) is $0.86 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT

**Fig. 15:** DWI images and ADC maps of Patient n.2, responder, at time 0. Six lymph nodes in right axilla (pathologic axilla) show mean ADC value of $1.01 \times 10^3$ mm$^2$/s; lymph nodes in healthy axilla (7 to 9) show mean ADC value of $1.06 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 16: DWI images and ADC maps of Patient n.2, responder, at time 0. Six lymph nodes in right axilla (pathologic axilla) show mean ADC value of $1.01 \times 10^3$ mm$^2$/s; lymph nodes in healthy axilla (7 to 9) show mean ADC value of $1.06 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 17: DWI images and ADC maps of Patient n.2, responder, at time 0. Six lymph nodes in right axilla (pathologic axilla) show mean ADC value of $1.01 \times 10^3$ mm$^2$/s; lymph nodes in healthy axilla (7 to 9) show mean ADC value of $1.06 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
**Fig. 18:** DWI images and ADC maps of Patient n.2, responder, at time 1. Lymph nodes from 5 to 13 in right axilla (pathologic axilla) show ADC mean value of $0.98 \times 10^3$ mm$^2$/s. Lymph nodes from 1 to 4 in left axilla (healthy axilla) show mean ADC value of $0.64 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 19: DWI images and ADC maps of Patient n.2, responder, at time 1. Lymph nodes from 5 to 13 in right axilla (pathologic axilla) show ADC mean value of $0.98 \times 10^3$ mm$^2$/s. Lymph nodes from 1 to 4 in left axilla (healthy axilla) show mean ADC value of $0.64 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 20: DWI images and ADC maps of Patient n.2, responder, at time 1. Lymph nodes from 5 to 13 in right axilla (pathologic axilla) show ADC mean value of $0.98 \times 10^3$ mm$^2$/s. Lymph nodes from 1 to 4 in left axilla (healthy axilla) show mean ADC value of $0.64 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 21: DWI images and ADC maps of Patient n.2, responder, at time 1. Lymph nodes from 5 to 13 in right axilla (pathologic axilla) show ADC mean value of $0.98\times10^3$ mm$^2$/s. Lymph nodes from 1 to 4 in left axilla (healthy axilla) show mean ADC value of $0.64\times10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 22: DWI images and ADC maps of Patient n.2, responder, at time 1. Lymph nodes from 5 to 13 in right axilla (pathologic axilla) show ADC mean value of $0.98 \times 10^3$ mm$^2$/s. Lymph nodes from 1 to 4 in left axilla (healthy axilla) show mean ADC value of $0.64 \times 10^3$ mm$^2$/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
Fig. 23: DWI images and ADC maps of Patient n.2, responder, at time 1. Lymph nodes from 5 to 13 in right axilla (pathologic axilla) show ADC mean value of 0.98×10³ mm²/s. Lymph nodes from 1 to 4 in left axilla (healthy axilla) show mean ADC value of 0.64×10³ mm²/s.

© Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Policlinico A. Gemelli, Roma/IT
**Conclusion**

Our preliminary data showed an overall uniformity in ADC values between pathologic and healthy axilla at the time of diagnosis; consequently, mean ADC value of the entire axilla is not useful in detecting pathologic lymph node involvement. Overlapping in these findings could be related to the hypercellular microstructure of lymph nodes due to the presence of lymphocytes [7]; on the other hand, arithmetic mean, which we adopted as a parameter representative of the entire axilla, could have reduced any difference due to single lymph node's ADC values. We observed a small increase of mean ADC value and a decrease in number of lymph nodes after chemotherapy in pathologic axilla, even with p values >0.05, probably due to small number of patients, thus further data is needed to confirm these findings; no significant variations in these parameters were appreciated in HA. Focusing on pathologic axilla, ADC mean value was higher in responder vs non responder at time 0, even though p value was >0.05, and this difference became higher at time 1 reaching statistical significance (p=0.049); on the basis of this, ADC mean value of pathologic axilla at the time of diagnosis could be a predictive factor of response to chemotherapy, while its value after chemotherapy could be an indicator of pathologic response. There are some limitations in this study. First, we have examined a low number of Patients, so further data is needed to confirm some findings which still didn't reach statistical significance. The small amount of available data didn't allow us to differentiate ADC values between responders vs micrometastasis, whose cellularity could be too poor to affect ADC value. Also, we haven't performed intra- and inter-observer variability in measurement of ADC, whose entity could affect feasibility of differentiation between malignant and benign lymph nodes according to literature. [20] Further investigation is needed to confirm clinical relevance of our findings.
Personal information

Chiara Buccheri,

Dipartimento di Radiologia, Università Cattolica del Sacro Cuore, Polyclinico A.Gemelli, Roma

chiara.buccheri@hotmail.com
References


