An Analysis of Nipple Enhancement at Breast MRI with Radiologic-Pathologic Correlation

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Jeffrey S. Klein, MD  Hi. I’m Jeff Klein, Editor of *RadioGraphics* and today I am pleased to have with us Dr. Yiming Gao from the Department of Radiology at NYU Langone Medical Center, who is the first author of one of our featured papers in the current January 2019 issue of *RadioGraphics*, and her paper is entitled, “Physiologic or Pathologic: An Analysis of Nipple Enhancement Anatomy on Breast MRI with Radiologic Pathologic Correlation”. Dr. Gao, welcome to our podcast.

Yiming Gao, MD  Thank you.

JSK  So Yiming, your paper begins by pointing out the importance of evaluating the nipple areolar complex on breast MRI. Can you summarize for our listeners the issues surrounding the assessment of the nipple region as it relates to cancer staging and in avoiding false-positive findings on contrast-enhanced breast MRI?

YG  Sure. Contrast-enhanced breast MRI is currently used primarily in two settings: both for diagnostic purposes and for screening purposes. And for diagnostics breast MR is most commonly used for cancer staging because tumor involvement of the nipple areolar complex upstages disease and is relevant to treatment management. So assessment of nipple areolar region on MRI is very important. Particularly given this area is often poorly assessed on other modalities that we have such as mammography or ultrasound. And in most recent surgical literature there has been a push to sort of lower the threshold for safe performance of nipple sparing mastectomies. For example, the conventionally established safe tumor to nipple distance has been 2cm or greater and the normal thickness of this superficial linear enhancement should not, in general, exceed 2mm. And if we move to Figure 6 what’s being depicted here is what’s called superficial linear enhancement. This refers to a thin rim of smooth superficial enhancement of the nipple areolar complex at the level of the skin with intensity greater than the adjacent skin. And as you can see here in the two separate examples, this enhancement is most commonly used for cancer staging because tumor involvement of the nipple areolar complex upstages disease and is relevant to treatment management.

JSK  Great. Thank you. So now your paper reviews the normal MRI nipple areolar findings in 265 normal patients that underwent screening breast MR at your institution. Following a review of the MRI appearance of the nipple areolar complex for the staging of cancer and for the adjunctive screening of women at high risk for breast cancer as you mentioned, you proceed to state that there is little information on the MR appearances of normal nipple enhancement. Based on a retrospective review of your patients, your paper describes a series of normal findings based on the use of a descriptive terminology that was extracted from the existing literature. Can we review the terms to be used to describe the various nipple enhancement patterns that are illustrated in Figures 6 through 8?

YG  Yes. So just a word about the terminology, our descriptive terminology is indeed based on a prior study from back in 1997 and refined by our own observations based on exams performed pre-tesla MRI with input from our pathologist’s colleagues. So in Figure 6 what’s being depicted here is what’s called superficial linear enhancement. This refers to a thin rim of smooth superficial enhancement of the nipple areolar complex at the level of the skin with intensity of enhancement greater than the adjacent skin. And as you can see here in the two separate examples, this enhancement may be limited to the nipple proper or extend into the areolar region depending on the subjects. It’s usually symmetric and the normal thickness of this superficial linear enhancement should not, in general, exceed 2mm. And if we move on to Figure 7, we’re indicating here the non-enhancing zone and as the name indicates it’s a zone of non-enhancement located immediately subjacent to the superficial linear enhancement. And this corresponds to the dermis on pathology correlation. And then further on to Figure 8, as you can see, we are now depicting internal nipple enhancement which is really enhancement subjacent to the superficial lin-
ear enhancement and non-enhancing zone now within the substance of the nipple and it may be linear or patchy in appearance or distribution based on our study.

**JSK** Great. The next section compares normal breast specimens with findings on contrast enhanced MRI. You then describe abnormal nipple enhancement patterns beginning with the loss of the normal superficial linear enhancement pattern as can be seen in Paget disease of the nipple. Figure 12 shows such a case. Can you take us through this case?

**YG** Sure. So this is a case of Paget disease of the nipple which is essentially adenocarcinoma involving the epidermis of the nipple. This is typically associated with inflammatory erosions and excoriations and because normal epidermal enhancement of nipple on MR it manifests as the superficial linear enhancement that we just described, this layer is obliterated and so MR you no longer perceive the superficial linear enhancement. And similarly because of tumor infiltration into the dermis as well, the previously described non-enhancing zone is also similarly no longer seen and if you look at the nipple grossly, the morphology is abnormal and retracted. The enhancement is also very avid and isointense to the underlying tumor within the breast. So in such a way the normal structural anatomy is disrupted.

**JSK** Thank you. So the paper next describes the disruption of normal anatomic boundaries and then discusses abnormal enhancement intensity. In particular the concept that any nipple enhancement that exceeds background parenchymal enhancement warrants further investigation. Importantly, you point out in the paper that both malignant and benign conditions could produce this finding. Let’s look at Figure 15 which is a case of DCIS that nicely illustrates this finding.

**YG** This is a case of cancer recurrence after nipple sparing mastectomy. In this case you see avid abnormal enhancement within the native nipple, which does not stop at the base of the nipple as we previously described normal internal nipple enhancement to be, but it extends below it and stopping only short at the surgical junction line between the reconstructed flap and the native tissue. So this is also much higher in intensity than would be expected for physiologic background parenchymal enhancement, although it’s somewhat difficult to rationalize this finding. Interestingly because the recurrence arose from a large central native duct within the nipple, you can see in this case actually the superficial linear enhancement and the non-enhancement zone are both preserved. This was high grade DCIS at surgery. So as you mentioned, one of our key findings from the study is that nipple enhancement compared to background parenchymal enhancement is an important indicator of whether it may be abnormal. And certainly they’re both benign and malignant etiologies and we’ve had some benign examples also in the paper.

**JSK** Alright, well thank you for that. So now the final section of the paper details artifacts and pitfalls including motion artifacts and nipple malposition, inverted nipples, skin lesions, and benign asymmetry. Can we show Figure 21 which shows how skin disease can present as abnormal nipple enhancement on MRI?

**YG** So speaking to motion, I just want to say nipples are very small structures that are very prone to motion at MR scanning. So positioning the patient well and careful instructions are very important before scanning. In fact in our study a large number of cases had to be excluded because of significant artifacts involving the nipples making it impossible to interpret. In this particular case here shown in the figure, there is abnormal asymmetric enhancement of the left nipple which turned out to be an inflamed Montgomery gland cyst involving the areola. But this is only clear after clinical correlation which highlights importance of clinical history. And so a nipple is a tricky area to assess, often time surgical consultation is maybe needed because nipple abnormalities are usually not amenable to a percutaneous sampling or biopsy. So that’s that case.

**JSK** Great. Well so Dr. Gao thanks so much for taking the time today to discuss your paper on MRI of nipple areolar complex, which can be found in the current January 2019 issue of *RadioGraphics*. Thanks so much.

**YG** Thank you.