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DIAGNOSTIC ALGORITHM FOR CLARIFYING INTRADUCTAL PAPILLOMA WITHOUT GALACTOGRAPHY

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Intraductal papilloma is a benign proliferative lesion of the mammary ducts that can mimic malignancy on clinical and radiological grounds. While galactography is typically used for evaluation, its absence can delay diagnosis. We present a case study of a 35-year-old woman with typical intraductal papilloma symptoms but without access to galactographic evaluation. Diagnosis relied on alternative modalities, including ultrasonography, digital breast tomosynthesis, and MRI, followed by histopathological confirmation. Initial imaging revealed a hypo-echoic lesion with irregular margins and no vascular signals. Subsequent ultrasonography revealed a hyper-echoic intraductal focus. Digital breast tomosynthesis was inconclusive, while MRI showed non-mass enhancement categorized as BI-RADS 4. Histological analysis confirmed a solitary intraductal papilloma with no atypia or malignancy. This case highlights that in the absence of galactography, a structured diagnostic pathway incorporating ultrasonography, digital breast tomosynthesis, and MRI can effectively identify intraductal papilloma. Early recognition and multidisciplinary assessment are essential to avoid misdiagnosis and ensure timely management.

Key words: galactography-lack circumstances, Intraductal papilloma, magnetic resonance imaging, ultrasonography, tomosynthesis.

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АЛГОРИТМ ДІАГНОСТИКИ ІНТРАДУКТАЛЬНОЇ ПАПІЛОМИ БЕЗ ГАЛАКТОГРАФА

Інтрадуктальна папілома – доброякісне проліферативне ураження молочних проток, яке може імітувати злоякісні новоутворення за клінічними та рентгенологічними ознаками. Для оцінки інтрадуктальної папіломи зазвичай використовується галактографія, з цієї причини відсутність апарату або професійного фахівця може затримати постановку діагнозу. Ми представляємо клінічне спостереження за 35-річною жінкою з типовими симптомами інтрадуктальної папіломи без галактографа, через відсутність якого діагноз був поставлений на підставі альтернативних методів, включаючи УЗД, цифровий томосинтез молочних залоз і МРТ з подальшим гістопатологічним підтвердженням. Первинна візуалізація виявила гіпоехогенне утворення з нерівними краями і відсутністю судинних сигналів. Подальше УЗД виявило гіперехогенне внутрішньопротокове вогнище. Цифровий томосинтез не дав однозначного результату, тоді як МРТ виявила немасивне посилення сигналу, класифіковане як BI-RADS 4. Гістологічний аналіз підтвердив наявність поодинокої інтрадуктальної папіломи без ознак атипії або злоякісності. Даний випадок демонструє, що за відсутності галактографії структурований діагностичний алгоритм, що включає УЗД, цифровий томосинтез і МРТ, дозволяє ефективно виявляти інтрадуктальну папілому. Раннє виявлення патології та міждисциплінарна оцінка мають вирішальне значення для запобігання помилкової діагностики та забезпечення своєчасного лікування.

Ключові слова: діагностика без галактографа, інтрадуктальна папілома, магнітно-резонансна томографія, ультрасонографія, томосинтез.

Intraductal papilloma (IDP) is a benign proliferative neoplasm originating from the epithelial lining of the mammary ducts, characterized by the growth of papillary structures into the ductal lumen. Lesions can range in size from 3 mm to over 2 cm, although they are typically detectable by imaging modalities when exceed 10 mm [1]. IDPs may present as solitary or multiple lesions. When present in clusters (typically more than five, the condition associated with a heightened risk for malignancy), it is termed papillomatosis.

Diagnostic evaluation of IDP using mammograph, US, galactograph and MRI can be required to establish a diagnosis, for which the following multimodal imaging strategy is employed, utilizing both conventional and adjunctive techniques to enhance diagnostic accuracy. Mammograph/tomosynthesis technical option serves as the initial imaging modality but has limited sensitivity for small intraductal lesions, and may demonstrate ductal dilatation or soft-tissue densities, often without specific features [4, 5]. Galactography remains a useful adjunct computational mechanics in cases of pathologic nipple discharge. By instilling contrast into the ductal system, it can identify intraductal filling defects and delineate ductal architecture, although it lacks specificity [6]. US technical option is particularly valuable for evaluating symptomatic patients with nipple discharge can identify intraductal masses, dilated ducts, or cystic lesions and allows for real-time assessment. The use of color doppler enhances diagnostic specificity by

revealing vascular flow within a lesion, supporting the identification of a vascular stalk [2]. MRI, especially with contrast enhancement, provides high sensitivity for the detection of small intraductal lesions [1].

Differential Diagnosis of IDP primarily involves distinguishing them from malignant intraductal and papillary lesions, including DCIS, invasive ductal carcinoma with an in-situ component and papillary carcinoma [2]. Breast carcinoma may mimic the imaging appearance of IDP, particularly in early or limited lesions, necessitating histologic confirmation [8]. Papillary carcinoma of the breast can also closely mimic the sonographic appearance of benign papillomas, particularly due to its intraductal growth pattern and potential presence of a vascular stalk [14]. Given these diagnostic overlaps, particularly in early or subtle presentations, histopathologic confirmation through core needle biopsy or excision remains essential to establish an accurate diagnosis and guide appropriate clinical management [7, 12]. Due to the potential for diagnostic overlap, especially on ultrasound, meticulous image analysis and correlation with clinical and histopathologic findings are essential for accurate diagnosis. Digital breast tomosynthesis (DBT) offers improved lesion characterization and ductal visualization over conventional mammography, particularly in dense breast tissue [13]. Ductoscopy (mammary duct endoscopy) enables direct visualization of the ductal lumen with intraductal lesions [8] and may assist in targeted biopsy or surgical planning [3, 11]. Elastography may help distinguish benign from malignant lesions based on tissue stiffness, aiding in non-invasive risk stratification [10]. Contrast-enhanced ultrasound is an emerging technique that can provide additional vascular detail, potentially improving the evaluation of intraductal vascularized lesions [15]. The purpose of the study was to develop a reliable diagnostic algorithm for identifying IDP in galactograph-lack condition.

The purpose of the study was to develop a reliable diagnostic algorithm for identifying IDP in circumstances where galactography is unavailable, since traditionally, galactography has been a key diagnostic tool; however, limited availability of specialized equipment and expertise can delay diagnosis.

Materials and methods. This study is structured as a descriptive case report combined with a diagnostic algorithm review, focusing on the diagnostic clarification of IDP in a galactography-limited setting. The diagnostic process was conducted between December 2021 and February 2025 at the National Oncology Center, Baku, Azerbaijan. A 35-year-old female presented with intermittent pain in the right breast and spontaneous clear nipple discharge. The patient underwent a stepwise diagnostic workup that excluded galactography due to limited local availability. All diagnostic and interventional procedures were performed in accordance with institutional protocols and ethical standards. Imaging Techniques Employed.

US as initial and follow-up high-resolution B-mode and color Doppler breast ultrasound was performed using a LOGIQ P5 system (GE Healthcare). Lesion characteristics, ductal changes, and vascular flow were evaluated. The BI-RADS classification system was used to categorize imaging findings. Digital Breast Tomosynthesis (DBT) was performed for structural imaging and density evaluation. MRI was performed to evaluate non-mass enhancement patterns not resolved by DBT or US. Sequences included T1- and T2-weighted imaging, with fat suppression and post-contrast acquisition. A non-mass-enhancing linear focus in the central right breast was categorized as BI-RADS 4.

A core needle (Tru-Cut) biopsy was performed to obtain a preoperative tissue diagnosis. Following persistent symptoms and suspicious MRI findings, the patient underwent extended sector resection. Intraoperative frozen section and final histopathology were conducted. All specimens were reviewed by board-certified pathologists.

Results of the study and their discussion. In 2021, a 35-year-old female presented to the Diagnostics Department of the National Oncology Center with complaints of intermittent pain in the right breast and spontaneous clear nipple discharge. Due to the unavailability of galactography, alternative imaging modalities – including high-resolution ultrasound, DBT, and MRI – were employed in conjunction with histopathological evaluation.

Patient's initial clinical evaluation was performed on December 17, 2021: ultrasound examination revealed an irregular, compared to surrounding tissues hypo-echoic nodular lesion measuring approximately 14×9 mm, lacking well-defined borders, located in the upper outer quadrant of the right breast at the 11–12 o'clock position. Adjacent to this lesion, a smooth-bordered, cystic structure measuring 4x2.1mm with weak unilateral dorsal acoustic enhancement was visualized. This cystic structure was not considered clinically significant for further evaluation. Color Doppler sonography revealed only non-vascular nodular projections. As there were no significant indications warranting urgent hospitalization, the patient was discharged and sent home. Next years US examinations revealed a persistently irregular, hypo-echoic, heterogeneous lesion measuring 12×9 mm at the 11 o'clock position of the right breast. At that time, the area exhibited fibroadenomatous characteristics with ill-defined margins.

But her clinical symptoms did not subside, and later, on 04/09/24, patient again returned for a follow-up consultation, and the initial indication of her problem emerged during that ultrasound examination. This

final follow-up ultrasonography imaging demonstrated a single dilated duct (up to 3.2 mm) and a small, previously not indicated, hyper-echoic intraductal focus, raising suspicion for IDP (Fig. 1).

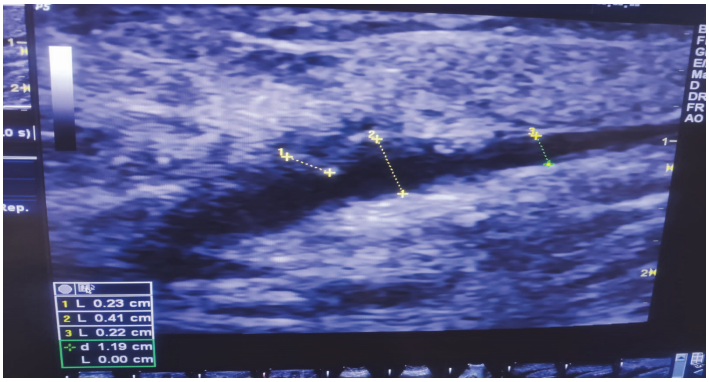


Fig. 1. US examination of right mammary gland at B-mode: A small pyper-echoic intraductal specimen in dilated ductus raised suspicion for IDP.

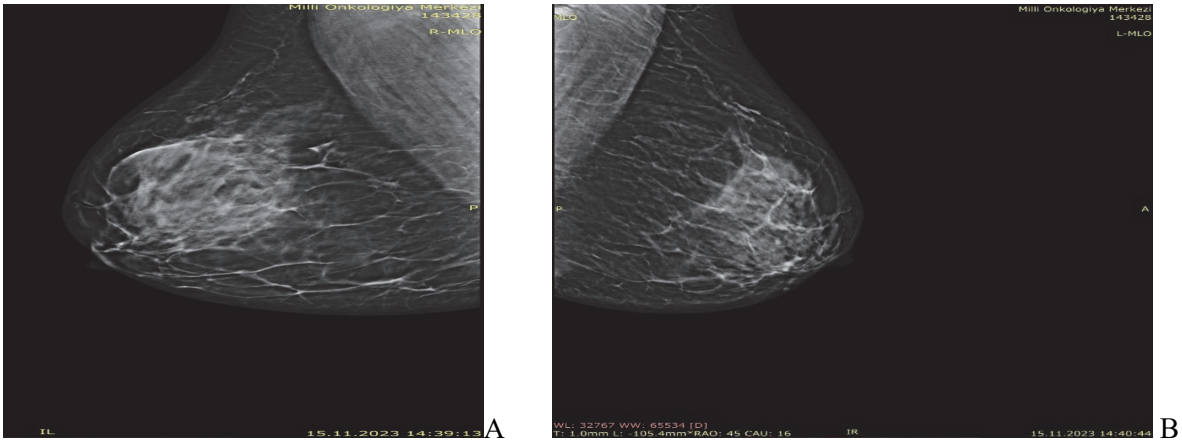
According to the ultrasound classification, the right breast was categorized as BIRADS 4A – indicating a suspicious abnormality for which a biopsy is recommended, while the left breast was classified as BIRADS 1 – showing no signs of malignancy. At this stage, galactography would typically be recommended; however, due to the absence of a specialized team in this field at the Azerbaijan National Oncology Center, we proceeded with alternative diagnostic methods described below.

Bypass steps for diagnosis in the Galactograph-lack option.

Galactography technique helps to visualize the lactiferous ducts and is typically done by a radiologist with expertise in breast imaging. In the absence of a galactographer/breast imaging, a combination of DBT mammography (tomosynthesis), and computed tomography (CT) may be utilized to improve diagnostic accuracy. This multimodal approach is particularly valuable when diagnostic uncertainty persists – especially in patients with dense breast tissue. In our case, we utilized tomosynthesis, which provides quasi-3D reconstructions of the breast, in conjunction with magnetic resonance imaging (MRI) instead of CT.

DBT (3D) mammography.

IDP remains a diagnostic challenge for tomosynthesis, and despite advancements in this mammographic technique, the machine failed to detect IDP in this patient. The tomosynthesis did not reveal the patient's issue and showed only bilateral fibroadenomatosis with a focal asymmetry in the right breast (Fig.2). The findings were assigned a BI-RADS 3 by the diagnostic radiologist and BI-RADS 2 by the screening radiologist, reflecting a discrepancy in interpretation, with the former suggesting a probably benign finding requiring short-term follow-up.



A B

Fig. 2. Mammography. A – 2D Mammography (full-field digital mammography); B – digital breast tomosynthesis (DBT/3D mammography).

Independently, tomosynthesis was insufficient for identifying the cause of the condition worsening: DBT obscures the underlying issue.

MRI Findings.

The patient's pain persisted and her condition worsened, prompting her to return to the clinic on 05/02/25. The MRI revealed a linear area of non-mass enhancement centrally located within the right breast (Fig.3). The differential diagnosis includes fibrocystic changes versus ductal hyperplasia. The lesion is categorized as BI-RADS 4, indicating a suspicious abnormality warranting tissue sampling.

Below, an algorithm outlining the preferred steps for clarifying the ductal papilloma diagnosis in the absence of galactographic imaging is presented.

Histopathological Evaluation.

As of February 11, 2025, microscopic evaluation of the Tru-Cut biopsy specimen showed only fibrocystic changes, with no evidence of malignancy detected at that time. Intraoperative frozen section

(24.02.2025) with urgent histological examination also revealed a malignancy-negative result with clear surgical margins of specimen. The further definitive histopathologal examination after the extended sector resection (24.02.2025) revealed only sclerosing adenosis, ductal ectasia, and a fibroadenomatous micronodule were identified xbt-o-3:9010/0 (ICD-O-3: 9010/0). However, in addition in the mammary duct a solitary intraductal papilloma was identified.

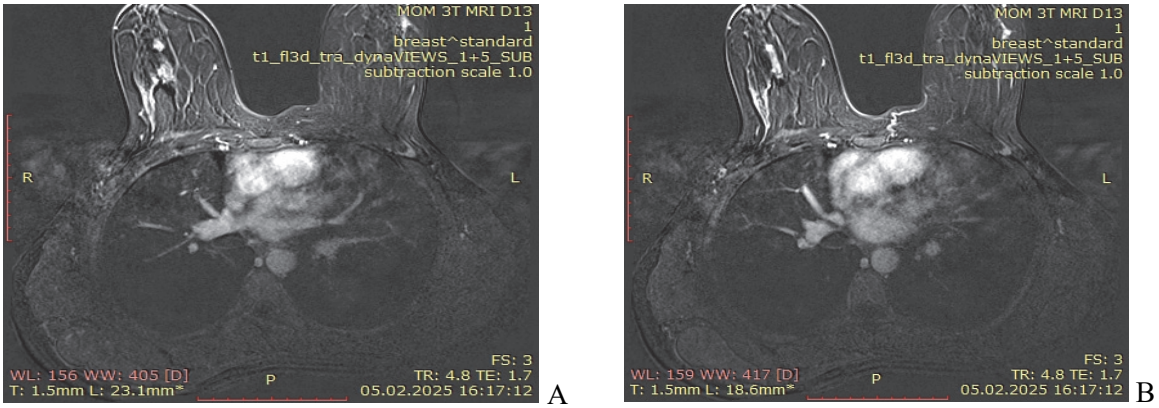


Fig. 3. Subtraction MRI. A – Early Subtraction MRI (initial enhancement phase) shows the first linear non-mass enhancement, suspicious for an intraductal lesion. B – Delayed subtraction MRI (progressive enhancement phase) demonstrates more intense enhancement of the same lesion, reflecting vascularity and supporting suspicion for intraductal papilloma versus other ductal pathology. MRI categorized the lesion as BI-RADS 4.

Our clinical observation emphasizes the diagnostic complexity of IDP in the absence of galactography. In this case, ultrasonography initially revealed a suspicious hypoechoic lesion with ill-defined margins, which evolved into a hyper-echoic intraductal focus. These findings are consistent with the value of ultrasound as the first-line modality in symptomatic patients, particularly in the context of nipple discharge, as highlighted by Hodge et al. (2023), who described similar ultrasonographic features in benign intraductal lesions. The use of color Doppler, although negative for vascular signals in our patient, is reported to improve diagnostic specificity by identifying vascular stalks within papillomas [9].

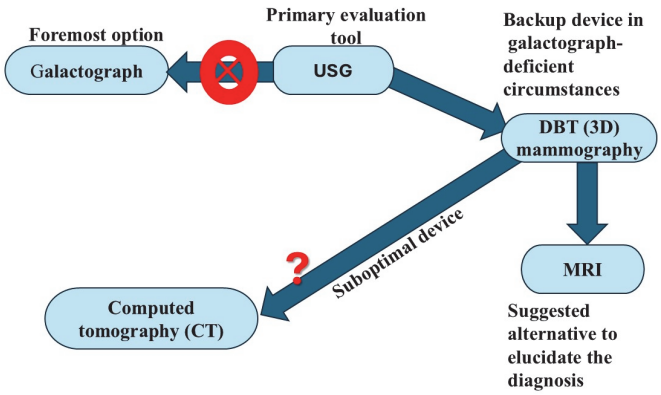


Fig. 4. Selecting device options algorithm in galactograph-limited settings for Intraductal papilloma diagnosis.

DBT did not reveal the papilloma in our case, showing instead fibroadenomatosis and asymmetry. This limitation aligns with the findings of Filipe et al. (2020) and Onega et al. (2023) who demonstrated that while DBT improves lesion characterization compared to conventional mammography, its sensitivity for small intraductal lesions remains suboptimal [8, 13]. Similar diagnostic challenges were noted by Cioni D. (2023), who underscored tomosynthesis' limited ability to detect non-mass intraductal abnormalities [5].

MRI in our patient detected linear non-mass enhancement, categorized as BI-RADS 4, which significantly contributed to the suspicion of IDP. This observation supports previous work by Abbassi-Rahbar et al. (2021), who emphasized MRI's high sensitivity in detecting small intraductal lesions, making it a critical adjunct when other imaging methods are inconclusive [1]. Furthermore, MRI's role in guiding biopsy decisions corresponds with Corbin et al. (2022), who noted that multimodal imaging combined with histological confirmation remains essential for distinguishing papillomas from malignant papillary neoplasms [5].

Histopathological evaluation ultimately confirmed a solitary intraductal papilloma without atypia or malignancy. This outcome is consistent with the low upgrade rates to carcinoma reported by Han et al. (2018) in cases of benign IDP diagnosed on core biopsy. Nonetheless, given the documented increased risk of progression to carcinoma, surgical excision remains the standard management approach in symptomatic or radiologically suspicious cases [9].

Taken together, our case demonstrates that in the absence of galactography, a multimodal diagnostic pathway – beginning with high-resolution ultrasound, supplemented by DBT, and confirmed by contrast-enhanced MRI – can provide a reliable strategy for the identification of IDP. This conclusion correlates with the growing body of literature supporting integrated imaging algorithms to minimize both underdiagnosis and overtreatment.

Conclusions

1. Ultrasound initially revealed an irregular hypo-echoic lesion (14×9 mm), evolving over time into a ductal dilatation with a hyper-echoic intraductal focus.

2. Color Doppler initially showed non-vascular projections, consistent with papilloma morphology.

3. DBT mammography failed to directly detect the lesion, showing only fibroadenomatosis and focal asymmetry.

4. MRI identified linear non-mass enhancement in the right breast (BI-RADS 4), raising suspicion for IDP.

5. BI-RADS categorization as right breast as 4A on ultrasound and MRI prompted tissue sampling.

6. Histopathology ultimately confirmed intraductal papilloma.

In settings where galactography is unavailable, a multimodal imaging algorithm becomes crucial. Starting with high-resolution ultrasound and DBT/mammography, clinicians should escalate to contrast-enhanced breast MRI when findings remain inconclusive. BI-RADS classification guides the need for biopsy, using core needle or vacuum-assisted techniques, with management decisions informed by histopathologic concordance and risk factors. This case demonstrates that sequential ultrasound monitoring, combined with MRI evaluation, can successfully identify IDP without galactography. Integrating evidence and imaging strategies facilitates reliable diagnosis, minimizing both missed lesions and unnecessary invasive procedures.

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