Aberrant metastasis of invasive pleomorphic lobular carcinoma: A case report and brief review of the literature

HADEEL ADNAN YASSEEN[1,2], ARI M. ABDULLAH[2,3], REBAZ M. ALI[4,5], LANA R.A. PSHTIWAN[6,7], KARZAN M. SALIH[8], ABDULWAHID M. SALIH[8,9], SAKAR O. ARIF[6], SHKO H. HASSAN[8], HARZAL H. FATIH[9], MASTY K. AHMED[9], ABDULLAH A. QADIR[8] and FAHMI H. KAKAMAD[1,10-12]

[1]College of Medicine, Department of Clinical Sciences, University of Sulaimani, Sulaymaniyah 46001, Iraq; [2]Department of Pathology, Smart Health Tower, Sulaymaniyah 46001, Iraq; [3]Department of Pathology, Sulaymaniyah Teaching Hospital, Sulaymaniyah 46001, Iraq; [4]Department of Oncology, Hiwa Cancer Hospital, Sulaymaniyah 46001, Iraq; [5]Department of Oncology, Smart Health Tower, Sulaymaniyah 46001, Iraq; [6]Department of Radiology, Smart Health Tower, Sulaymaniyah 46001, Iraq; [7]Department of Radiology, Shar Teaching Hospital, Sulaymaniyah 46001, Iraq; [8]Department of Head and Neck Surgery, Smart Health Tower, Sulaymaniyah 46001, Iraq; [9]Department of Breast Surgery, Smart Health Tower, Sulaymaniyah 46001, Iraq; [10]Department of Thoracic and Vascular Surgery, Smart Health Tower, Sulaymaniyah 46001, Iraq; [11]Department of Scientific Affairs, Smart Health Tower, Sulaymaniyah 46001, Iraq; [12]Kscien Organization for Scientific Research (Middle East Office), Sulaymaniyah 46001, Iraq

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Abstract. Pleomorphic lobular carcinoma (PLC) is a rare type of invasive lobular carcinoma. It is more aggressive and is associated with a poorer prognosis, and distinct cytologic characteristics. The present study reports a rare case of invasive PLC metastasis to the peritoneum and ovaries, and also performs a brief review of the literature. A 51-year-old woman with a family history of breast cancer presented with multiple right breast masses and right axillary lymphadenopathy. Imaging and biopsy confirmed invasive PLC, which was estrogen receptor (ER)/progesterone receptor (PR)-positive and human epidermal growth factor receptor 2 (HER2)-negative, with metastatic involvement of the axillary lymph nodes. Laparoscopy and immunohistochemistry revealed bilateral ovarian and peritoneal metastases. The patient was diagnosed with metastatic PLC of breast origin. A multidisciplinary team initiated systemic therapy with palbociclib, letrozole and Zoladex. She is currently on her fifth treatment cycle, with stable disease and no reported complications. Ongoing follow-up continues to monitor her progress. From the literature, a total of 6 cases of breast cancer metastasis to the ovaries and 1 case involving the peritoneum were reviewed. Computed tomography was the most commonly used imaging modality, with diagnostic confirmation achieved through histopathological examination. Surgeries were performed, 1 patient succumbed, and 1 patient was lost to follow-up. Immunohistochemistry is critical for differentiating primary and metastatic ovarian tumors. These markers include GATA3, ER, PR, HER2, Ki-67, GCDFP-15, CK7 and the lack of E-cadherin. The same differentiation is crucial for metastasis to the peritoneum. On the whole, the present case report demonstrates that breast carcinoma metastases to the ovaries and peritoneum are rare, yet essential to consider. Immunohistochemistry helps differentiate them from other carcinomas.

Correspondence to: Dr Fahmi H. Kakamad, College of Medicine, Department of Clinical Sciences, University of Sulaimani, HC8V+F66, Madam Mitterrand Street, Sulaymaniyah 46001, Iraq
E-mail: kakamad.fahmi@gmail.com

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Introduction

Invasive lobular carcinoma (ILC) is the second most commonly occurring type of breast cancer, which comprises up to ~15% of breast cancer cases, with positive results for progesterone receptor (PR) and estrogen receptor (ER), and typically has a good prognosis and is low-grade (1). There are multiple histological subtypes of ILC; however, they are defined by a lack of cohesive growth due to the inactivation of the cell-adhesion protein, E-cadherin (2,3). One of these subtypes is pleomorphic lobular carcinoma (PLC), which is clinically significant, although rare. This phenotype is associated with a poorer prognosis and is more aggressive, resulting from distinct histopathological characteristics. It may lack the expression of PR and ER, and exhibit human epidermal growth factor receptor 2 (HER2)/neu amplification, in contrast to ILC (4).

A post-menopausal status and an older age have been linked to PLC, and it represents ~15% of ILC cases and <1% of all breast cancers (4). It exhibits distinct cytological characteristics that differ from those of ILC, including higher-grade cytological features, a larger tumor size, an increased likelihood of developing distant metastases, the invasion of the lymphovascular system and a more advanced stage at diagnosis. Distinct clinical behavior is observed in lobular carcinomas, which tend to metastasize to serosal surfaces, including the gastrointestinal

tract, peritoneum, uterus and ovaries (5). Breast cancer fatalities are linked to their distant metastases, and classifying breast cancer into molecular and histologic subtypes is recognized for its essential prognostic and predictive significance (6).

The present study describes a rare case of invasive PLC metastasis to the peritoneum and ovaries of a patient and also performs a brief review of the literature.

Case report

Patient information. A 51-year-old woman presented to Smart Health Tower (Sulaymaniyah, Iraq) in May, 2025 with a right breast mass that had been noticed three weeks before presentation. She had a family history of breast cancer involving her maternal aunt, maternal uncle and paternal cousin. Her medical history was significant for kidney disease, for which she had undergone three surgical procedures for renal stone removal, as well as a prior diagnostic laparoscopy for a peritoneal mass and a left thyroid lobectomy. Her obstetric history revealed gravida 6, para 6, with no history of abortion and a cumulative lactation period of 12 years.

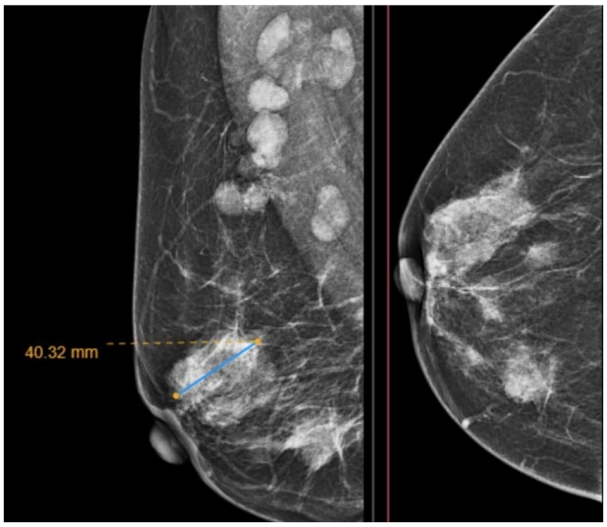

Figure 1. Full-field digital mammography of the right breast (mediolateral oblique and craniocaudal views) revealing multiple heterogeneously dense masses in different quadrants, the largest measuring 40 mm in the central lateral region.

Clinical findings. Upon a clinical examination, palpable masses were detected in the right breast, including one in the lower inner quadrant at the 4-5 o'clock position and another in the retroareolar region at the 10 o'clock position. Both masses were irregularly shaped, hard in consistency, and not fixed to the underlying structures. They caused bulging and mild tethering of the areola. Additionally, palpable right axillary lymph nodes were noted, raising concerns about possible nodal involvement.

Diagnostic assessment. A right breast ultrasound revealed multiple heterogeneous, irregular and hypoechoic masses mixed with fat echogenicity. A lesion measuring 27x19 mm was identified in the lower inner quadrant, while another mass at the 9 o'clock position, located at an anterior-middle depth, measuring 40x14 mm and extending to the nipple base. Additionally, multiple smaller adjacent masses measuring <10 mm were observed in the upper central part of the breast. The evaluation of the right axilla revealed >10 abnormal, matted lymph nodes across all axillary levels, with the largest node in level I, measuring 15 mm. No supraclavicular lymphadenopathy was detected. The findings were classified as BIRADS-5.

An abdominal ultrasound revealed bilateral renal staghorn stones, suggesting a possible underlying metabolic disorder, while the remainder of the examination did not reveal any notable findings. A breast mammography revealed multiple hyperdense masses with irregular margins throughout the right breast, with the largest lesion in the central region, measuring 40x32 mm. No microcalcifications were observed (Fig. 1). Right axillary lymph node involvement was also noted, with a small number of matted abnormal lymph nodes identified. The findings were classified as BIRADS-5. Although the ultrasound examinations was performed at the institution, the images were not available because they had not been digitally archived in the radiology database at the time of the examination. A core biopsy of the right breast mass and right axillary lymph node confirmed invasive PLC, grade II (moderately differentiated). The right axillary lymph node biopsy also revealed metastatic carcinoma (Fig. 2). Immunohistochemical analyses were performed on formalin-fixed, paraffin-embedded tissue. Sections at a thickness of 4-6 μm were prepared from paraffin blocks, mounted on charged slides and incubated overnight at 60˚C. Heat-induced antigen retrieval was carried out using the Dako PT Link system (Agilent Technologies, Inc.) at 100˚C for 5-10 min, employing either citrate buffer (pH 6.0) or Tris-EDTA buffer (pH 9.0) according to the antibody used. Following antigen retrieval, the slides were rinsed for 15 min at room temperature in Tris-buffered saline containing 0.05% Tween-20 (0.05 mol/l Tris/HCl, 0.15 mol/l NaCl; pH 7.6). The tissue sections were then demarcated using a hydrophobic pen, and endogenous peroxidase activity was quenched with 3% hydrogen peroxide. Primary antibodies directed against ER, PR, HER2, Ki-67 and E-cadherin were applied using the following reagents: ER (rabbit monoclonal, clone SP1; cat. no. RM-9101-S; Thermo Fisher Scientific, Inc.; dilution 1:100), PR (mouse monoclonal, clone PgR636; cat. no. M3569; Agilent Technologies, Inc.; dilution 1:100), HER2 (rabbit monoclonal, clone 4B5; cat. no. 790-2991; Roche Diagnostics; ready-to-use), Ki-67 (mouse monoclonal, clone MIB-1; cat. no. M7240; Agilent Technologies, Inc.; dilution 1:200) and E-cadherin (mouse monoclonal, clone NCH-38; cat. no. M3612; Agilent Technologies, Inc.; dilution 1:100). All antibodies were diluted in the manufacturer's antibody diluent and incubated for 80 min at room temperature (20-25˚C). Detection was achieved using a horseradish peroxidase-linked secondary antibody (EnVision™ FLEX HRP polymer detection system; cat. no. SM802; Agilent Technologies, Inc.; ready-to-use, no dilution) and 3,3'-diaminobenzidine (DAB) chromogen, each incubated for 15 min at room temperature (20-25˚C). Counterstaining was performed with Gill II hematoxylin for 30 sec at room temperature, after which the slides were dehydrated and coverslipped. Immunostaining results demonstrated strong nuclear ER expression with an Allred score of 8 (3 + 5) and PR positivity with an Allred score of 4

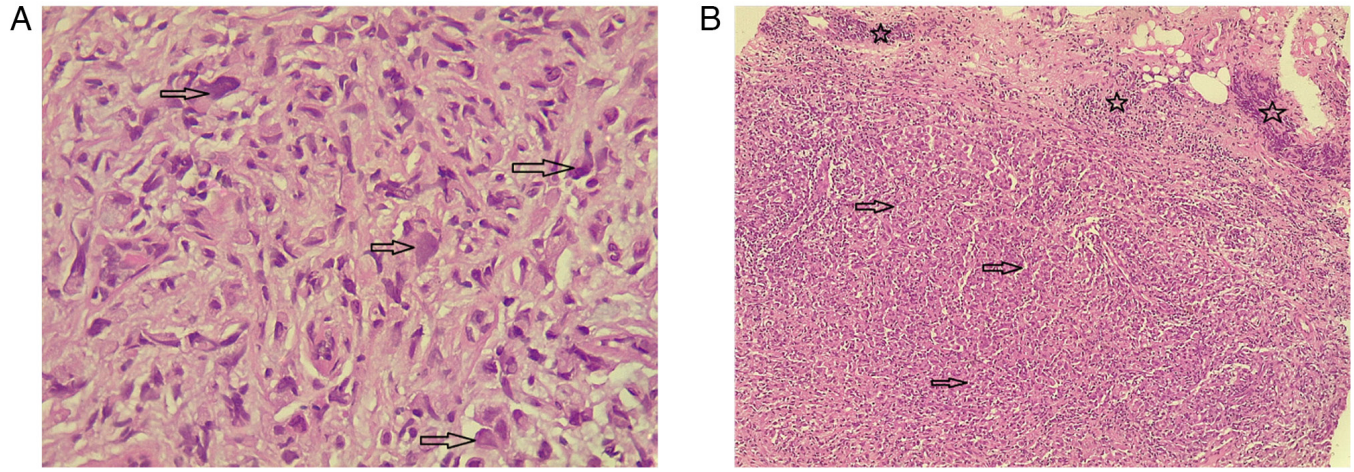

Figure 2. Hematoxylin and eosin-stained sections. (A) Core biopsy of the breast mass demonstrating infiltrative malignant pleomorphic dyscohesive cells (black arrows) within a desmoplastic stroma (magnification, x40). (B) Core biopsy of the lymph node from the same patient showing a tissue fragment with a peripheral rim of benign lymphoid cells (black stars), infiltrated by malignant dyscohesive epithelial cells (black arrows) (magnification, x10).

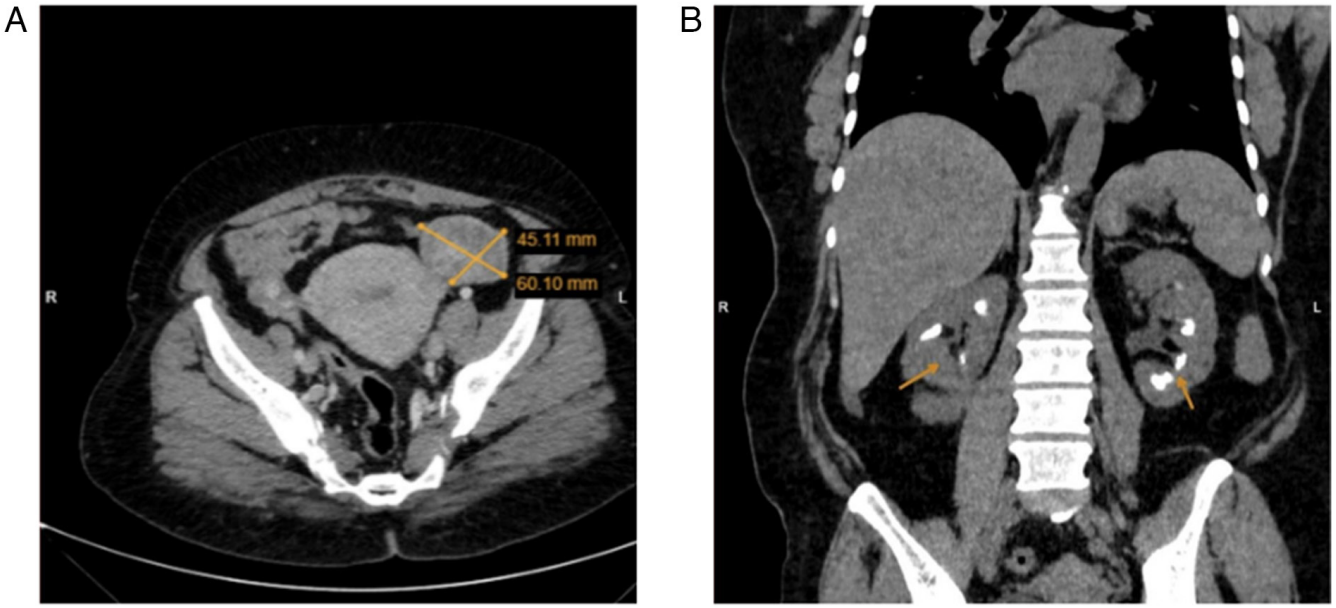

Figure 3. Contrast-enhanced CT images. (A) Axial post-contrast CT scan demonstrating a heterogeneously enhancing complex cystic lesion in the left adnexa, measuring 60x45 mm, consistent with metastatic involvement from primary invasive lobular carcinoma of the breast. (B) Coronal non-contrast CT scan showing multiple hyperdense calcific foci in the medullary regions of both kidneys, consistent with medullary nephrocalcinosis. CT, computed tomography.

(2 + 2). HER2 staining was negative (score 1), and the Ki-67 labeling index was approximately 22%. The loss of E-cadherin expression in tumor cells was observed, consistent with ILC.

A contrast-enhanced computed tomography (CT) scan of the chest, abdomen, and pelvis revealed two right breast masses, the largest measuring 4 cm, with no evidence of chest wall invasion. Pathological right axillary lymph nodes were present across all levels, with the largest measuring 1.6 cm, while no enlarged internal mammary lymph nodes were detected. Additionally, bilateral adnexal masses were identified, raising the suspicion of primary ovarian cancer or metastatic disease with associated peritoneal deposits. Multiple bilateral renal calcifications were noted in the medullary region, suggesting medullary nephrocalcinosis (Fig. 3). To further evaluate the ovarian and peritoneal lesions, a diagnostic laparoscopy was performed, and biopsies were taken. A histopathological analysis was then performed. Sections (5-μm-thick tissue sections were fixed in 10% neutral-buffered formalin at room temperature for 24 h and subsequently embedded in paraffin. The sections were then stained with hematoxylin and eosin (Bio Optica Co.) for 1-2 min at room temperature and examined under a light microscope (Leica Microsystems GmbH). The histopathological examination revealed extensive infiltration by dyscohesive sheets and cords of malignant epithelial cells embedded within a desmoplastic stroma. The tumor cells exhibited marked nuclear pleomorphism, hyperchromatic nuclei, prominent nucleoli, and frequent mitotic figures. Occasional intracytoplasmic vacuoles imparted a signet-ring-like appearance. The peritoneal deposits exhibited infiltrative epithelial cells associated with stromal desmoplasia and focal crush artifact, supporting metastatic

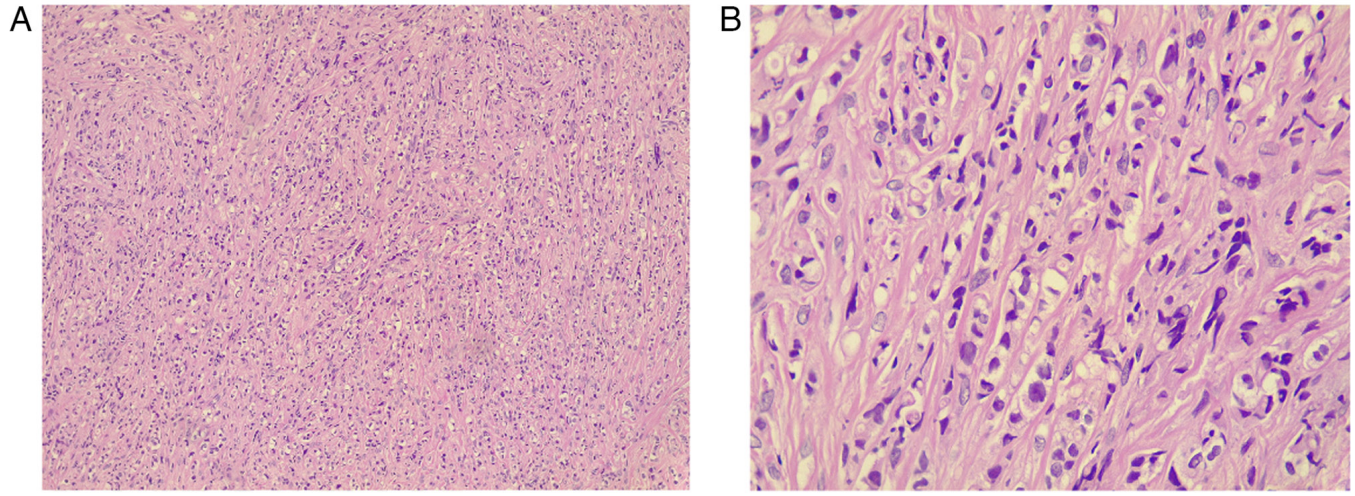

Figure 4. (A) Hematoxylin and eosin-stained sections of ovarian tissue demonstrating extensive infiltration by dyscohesive sheets and cords of malignant epithelial cells with marked nuclear pleomorphism and prominent nucleoli (magnification, x40). (B) Occasional tumor cells exhibit intracytoplasmic vacuoles, imparting a signet ring-like appearance (magnification, x100).

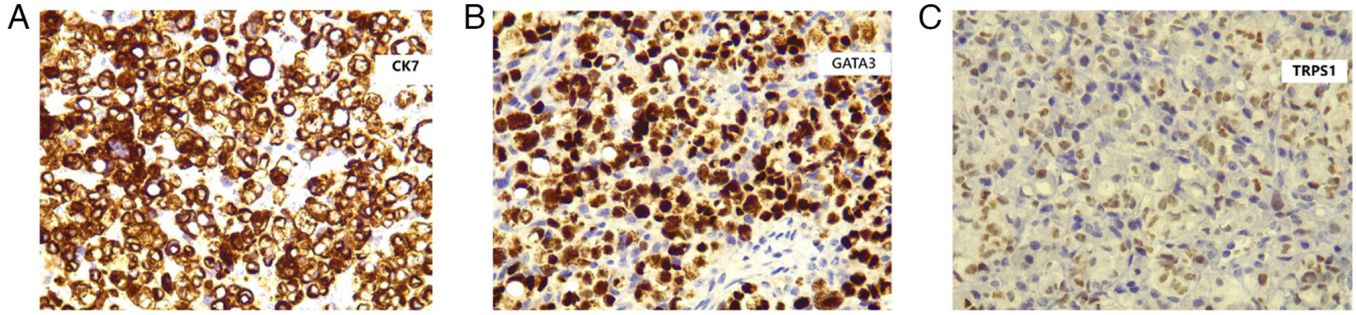

Figure 5. Tumor cells showing cytoplasmic positivity for (A) CK7 (magnification, x100), along with nuclear positivity for (B) GATA3 (magnification, x100) and (C) TRPS1 (magnification, x100) on immunohistochemistry. CK7, cytokeratin 7; GATA3, GATA-binding protein 3; TRPS1, trichorhinophalangeal syndrome type 1.

involvement (Fig. 4). The findings of IHC were consistent with metastatic PLC of the breast. The cytological analysis of the peritoneal fluid was positive for malignancy, confirming metastatic disease. IHC staining of the ovarian and peritoneal tumor cells revealed positivity for cytokeratin 7 (CK7), GATA-binding protein 3 (GATA3) and trichorhinophalangeal syndrome type 1 (TRPS1), further supporting a breast origin for the malignancy (Figs. 5 and 6). IHC was performed on formalin-fixed, paraffin-embedded tissue sections (4 μm thickness). The sections were deparaffinized in xylene and rehydrated through graded ethanol to distilled water. Heat-induced epitope retrieval was carried out using EnVision™ FLEX Target Retrieval Solution, High pH (cat. no. K8004, Agilent Technologies, Inc.) in a pressure-based retrieval system according to the manufacturer's instructions. Endogenous peroxidase activity was blocked using EnVision™ FLEX Peroxidase-Blocking Reagent (cat. no. SM801, Agilent Technologies, Inc.). The primary antibodies were applied at the following working dilutions: CK7 (mouse monoclonal, clone OV-TL 12/30; cat. no. M7018, Agilent Technologies, Inc.) at 1:200, GATA3 (mouse monoclonal, clone L50-823; cat. no. 386M-16, Cell Marque™ Tissue Diagnostics) at 1:100, and TRPS1 (rabbit monoclonal, clone EPR16171; cat. no. ab209664, Abcam) at 1:250. All primary antibodies were diluted in antibody diluent supplied by the manufacturer and incubated according to standard laboratory protocols. Antibodies were incubated at room temperature for 30-60 min according to the manufacturer's recommendations. Immunodetection was performed using the EnVision™ FLEX detection system (cat. no. SM802, Agilent Technologies, Inc.), which employs a dextran-based polymer secondary antibody conjugated to horseradish peroxidase (HRP). This system provides species-specific secondary antibodies against mouse and rabbit immunoglobulins and was used ready-to-use (no dilution required), in accordance with the manufacturer's instructions. All immunohistochemical staining procedures, including primary antibody incubation and polymer-based secondary antibody incubation, were carried out at room temperature (20-25˚C). Primary antibodies were incubated for 30-60 min at room temperature (20-25˚C), as recommended by the respective manufacturers. The EnVision™ FLEX HRP-labeled polymer secondary antibody was applied for 20 min at room temperature. Visualization with 3,3'-diaminobenzidine (DAB) chromogen (cat. no. DM827, Agilent Technologies, Inc.) was performed for 5-10 min, with microscopic monitoring to ensure optimal signal development. Nuclear counterstaining was performed using hematoxylin

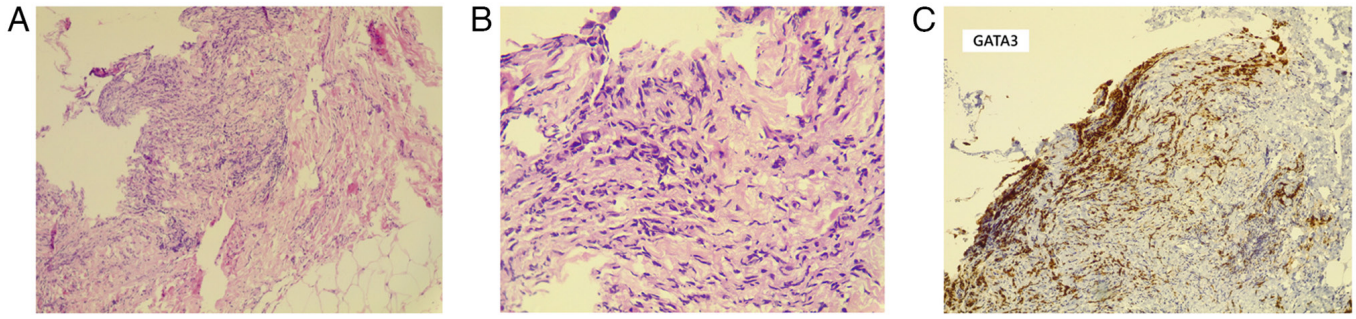

Figure 6. Sections from the peritoneal biopsy illustrating (A) fibroadipose tissue infiltrated by epithelial cells exhibiting crush artifact (magnification, x40), and (B) associated desmoplastic stroma (magnification, x40). (C) These cells demonstrate nuclear positivity for GATA3 on immunostaining (magnification, x40).

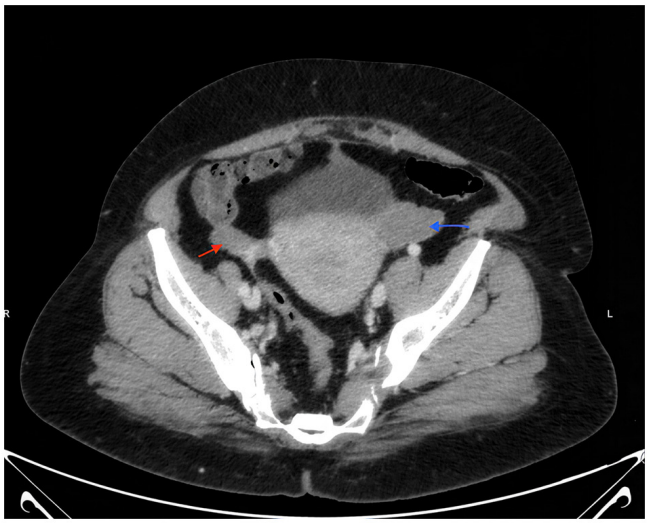

Figure 7. Axial contrast-enhanced computed tomography scan (delayed phase) demonstrating bilateral enhancing ovarian tumors (right ovarian tumor, red arrow; left ovarian tumor, blue arrow).

solution (cat. no. 05-M06002, Bio Optica S.p.A.) for ~1-2 min at room temperature, followed by rinsing in running tap water, dehydration through graded alcohols, clearing in xylene and mounting. The patient was diagnosed with primary invasive PLC of the right breast, with metastatic involvement of the right axillary lymph nodes, bilateral ovaries and peritoneum. Based on clinical, radiological and histopathological findings, the disease was staged as cT2N3M1 according to the TNM classification system.

Therapeutic intervention. A multidisciplinary team evaluated the case of the patient, and referral to medical oncology was recommended for definitive management. She subsequently commenced systemic therapy and received five cycles of palbociclib (125 mg orally once daily) in combination with letrozole (2.5 mg orally once daily) and goserelin (Zoladex® 3.6 mg administered subcutaneously every 28 days) as part of her treatment regimen. The selection of systemic therapy was guided by the presumed hormone receptor-positive and HER2-negative profile.

Follow-up and outcomes. The patient undergoes regular follow-ups to monitor her treatment response and disease progression. A CT scan after the third cycle revealed a partial response (Fig. 7). Thus far, she remains stable, with no reported complications or adverse effects from therapy. Her condition is being closely monitored to ensure optimal management.

Discussion

Breast cancer metastatic sites usually include the bones, liver, brain and lungs, while metastases to the female genital tract are rare. When it occurs, the ovary is the most frequently affected site (75.8%), followed by the vagina (13.4%), the uterine corpus (4.7%), the cervix (3.4%), the vulva (2%) and the fallopian tubes (0.7%), respectively (6). Numerous patients remain asymptomatic, underscoring the importance of routine gynecologic check-ups. Distinguishing metastatic disease in the ovary and uterus from primary ovarian or uterine cancer can be particularly challenging (6). A focused literature search was performed using Google Scholar, limited to English-language publications and case reports describing ovarian or peritoneal metastases originating from breast cancer. In total, 6 reported cases of ovarian metastases and 1 case of peritoneal metastasis were identified and reviewed (Table I) (6,7-10). A CT scan was the most frequently utilized imaging modality, and the diagnosis was supported by microscopic examination. Surgical intervention was undertaken as the primary treatment. One patient died during the course of follow-up, and another was lost to follow-up.

Women who have a breast cancer history are up to 3- to 7-fold more likely to develop primary ovarian cancer than ovarian metastases. Risk factors contributing to the development of breast and ovarian cancers include an older age, low parity, exogenous estrogen exposure, and having a familial history of BRCA1 and BRCA2 gene mutations (11). Being a type of ILC, PLC exhibits a classic growth pattern but is distinguished by nuclear atypia and often presents with a plasmacytoid, histiocytoid, or apocrine morphological appearance (2). The molecular genetics of PLC is similar to that of ILC. However, they also exhibit additional genetic changes, such as HER2 amplification, which may contribute to their aggressive behavior. The genetic modifications in PLC are more similar to those of invasive ductal carcinoma than those of ILC (12).

IHC is an essential tool for diagnosing and differentiating primary ovarian tumors from metastatic ones. For example, GATA3 can help distinguish between the two in cases with a history of breast cancer, as its expression is positive in breast

Table I. Review of some breast cancer metastases cases to the ovaries or peritoneum in literature.

First author, year of publication	No. of patients	Age, years	Type of cancer	Presentation/ clinical findings	Imaging	Histopathological, Immunohistochemical and cytological examinations	Treatment	Postoperative care	Outcome	(Refs.)
Dominguez, 2021	Case 1	42	Invasive lobular carcinoma.	Abdominal pain, bloating vomiting and appetite loss.	CT: Revealed ovarian growth, bilateral, probably malignant.	PFC: Invasive lobular carcinoma of breast origin.	Exploratory laparotomy, total abdominal hysterectomy and bilateral salpingo-oophorectomy	Lost to follow up.	Lost to follow-up.	(6)
	Case 2	43	Metastatic carcinoma with mixed lobular and ductal features.	Intraoperatively a grossly normal cervix, bilateral ovaries and appendix. Uterus: endometrial polyp, multiple leiomyoma, and thin endometrium	Not mentioned.	HPE: Metastatic carcinoma, mixed lobular and ductal features, probably breast in origin on bilateral ovaries. IHC: +ve ER/PR stains.	Total abdominal hysterectomy & bilateral salpingo-oophorectomy.	Tamoxifen, adjuvant therapy continued.	Not mentioned.	(6)
	Case 3	38	Invasive ductal carcinoma.	Uterus, bilateral ovaries and fallopian tubes grossly normal. Multiple implants over the peritoneum.	CT: Pelvic mass.	IHC: Triple-negative result of ER,PR/HER2-neu. HPE: metastatic, poorly differentiated, probably ductal carcinoma, bilateral ovaries.	Exploratory laparotomy, ascitic fluid drainage, bilateral salpingo-oophorectomy infracolic omentectomy, and peritoneal biopsy.	Advised adjuvant chemotherapy but refused treatment.	Not mentioned.	(6)
Naito, 2012	1	54	Breast cancer with solid and luminal structures.	Abdominal distention, high serum carcinoembryonic antigen & carbohydrate antigen 15-3.	PET/CT: Bilateral ovarian tumors with ascites.	HPE: Solid and luminal structures. IHC: +ve for ER, PR, CK-7 and GCDFP15.-ve for HER2 overexpression and CK20.	Bilateral oophorectomies for definitive ovarian tumors diagnosis.	Aromatase inhibitor therapy.	Patient in stable condition.	(7)
Sohail, 2021	1	69	Invasive lobular breast carcinoma metastasizing to the gastric wall	Black tarry stool, increased lethargy with early satiety, mild abdominal	CT: Gastric wall thickening, bilateral hydronephrosis and mild to	IHC: +ve for ER, PR and -ve for human epidermal growth factor receptor-2.	Diagnostic paracentesis, gastroduodenoscopy, endoscopic	Patient decided on palliative care.	Succumbed after a few weeks in the hospice facility.	(8)

Table I. Continued.

First author, year of publication	No. of patients	Age, years	Type of cancer	Presentation/ clinical findings	Imaging	Histopathological, Immunohistochemical and cytological examinations	Treatment	Postoperative care	Outcome	(Refs.)
			and peritoneum.	tenderness, thickened gastric folds.	moderate ascites.		ultrasound, wedge resection and biopsy of stomach and peritoneum.			
Tada, 2022	1	57	Malignant phyllodes tumor.	Abdominal fullness, bilateral lower leg edema, an enlarged cystic mass occupying the pelvic cavity and abdomen.	CT: Cystic mass with a thickened septum and solid component occupying abdominal cavity.	HPE: proliferating stromal spindle-shaped cells with irregular nuclei arranged in a fascicular or sheeted pattern. IHC: +ve for CD10, CD34, and SMA, -ve for desmin, S-100, AE1/AE3, EMA, STAT6, ER, PR, MDM2, p16 and IMP3	Emergent laparotomy, right oophorectomy & partial omentectomy.	6 courses of chemotherapy consisting of doxorubicin and ifosfamide	Patient in stable condition.	(9)
Lin, 2023	1	53	Invasive breast carcinoma.	Abdominal distension, irregular vaginal bleeding, and chest distress, abnormal bone metabolism, cancer antigen 125 present.	CDU: A mass in right adnexal area.	HPE: Left breast cancer with ovarian and multiple bone metastases. IHC: Ki-67 5%, +ve for ER, PR, CK, CK7, HER2 and GCDFP15. -ve for CA125, and p53.	Removed uterus, bilateral adnexa, bilateral pelvic lymph nodes, abdominal para-aortic lymph nodes, greater omentum, and appendix.	Fulvestrant and azolephosphonic after the breast cancer diagnosis.	Patient in stable condition.	(10)

HPE, histopathological examination; IHC, immunohistochemistry; PFC, peritoneal fluid cytology; CT, computed tomography; CDU, color Doppler ultrasound; -ve, negative; +ve, positive; ER, estrogen receptor; PR, progesterone receptor; GCDFP15, gross cystic disease fluid protein 15; PLAP, placental alkaline phosphatase; CK, cytokeratin; SMA smooth muscle actin; EMA, epithelial membrane antigen.

carcinoma, but negative in ovarian carcinoma. However, this differentiation may not be relevant in the rare case of ovarian mesonephric carcinoma, as it may produce GATA3. In cases of breast cancer metastatic to the ovary, CK7 positivity may also be observed. Furthermore, when the primary breast carcinoma expresses ERs, ER immunoreactivity can serve as an additional supportive diagnostic marker, as demonstrated in the present patient (13). The expression of ER and PR is at lower levels in PLC, and it can exhibit an increase in HER2/neu, in contrast to other types of ILC, which usually strongly express ER and PR and are negative for HER2 (2,4). The expression rates of PR and ERα in ILC are up to 60-70 and 95%, respectively, and Ki-67 staining results are usually low in ILC (3).

In another study, 24 patients were retrospectively reviewed who were pathologically confirmed to have metastases in ovaries from breast cancer, with data collected from two centers between 2000 and 2019 (11). The results of that study demonstrated that 80% of the cases had negative HER2/neu results, and almost 90% were ER- and PR-positive (11). Another component sought is gross cystic disease fluid protein 15 (GCDFP-15), which has high specificity for breast carcinoma, but low sensitivity (14). In a previous case report described the case of a 53-year-old with abdominal distension, irregular vaginal bleeding, chest distress and a history of having a left breast mass for 2-3 years (10). The patient had an invasive breast carcinoma along with ovarian and multiple bone metastases; IHC results revealed Ki-67 5%, positive results for ER, PR, cytokeratin, CK7, HER2 and GCDFP15, and negative results for CA125 and p53 (10).

The lack of E-cadherin expression is commonly used in IHC to distinguish between lobular and ductal lesions histologically (1). E-cadherin, consisting of the transmembrane E-cadherin protein along with α, β, γ and p120 catenin, is crucial for establishing intercellular tight junctions (15). It binds to identical molecules on adjacent cells in a homophilic fashion, facilitating cell-cell adhesion and maintaining cellular polarity. The cytoplasmic localization of p120 catenin can serve as a positive IHC marker for ILC (3).

The pattern of metastasis in ILC is distinct from that of invasive ductal carcinoma, which generally spreads more extensively and often affects the plasma membrane layer. While both ILC and invasive ductal carcinoma commonly metastasize to the bones and liver, ILC is more likely to spread to the gastrointestinal tract, peritoneum, retroperitoneum, and genitourinary system, with the ovaries being a particularly frequent site. Additionally, ILC often spreads to the central nervous system, including the meninges, where carcinomatous meningitis is almost exclusively seen in ILC patients. Rare metastatic sites for ILC include the orbit, parotid gland, perianal region, and even within the tumor itself. The loss of E-cadherin, due to a CDH1 mutation, disrupts cell adhesion, which contributes to the characteristic infiltration pattern of ILC. This mutation can also activate signaling pathways such as Rho/ROCK, potentially aiding tumor cell survival and spread. However, these mechanisms do not fully explain the tendency of ILC to metastasize to particular sites, suggesting that additional molecular and environmental factors are at play and need further investigation (16).

Metastasis from breast cancer to the gastric wall is uncommon and can be challenging to identify due to its morphological similarity to primary gastrointestinal cancers (8). McLemore *et al* (17) found an incidence rate of 0.3% of patients with metastatic gastrointestinal tract disease originating from breast carcinoma among 12,001 cases of metastatic disease. Sohail *et al* (8) reported the case of a 69-year-old woman presenting with abdominal pain and episodes of black tarry stool. The patient had a history of stage II-B left breast cancer, which using IHC, was found to be ER +95%, PR +5%, HER2-negative and Ki-67 70%. A CT scan of the abdomen revealed moderate to severe thickening of the gastric wall, bilateral hydronephrosis, and mild to moderate ascites (8). Wedge resection and biopsy were performed for the stomach and peritoneum, with biopsy results suggesting the diagnosis of metastatic disease originating from ILC of the breast, as indicated by GATA3 positivity in the peritoneal tumor deposit. The IHC results were ER +80%, PR +1% and HER2-negative, consistent with their diagnosis (8). Breast cancer metastasis to the stomach clinically presents similarly to that of primary gastric cancer; dyspepsia, epigastric pain, anorexia, vomiting, early satiety and bleeding are commonly occurring symptoms. Linitis plastica is the most frequent pattern of metastasis, characterized by diffuse infiltration of the submucosa and muscularis propria (18).

Haque *et al* (19) analyzed patients with cT1-4N1-3M0 breast cancer who had either ILC or PLC histology from the national cancer database and had undergone definitive surgical treatment. Of a total of 115,260 patients, 99.63% had ILC, while only 0.37% had PLC. Patients with PLC received systemic chemotherapy more often, whereas hormonal therapy was administered less often. They also found that worse overall survival was associated with PLC (19). The administration of chemotherapy, radiation therapy, and hormonal therapy has been linked to improved overall survival in patients (19).

Given the rarity yet clinical significance of gynecological metastases from breast cancer, particularly lobular subtypes such as PLC, patients require vigilant surveillance. Routine monitoring should include annual pelvic examinations and transvaginal ultrasound, especially for premenopausal women or those with lobular histology, family history, or symptoms such as abdominal distension or irregular bleeding.

The present case report has several limitations that should be acknowledged. First, the IHC evaluation of the ovarian and peritoneal metastatic lesions was limited to CK7, GATA3 and TRPS1. A broader IHC panel commonly used to exclude primary ovarian, peritoneal, gastrointestinal, or pulmonary malignancies, such as PAX8, WT1, mammaglobin, GCDFP-15, CK20, p53 and TTF-1, was not performed. Consequently, the exclusion of non-breast primary tumors relied on a combination of clinical context, radiological findings, morphological concordance with the primary breast tumor, and positivity for breast-associated markers rather than on an extensive exclusionary immunoprofile. Second, the original breast ultrasound images were not available for inclusion. Although the examination was performed at the institution, the images had not been digitally archived in the radiology database at the time of the study. Third, as a single-patient case report, the findings cannot be generalized, and causal inferences regarding disease behavior or treatment response are limited. Finally, although histopathological images were provided, quantitative morphometric analysis and a larger

set of representative images were not available because the pathological evaluation was conducted in a routine clinical setting without access to digital whole-slide scanning and validated image-analysis tools. Despite these limitations, the present case report contributes valuable clinical, histopathological and diagnostic insights into the rare occurrence of PLC metastasizing to the ovaries and peritoneum.

In conclusion, breast cancer metastases to the ovaries and peritoneum are uncommon, yet clinically significant. IHC is a crucial tool for distinguishing between these metastatic carcinomas and other carcinomas they may resemble.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

AMS and HAY were major contributors to the conception of the study, as well as to the literature search for related studies. SHH, MKA, AAQ and HHF contributed to the literature search, the acquisition and interpretation of the patient's data, and manuscript preparation. FHK and KMS contributed to the design of the study, the literature review, the critical revision of the manuscript, and the processing of the table. AMS, LRAP, SOA and RMA assisted in the diagnosis and management of the patient, and participated in manuscript review. HAY and AMA were the pathologists who performed the diagnoses. FHK and SHH confirm the authenticity of all the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

Written informed consent was obtained from the patient for participation in the present study.

Patient consent for publication

Written informed consent was obtained from the patient for the publication of the present case report and any accompanying images.

Competing interests

The authors declare that they have no competing interests.

Use of artificial intelligence tools

During the preparation of this work, AI tools were used to improve the readability and language of the manuscript or to generate images, and subsequently, the authors revised and edited the content produced by the AI tools as necessary, taking full responsibility for the ultimate content of the present manuscript.

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