

# Triple-Negative Mucinous Breast Carcinoma: A Case Report

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**Abstract:** Mucinous breast carcinoma (MBC) is a rare histological type, accounting for 1% to 6% of breast neoplasms. It is more frequent in older women and generally associated with a favorable prognosis. This paper reports on the case of a 52-year-old patient who initially presented with edema associated with mastalgia and nipple retraction in the left breast and was admitted to our service with only a routine mammogram. Initial staging examinations and biopsy with immunohistochemistry, followed by the need for panel expansion, initially suggested a primary site in the gastrointestinal tract; however, subsequent investigation revealed a primary triple-negative mucinous breast neoplasm. Thus, this report describes an uncommon case of triple-negative MBC, with few similar cases reported in the literature, as well as its diagnostic workup, definitive diagnosis, instituted treatments, and therapeutic response.

**Keywords:** Ductal Breast Carcinoma; Immunohistochemistry; Case Report.

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## 1. Introduction

Mucinous breast carcinoma (MBC), also referred to as colloid or mucous carcinoma, is an uncommon subtype of invasive ductal carcinoma (IDC) and accounts for approximately 1% to 6% of breast neoplasms. This histological type typically occurs in postmenopausal women, with a mean age of 62 years, and is generally associated with a favorable prognosis [3,5]. Two histological variants are recognized, with distinct imaging features and prognostic implications: the pure form, in which the mucinous component comprises nearly the entire tumor extent, and the mixed form, which shows a greater proportion of neoplastic cells not surrounded by mucin.

The most characteristic immunohistochemical (IHC) findings in MBC consist of luminal A-type tumors, which are usually associated with a good prognosis [1]. In contrast, triple-negative breast cancer (TNBC) is defined by the absence of estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2) expression. TNBC accounts for approximately 15% of all breast cancers and is known for its clinical aggressiveness, high proliferative rate, and poorer prognosis when compared with MBC [2,3]. The coexistence of a mucinous carcinoma with a triple-negative molecular profile is extremely rare. Available information most often refers either to MBC in general or to TNBC as a distinct entity. Furthermore, there is no robust, specific epidemiological data on triple-negative MBC in the literature, which underscores its rarity [7,10,15].

In this context, the present report describes an uncommon case of triple-negative MBC, detailing the challenges involved in establishing a definitive diagnosis, as well as the therapeutic approaches employed during the diagnostic workup and the patient's

clinical response, with the aim of contributing to the limited body of literature on this subject.

## 2. Case Report

A 52-year-old female patient was admitted to our service in September 2021 with complaints of edema of the left breast and mastalgia associated with nipple retraction, with symptom onset in November 2020. At admission, she brought only a routine mammogram, which described an irregular and heterogeneous nodule (BI-RADS 4), focal breast asymmetry, and enlargement of left axillary lymph nodes. On physical examination, a palpable mass measuring 6 × 5 cm was identified in the left retroareolar region; the mass was painful, firm, poorly mobile, and had an irregular surface. There was no nipple discharge. An adjacent left axillary lymph node measuring 4 × 3 cm was also noted; it was single, firm, painless, and mobile. The contralateral breast and axillary lymph nodes showed no abnormalities.

Initial investigation with core needle biopsy revealed histopathological findings consistent with moderately differentiated mucinous breast carcinoma, nuclear grade 2. As part of staging, computed tomography scans of the chest, abdomen, and pelvis were performed, identifying a solid mass in the left breast, an enlarged left axillary lymph node measuring approximately 22 mm in the short axis, and multiple diffuse, nonspecific nodules in the pulmonary parenchyma, the largest measuring 7 mm, suggestive of secondary implants, although no prior imaging was available for comparison.

Bone scintigraphy performed in October of the same year showed no evidence of bone metastases. Two months after the biopsy, while awaiting the results of subsequent immunohistochemical investigation, the patient returned with retrosternal pain, presenting enlargement of the left breast mass to 10 × 5 cm and the appearance of supraclavicular lymphadenopathy. The initial immunohistochemical panel demonstrated a triple-negative profile and, due to its rarity in mucinous histology, was subsequently expanded to include markers of other potential primary sites. This revealed diffuse positivity for CK7 and CDX2, with negativity for GATA-3, PAX8, CK20, and TTF-1, suggesting metastatic breast cancer with a probable primary site in the upper gastrointestinal tract or pancreaticobiliary ducts.

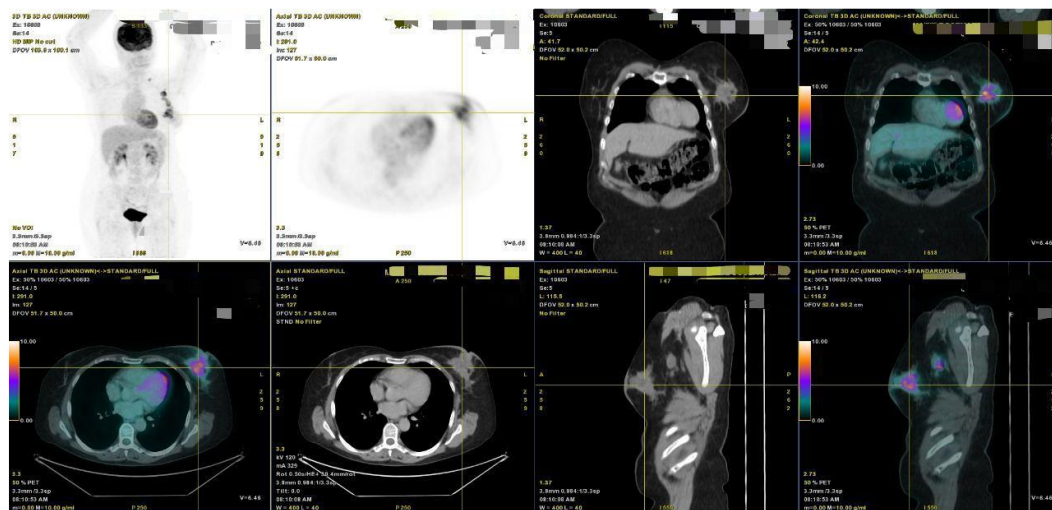
While awaiting expansion of the immunohistochemical panel and complementary staging, the patient initiated neoadjuvant chemotherapy consisting of four cycles of dose-dense doxorubicin and cyclophosphamide, administered between October 29, 2021, and December 13, 2021, followed by seven cycles of weekly paclitaxel. After neoadjuvant chemotherapy, follow-up computed tomography demonstrated a partial clinical response according to RECIST criteria, with a significant reduction of the breast mass from 10 × 5 cm to 5 × 5 cm and of the axillary lymph node from 4 × 3 cm to 2.5 × 2.5 cm; however, there was an increase in the size of pulmonary nodules, with the largest measuring 12 mm.

Complementary staging examinations performed concomitantly with the expanded immunohistochemical analysis included colonoscopy, upper gastrointestinal endoscopy, magnetic resonance imaging of the abdomen and pelvis, bone scintigraphy, and PET-CT (Figures 1–3). These studies demonstrated no evidence of distant metastases, thereby excluding metastatic disease and supporting the initial hypothesis of a primary breast tumor. A total left mastectomy was subsequently performed in April 2022.

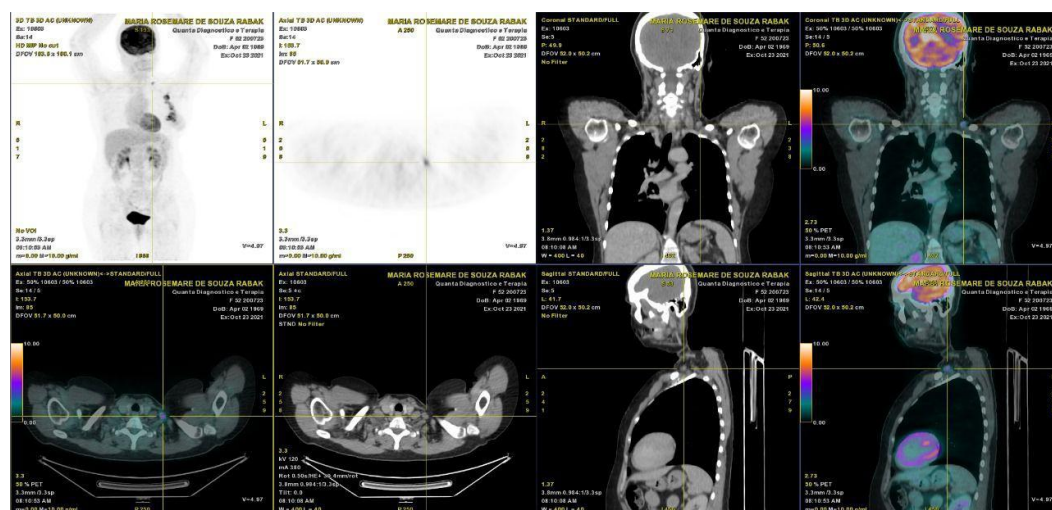
Histopathological examination of the surgical specimen (Figure 4) revealed mixed invasive mucinous carcinoma of the breast, composed of 75% mucinous and 25% ductal components, measuring 6.0 × 4.5 × 4.7 cm. The tumor was classified as histologic grade 3 according to the Nottingham system and showed lymphovascular invasion, perineural infiltration, and musculoskeletal involvement, corresponding to a pathological stage of pT4c pN3a. Axillary dissection demonstrated metastases in 11 of 19 lymph nodes, with extranodal extension and a largest metastatic focus measuring 4.6 cm in its greatest dimension. The patient subsequently underwent adjuvant radiotherapy and chemotherapy

with capecitabine; however, treatment was discontinued after four cycles due to elevated bilirubin levels associated with infectious diarrhea.

**Figure 1.** PET-CT (10/2021) showing an expansive and heterogeneous lesion in the left breast with markedly increased metabolic activity. Enlarged and prominent lymph nodes were observed in the left supraclavicular, left internal mammary, and left axillary chains, all with markedly increased metabolic activity. Bilateral, irregular, non-calcified pulmonary nodules with random distribution were also identified, without significant increase in metabolic activity.



**Figure 2.** PET-CT (10/2021) – Expansive and heterogeneous lesion in the left breast, with markedly increased metabolic activity. Enlarged and prominent lymph nodes in the left supraclavicular, left internal mammary, and left axillary chains, also showing markedly increased metabolic activity. Bilateral, irregular, noncalcified pulmonary nodules with random distribution, without significant increase in metabolic activity.



Follow-up computed tomography staging (Figure 5), performed five months after mastectomy, revealed pulmonary nodules suggestive of metastatic disease, with the largest measuring 7 mm, precluding biopsy. The patient was then enrolled in a clinical trial evaluating datopotamab deruxtecan (Dato-DXd).



Caption. Antibodies used: anti-estrogen receptor, anti-progesterone receptor, anti-Ki-67, and anti-HER2/neu. Criteria for interpretation of HER2/neu immunostaining (ASCO 2013): Score 0, absence of staining; Score 1+, weak or incomplete staining in any percentage of cells (negative); Score 2+, strong membranous staining in less than 10% of cells or weak to moderate, heterogeneous membranous staining (equivocal, to be confirmed by FISH); Score 3+, intense, homogeneous, and complete membranous immunostaining in more than 10% of neoplastic cells (positive). Microscopy and immunohistochemistry: Estrogen receptor, negative, nonreactive (0/+++), in neoplastic cells; Progesterone receptor, negative, nonreactive (0/+++), in neoplastic cells; HER2/neu, negative, nonreactive (0/+++), score 0; Ki-67, positive in approximately 80% of neoplastic cells. Histopathological interpretation: Left mastectomy specimen with axillary dissection (04/06/2022), demonstrating poorly differentiated infiltrating breast adenocarcinoma, with negative estrogen and progesterone receptors and absence of HER2/neu overexpression. Allred score: Estrogen receptor, 0/5 + 0/3, total score 0/8; Progesterone receptor, 0/5 + 0/3, total score 0/8.

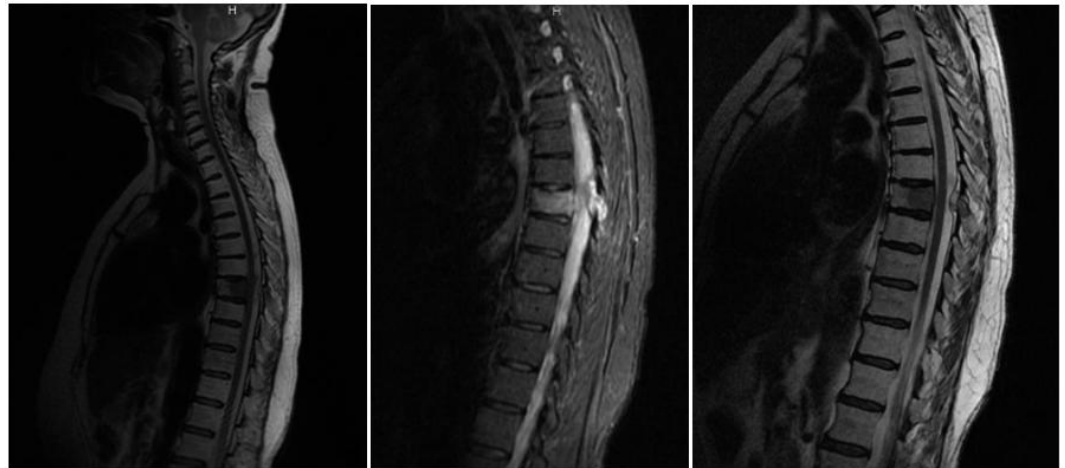
**Figure 5.** CT 09/09/2022 – First post-mastectomy staging, demonstrating pulmonary nodules.



During the screening phase, she developed severe low back pain, prompting spinal magnetic resonance imaging (Figure 6) in December 2022, which demonstrated progression of metastatic disease to the T7 vertebral body, with infiltration of the left radicular canal. Thoracic spinal arthrodesis and decompression were performed, and biopsy obtained during the decompression procedure revealed only bone tissue. Subsequent histopathological analysis demonstrated moderately differentiated metastatic adenocarcinoma in soft tissue, compatible with metastasis from breast carcinoma. At that time, testing for PD-L1 expression was not feasible, as the patient was treated within the public health system (SUS), where the use of PD-1/PD-L1 checkpoint inhibitors was not available.

Given this clinical scenario, in January 2023 palliative chemotherapy was initiated with cisplatin in combination with gemcitabine, for a total of eight cycles. In April of the same year, bone scintigraphy demonstrated increased osteogenic activity in the vertebral column (T6 to T9 and L1), with involvement of the costal arches, pelvis, and bilateral proximal femurs. On July 29, 2023, the patient was admitted due to deterioration of general condition and progressive dyspnea associated with ventilatory-dependent pain.

**Figure 6.** Spinal MRI (12/16/2022) – Lesion with low signal intensity on T1- and T2-weighted images, showing contrast enhancement, involving the C7 vertebral body and resulting in mild reduction of vertebral height. The lesion also involves the corresponding pedicle, lamina, articular facets, right costal arch, and spinous process, and is associated with posterior and anterior paravertebral and epidural soft-tissue components, leading to narrowing of the spinal canal and displacement of the dural sac anteriorly and to the left, with obliteration of the right neural foramina at D6–D7 and D7–D8. An epidural component extending superiorly to D6 and inferiorly to D8 is noted, along with leptomeningeal enhancement from D7 to D10. Mild diffuse posterior disc protrusions at D7–D8 and D9–D10 are present, contacting the ventral surface of the dural sac.



CT pulmonary angiography (Figure 7) was requested for diagnostic clarification and clinical management and revealed sudden and marked disease progression, with a substantial increase in the volume of pulmonary lesions compared with the computed tomography scans performed in April 2023 (Figures 8). During this hospitalization, the family and the multidisciplinary team jointly decided not to implement advanced life support measures.

The patient progressed to death in August of the same year. It is important to emphasize that, due to the patient's socioeconomic conditions and follow-up within the Brazilian Unified Health System (SUS), there were limitations in performing gold-standard diagnostic and staging examinations. Consequently, available tests were prioritized for follow-up, which explains the absence of serial PET-CT imaging and the difficulty in achieving improved clinical outcomes during the treatment period (Figure 9).

### 3. Discussion

Mucinous breast carcinoma (MBC) is a rare histological type, with an incidence of approximately 1–6% of breast carcinomas. This tumor type can be microscopically classified into two subtypes: pure or mixed [16]. In pure MBC, a mucinous component is present in more than 90% of the tumor volume, and it is typically associated with smaller tumor size, a lower rate of axillary nodal involvement at diagnosis, and greater disease-free survival when compared with the mixed subtype [4,5,18]. The mixed subtype, in turn, exhibits a mucinous component comprising less than 90% of the tumor volume and is associated with infiltrative components, such as those observed in other ductal or lobular carcinomas of the breast [1,4,19].

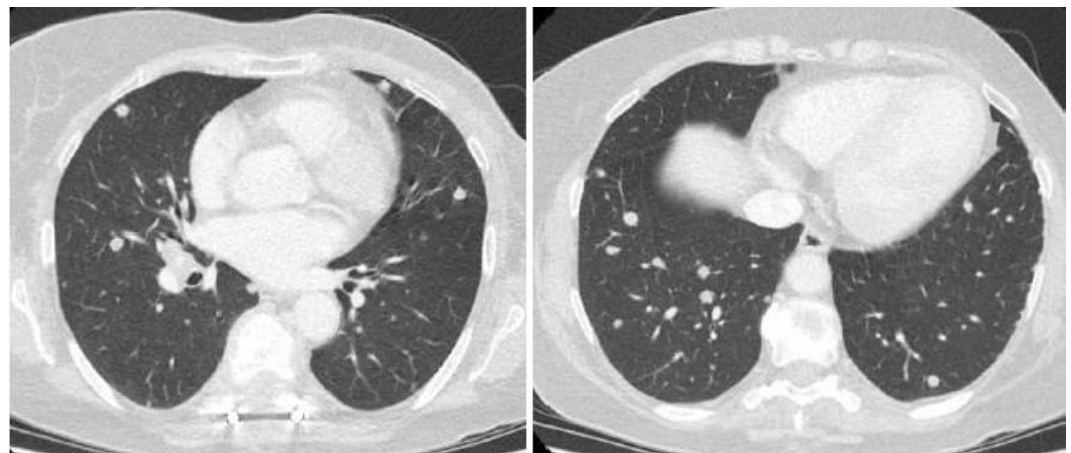
Although the pathogenesis is not yet fully elucidated, Koenig and Tavassoli, who first described this entity, suggested that mucinous carcinoma corresponds to a specific type of invasive ductal carcinoma that, after undergoing a process of metaplasia, results in cystic dilation of the luminal duct, loss of myoepithelial cells (marked by the absence of p63), and invasion of the adjacent stroma [10,13]. This hypothesis is supported by several reports in which ductal carcinoma in situ (DCIS) and/or invasive ductal carcinoma are

identified surrounding mucinous cystadenocarcinoma of the breast [10,13]. At the genetic level, mutations in the *TP53*, *RB1*, and *BAP1* genes have been described, representing alterations in genes responsible for cell cycle control and chromatin remodeling [17].

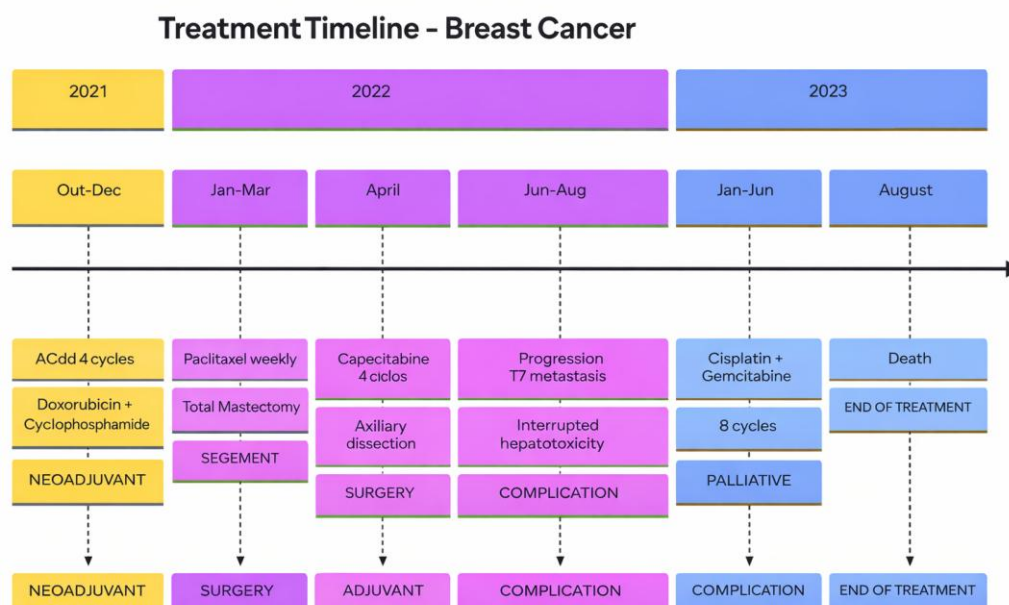
**Figure 7.** CT Pulmonary Angiography (07/29/2023) – Examination demonstrating disease progression, consistent with a pulmonary visceral crisis. Multiple nodules and soft-tissue–density masses diffusely distributed throughout both lungs, suggestive of secondary metastatic lesions. Moderate bilateral pleural effusion causing atelectasis of the adjacent pulmonary parenchyma. Scattered atelectatic bands in both lungs. A soft-tissue–density lesion in the left parasternal region measuring 4.1 × 3.0 cm, suspicious for metastasis. Mediastinal and right axillary lymphadenopathy. Cardiomegaly. Sclerotic changes and reduced height of dorsal vertebral bodies in the mid-thoracic spine, suggestive of secondary neoplastic lesions. Degenerative changes of the thoracic spine. Thoracic spine arthrodesis.



**Figure 8.** CT 04/14/2023 – Follow-up examination demonstrating progression of pulmonary disease.



**Figure 9.** Illustrative image demonstrating the treatment trajectory and clinical course of the patient.



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From an epidemiological standpoint, postmenopausal women are more likely to develop this disease, with a mean age at diagnosis of 62.1 years, a value comparable to the age of the patient described in this report, who was 52 years old [8]. Regarding tumor size, the vast majority of cases present with a diameter smaller than 5 cm, in contrast to the present case, in which the lesion initially measured 6 cm and progressed to 10 cm prior to neoadjuvant chemotherapy. As a clinicopathological feature, lymph node metastases are uncommon and, when present, generally do not alter short-term prognosis [7,10,15,25]. In the case reported herein, extensive nodal involvement was identified, with metastases detected in 11 of the 19 lymph nodes biopsied during axillary dissection.

The topographic diagnosis of mucinous breast carcinoma is based not only on the analysis of the immunohistochemical profile but also on the exclusion of metastatic disease, a factor of major importance, as this group of tumors exhibits cytomorphological

features similar to those of pancreaticobiliary and ovarian tumors [5,9]. To assist in the differential diagnosis between primary and metastatic mucinous tumors, evaluation of cytokeratin (CK) expression patterns may be useful. Tumor cells of ovarian and pancreatic origin are generally positive for CK7 and CK20, whereas mammary tumor cells typically show positivity for CK7 and negativity for CK20 [11,12,22]. In addition, the CDX2 marker may be investigated for the identification of adenocarcinomas of gastrointestinal origin [12,18].

Contrary to expectations, the reported case exhibited a challenging immunohistochemical profile, with diffuse positivity for CK7 and CDX2 and negativity for CK20, GATA-3, PAX8, and TTF-1. CDX2 positivity, although rare in primary breast carcinomas, initially raised the hypothesis of a primary tumor in the upper gastrointestinal tract or pancreaticobiliary ducts. However, after extensive investigation using imaging methods to assess for distant metastases, no evidence of tumor was identified in abdominal or pelvic organs, and the clinical presentation was not compatible with neoplasms arising from these sites. Consequently, the hypothesis of metastatic disease was excluded, and the diagnosis of a primary breast tumor was established.

The literature reiterates that CDX2 positivity in primary breast carcinoma may represent an isolated finding, indicating that the breast rarely constitutes an early metastatic site in the absence of an identifiable primary malignancy [12]. In this context, immunohistochemical evaluation of mucins may serve as a useful adjunct to other markers, with the aim of improving diagnostic accuracy. Mucins are glycoproteins whose expression varies according to the affected organ and the histological tumor type [8,12]. One study suggests that mucinous breast carcinoma exhibits expression of MUC5 and low levels of MUC2, which may aid in excluding the possibility of metastatic disease [12]. Although mucin profiling was not performed in this case due to the unavailability of the test within the Brazilian Unified Health System (SUS) at the time of investigation, this panel has recently been incorporated into immunohistochemical assessment because of its high relevance in situations requiring exclusion of differential diagnoses, which could have had a significant clinical impact for the patient described herein.

The present case illustrates a central diagnostic ambiguity: a tumor with mucinous histological morphology, breast localization, and absence of an identifiable primary site in conventional locations, yet with an atypical immunohistochemical profile (CK7+, CDX2+, CK20-) highly suggestive of gastrointestinal or pancreaticobiliary origin. This discrepancy resulted in a period of diagnostic uncertainty of approximately two months during expanded investigation and highlights an important limitation of diagnoses based exclusively on immunohistochemical markers.

CDX2 is a transcription factor critical for intestinal differentiation and is rarely expressed in primary breast carcinomas, with fewer than ten cases reported in the literature. In this case, CDX2 positivity was initially interpreted as evidence of metastasis from a gastrointestinal primary tumor. Nevertheless, comprehensive investigation using imaging modalities, including computed tomography, colonoscopy, upper gastrointestinal endoscopy, magnetic resonance imaging, and PET-CT, failed to identify a primary tumor in the stomach, colon, pancreas, or biliary tract. CK7 positivity combined with CK20 negativity is consistent with a mammary origin, creating a paradoxical pattern in which breast localization is associated with an atypical marker expression.

CDX2 positivity in primary mucinous breast carcinoma may result from: (1) intestinal metaplasia occurring during carcinogenesis, particularly in contexts associated with mutations in *TP53* or *RB1* that affect cellular differentiation; or (2) ectopic expression in basal-like or triple-negative phenotypes, in which aberrant transcriptional programs may activate transcription factors typically associated with other tissues. The absence of mucin profiling in this case, due to technical limitations within the SUS, precluded further diagnostic validation. In primary mucinous breast carcinoma, one would expect positivity for MUC5AC and negativity for MUC2, whereas metastatic gastrointestinal tumors typically

demonstrate a MUC2+/MUC5AC- profile. Implementation of this panel would likely have significantly reduced diagnostic ambiguity.

Thus, the diagnosis of primary triple-negative mucinous breast carcinoma was established through integrated clinicopathological correlation, taking into account tumor location, the absence of an identifiable primary site elsewhere, and response to local treatment. Nevertheless, the diagnosis remains partially limited by immunohistochemical ambiguity. This case underscores that diagnostic investigations in rare tumors should incorporate not only conventional markers, such as ER, PR, HER2, and cytokeratins, but also expanded panels, including mucin profiling and, when available, molecular genotyping, particularly when discordance exists between tumor location and immunohistochemical pattern.

About molecular diagnosis, assessment of hormone receptor expression (estrogen and progesterone) and HER2 status allows not only estimation of prognosis but also guidance of available therapeutic options [2,15,21]. The present case involves a mucinous carcinoma with a triple-negative profile, an extremely rare and challenging condition given the typical hormone receptor positivity observed in mucinous breast carcinomas. Triple-negative tumors tend to exhibit more aggressive behavior and do not respond adequately to hormonal therapies or HER2-targeted treatments, resulting in limited therapeutic options and poorer prognosis [2,6,14,26]. Furthermore, the lack of resources to assess PD-L1 expression precluded consideration of treatment with PD-1/PD-L1 checkpoint inhibitors [2,6,23].

The clinical course of this patient was marked by exceptional aggressiveness when compared with the behavior typically expected for mucinous breast carcinoma (MBC). The tumor doubled in diameter (6 cm → 10 cm) within only two months prior to neoadjuvant chemotherapy, showed only a partial response to chemotherapy (reduction from 10 × 5 cm to 5 × 5 cm), and, critically, progressed to vertebral metastases just four months after mastectomy. The tumor proliferation index (Ki-67 ~80%) was high, consistent with a highly aggressive phenotype. Death occurred 24 months after diagnosis, a dramatically worse outcome than the expected 5-year overall survival rates of 80–95% reported for conventional MBC.

This aggressive behavior may be attributed to the hybrid biology of the tumor, characterized by the combination of mucinous differentiation, typically associated with indolent tumors, and a triple-negative molecular phenotype, which is linked to highly aggressive neoplasms. It is possible that the mucinous program acts as a histological “mask,” obscuring an underlying basal-like phenotype with high metastatic potential. The presence of lymphovascular invasion, perineural infiltration, and musculoskeletal involvement (pmT4c pN3a) in the mastectomy specimen, together with extensive nodal involvement (11 of 19 lymph nodes), suggests a tumor biologically closer to mixed mucinous carcinoma (25% ductal and 75% mucinous) than to pure MBC. This hybrid pattern may represent a biologically distinct subtype, refractory to both conventional MBC treatment regimens and standard protocols for triple-negative breast cancer.

If confirmed in larger series, the triple-negative MBC phenotype may justify a distinct prognostic stratification, separate from both conventional MBC and TNBC. Patients with this profile could potentially benefit from comprehensive molecular investigation, including BRCA1/2 testing, mutational profiling, and assessment of PD-L1 expression; early consideration of immunotherapy when eligible; and possible inclusion in clinical trials targeting basal-like phenotypes, such as PARP inhibitors in BRCA-deficient cases and anti-PD-1 or anti-PD-L1 therapies in immunoinflamed tumors.

The diagnosis of primary triple-negative mucinous breast carcinoma was established through integrated clinicopathological correlation; however, the immunohistochemical presentation challenges the typical profile of this neoplasm. The initial panel, characterized by CK7 positivity, CDX2 positivity, CK20 negativity, GATA-3 negativity, PAX8 negativity, and TTF-1 negativity, is strongly suggestive of gastrointestinal or pancreaticobiliary origin, generating significant diagnostic ambiguity that warrants critical discussion.

Analysis of the mucin profile, specifically MUC2 and MUC5AC, represents a validated additional marker for discriminating primary mucinous breast adenocarcinomas from metastatic tumors. In this case, testing was not initially performed due to unavailability within the Brazilian Unified Health System (SUS) at the time of diagnosis in October 2021. Subsequent availability of this panel could potentially have demonstrated MUC5AC positivity and MUC2 negativity, a pattern compatible with pure or mixed MBC; strengthened the diagnosis of a primary breast tumor; and avoided the two-month period of diagnostic uncertainty while an expanded panel was being pursued. This gap represents a relevant technical limitation that affected both the timing and confidence of the diagnosis.

CDX2, a homeobox transcription factor, is a marker of intestinal differentiation and is classically associated with adenocarcinomas of gastrointestinal, pancreatic, and biliary origin. Its expression in primary breast carcinoma is extraordinarily rare, with fewer than ten cases reported in the literature. Two pathophysiological mechanisms have been proposed to explain CDX2 positivity in primary MBC: intestinal metaplasia of the mammary epithelium during carcinogenesis, similar to that observed in pancreatic cystadenocarcinomas; and ectopic expression in mucinous carcinomas with a basal-like or triple-negative molecular phenotype, a hypothesis that remains insufficiently established.

In the present case, extensive investigation using imaging modalities, including computed tomography of the chest, abdomen, and pelvis, colonoscopy, upper gastrointestinal endoscopy, magnetic resonance imaging of the abdomen and pelvis, and PET-CT, excluded the presence of distant metastases. However, these findings do not constitute definitive proof of primary breast origin. The absence of an identifiable primary tumor in sites with a predilection for CDX2 positivity, such as the stomach, colon, and pancreas, provides indirect evidence supporting a primary breast tumor, but also reinforces the need for additional validation, such as mucin profiling or eventual genomic sequencing. Therefore, although clinicopathological correlation supports the diagnosis of primary triple-negative MBC, the immunohistochemical profile remains atypical and requires cautious interpretation. This case illustrates an important limitation of diagnoses based exclusively on immunohistochemistry, as specific markers may fail to capture the biological heterogeneity of rare tumors, particularly in contexts where expanded testing, such as mucin profiling and genomic panels, is not readily available.

Furthermore, the scarcity of reports in the literature involving triple-negative subtypes of mucinous breast carcinoma, together with the heterogeneity of therapeutic approaches described, limits the establishment of appropriate treatment strategies for this group of patients. In most reported cases, patients underwent partial or radical mastectomy without indication for additional therapies. Few cases received adjuvant chemotherapy or radiotherapy, and to the best of our knowledge, there are no previous reports of neoadjuvant treatment. Follow-up duration reported in the literature ranges from three to ninety-six months. In this context, the role of chemotherapy and radiotherapy remains uncertain, as analysis of these studies suggests that, in the short term, complete surgical resection of the tumor may represent the main viable therapeutic option [18,20,21,24,27]. Nevertheless, despite the patient in the present report having undergone neoadjuvant chemotherapy with partial clinical response, followed by adjuvant radiotherapy and chemotherapy, tumor recurrence and distant metastases developed during follow-up at our institution, reinforcing the aggressive and refractory nature of this rare subtype.

Additionally, it is important to emphasize that the patient had unfavorable socioeconomic conditions, and all follow-up and treatment were conducted within the Brazilian Unified Health System. This reality imposes additional challenges, as the availability and timeliness of more precise complementary diagnostic tests were limited to the resources accessible at the time and place of care. At several stages, investigation and disease monitoring had to be carried out using available diagnostic methods rather than those recommended as the gold standard, which may have influenced the time required to confirm findings and optimize clinical management decisions.

Finally, given the rarity of mucinous breast carcinomas with a triple-negative molecular profile, discrepancies in the literature regarding prognosis and therapeutic strategies are to be expected. The present case describes a patient with an epidemiological profile consistent with that reported for this group, yet with clinical and molecular features that diverge from the available literature, complicating both definitive identification of the primary tumor site and the selection of the most appropriate therapies. Thus, this report reinforces the need for additional case reports and studies based on current literature to improve understanding of this tumor subtype and, in the future, enable the development of more effective therapeutic approaches with a positive impact on clinical outcomes for these patients.

#### 4. Conclusion

This report describes a rare case of triple-negative mucinous breast carcinoma and provides relevant contributions to the literature by highlighting the diagnostic and therapeutic challenges associated with this subtype. The case demonstrates the critical value of integrated clinicopathological correlation in scenarios of immunohistochemical ambiguity, particularly when markers such as CDX2 and CK7 display patterns that conflict with tumor location. In such situations, the use of complementary panels, including mucin profiling, should be considered part of the standard diagnostic workflow for mucinous breast carcinomas with atypical profiles.

Moreover, the observed clinical behavior suggests that patients with triple-negative MBC may exhibit a biologically aggressive phenotype, characterized by a high proliferative rate, early development of metastases, and limited response to conventional chemotherapy. These findings support the hypothesis that this subtype represents a biologically distinct entity, thereby justifying comprehensive molecular investigation and early consideration of immunomodulatory therapies in cases with PD-L1 expression.

The heterogeneity of therapeutic approaches described in the literature reflects the lack of robust data regarding the efficacy of available treatments for this rare subtype. In this context, the need for a targeted therapeutic algorithm becomes evident, one that is based on robust diagnostic confirmation, detailed molecular and immunological characterization, and biomarker-driven therapeutic selection, with the aim of reducing uncertainty and optimizing clinical management in future similar cases.

It is anticipated that the accumulation of additional case reports and the development of prospective studies will expand knowledge of triple-negative mucinous breast carcinoma, enabling the development of more effective and personalized therapeutic protocols. Such advances may positively impact clinical outcomes for future patients, including consideration of immune checkpoint inhibitors such as pembrolizumab and atezolizumab when indicated. It should be emphasized, however, that a definitive protocol cannot be established based on a single case with an unfavorable outcome, particularly in the context of atypical histology associated with aggressive tumor behavior.

Only a few cases of triple-negative mucinous carcinoma have been reported in the current literature, and the therapeutic strategies employed are highly divergent. The present report illustrates an epidemiological profile consistent with available data, yet with clinical, molecular, and therapeutic response characteristics that differ from those previously described. Thus, in situations like the one presented, maintaining a high level of diagnostic suspicion, grounded in epidemiological and clinical data, is recommended to minimize delays in diagnosis and in the initiation of the most appropriate treatment.

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