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Solitary Cavitary Pulmonary Metastasis from Hormone Receptor-Positive Breast Cancer: A Rare Radiologic Presentation

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ABSTRACT

Background: Pulmonary metastases from breast carcinoma typically present as multiple solid nodules or diffuse lung involvement. Cavitary pulmonary metastases are uncommon, especially when appearing as a solitary lesion, and may closely resemble infectious or primary cavitary lung diseases. These atypical radiologic presentations pose significant diagnostic challenges and can delay appropriate treatment.

Case Presentation: We report the case of a 49-year-old woman with a history of right breast invasive ductal carcinoma diagnosed approximately nine years earlier. Her tumor was estrogen receptor-positive, progesterone receptor-positive, and HER2-negative. Initial treatment included lumpectomy, chemoradiotherapy, and endocrine therapy with tamoxifen. She presented with a persistent cough, and chest CT revealed a solitary thick-walled cavitary lesion in the right lower lung lobe. Bronchoscopy showed no endobronchial abnormalities, and bronchoalveolar lavage was negative for both malignancy and infection. Due to ongoing suspicion, a CT-guided transthoracic biopsy was performed, confirming metastatic carcinoma consistent with breast primary. This case highlights a rare instance of solitary cavitary pulmonary metastasis occurring several years after the initial treatment.

Conclusion: Solitary cavitary pulmonary metastasis from hormone receptor-positive breast carcinoma is an exceptionally rare phenomenon that can mimic infectious or primary lung malignancies. Persistent cavitary lung lesions in patients with a prior history of breast cancer warrant thorough evaluation and tissue diagnosis, even after extended disease-free periods.

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INTRODUCTION

Breast cancer is the most commonly diagnosed cancer in women worldwide and, sadly, remains the leading cause of cancer-related deaths among them.[1] Despite major advances in early detection, treatments, and targeted therapies, the spread of cancer to distant organs still causes most of the serious complications and deaths in patients.[2] The lungs are among the most frequent sites where breast cancer spreads, along with the bones, liver, and brain.[3] When breast cancer spreads to the lungs, it usually appears on imaging as multiple solid nodules, lymphatic involvement, pleural disease, or diffuse lung tissue changes.[4] However, lung metastases that form cavities—hollow spaces within the tumor—are quite rare. Cavitary pulmonary metastases account for approximately 4% of all metastatic pulmonary lesions, with up to 69% originating from squamous cell carcinoma primaries.[5]

Cavitary lung lesions can be caused by a wide range of conditions including infections, inflammation, autoimmune diseases, and cancers. Common causes include tuberculosis, fungal infections, bacterial abscesses, granulomatosis with polyangiitis, septic emboli, and primary lung cancers that form cavities.[6,7] Because imaging findings often overlap, it can be difficult to tell if a cavitary lesion is cancerous or due to infection or inflammation, especially in patients who are immunocompromised or have a history of cancer.[8] Typically, a single cavitary lung lesion suggests primary lung cancer or infection rather than metastasis.[9]

While breast cancer commonly spreads to the lungs, cavitary pulmonary metastases are extremely rare, especially when they appear as a solitary lesion many years after the initial treatment.[5,10] The mechanisms underlying cavitation in metastatic lesions remain incompletely understood, but may involve central tumor necrosis from poor blood supply, invasion of airways, or treatment-related cell death.[11] Atypical metastatic patterns like this can delay diagnosis and sometimes lead to a prolonged diagnostic workup, including empirical antibiotic trials or additional invasive testing.[4]

Hormone receptor-positive breast cancer tends to have a longer, slower course and can come back many years after the primary tumor seems to be successfully treated. Still, finding a single cavitary lung metastasis nearly a decade later is very unusual.[12] In such cases, confirming the diagnosis through tissue biopsy is essential because less invasive tests like bronchoscopy may not provide clear answers.[13]

We report a rare case of a woman with hormone receptor-positive breast cancer who developed a solitary cavitary pulmonary metastasis approximately nine years after her initial treatment. The lesion first looked like an infection but was ultimately diagnosed by a CT-guided biopsy. Published reports of cavitary pulmonary metastases from breast carcinoma are sparse, and the combination of a solitary cavitary lesion, a prolonged disease-free interval, and a conventional hormone receptor-positive ductal breast primary appears to be particularly uncommon, as discussed below and summarized in Table 1.

CASE PRESENTATION

A 49-year-old female presented with a 3-month history of a non-productive cough that was refractory to symptomatic therapy. Her medical history was significant for right breast invasive ductal carcinoma (IDC) diagnosed approximately nine years earlier. Histopathologic analysis of the primary tumor had revealed hormone receptor-positive disease, with both estrogen receptor (ER) and progesterone receptor (PR) positivity, and negative human epidermal growth factor receptor 2 (HER2) status.

At the time of diagnosis, she underwent breast-conserving surgery (lumpectomy) and sentinel lymph node biopsy (1/1 positive for macrometastasis; 0/4 additional nodes involved).

The primary tumor measured 1.8 × 1.8 cm, was histologically confirmed invasive ductal carcinoma, not otherwise specified (NOS), grade 3 (Nottingham score 8/9), and had an extensive micropapillary ductal carcinoma in situ (DCIS) component. Surgical margins were negative except for a close superior margin (2–3 mm); no lymphovascular invasion was identified. Final pathologic stage was IIA (pT1c pN1a M0).

This was followed by adjuvant chemotherapy using the TAC regimen (docetaxel, adriamycin, and cyclophosphamide), followed by adjuvant radiotherapy. Subsequently, long-term endocrine therapy with tamoxifen was administered.

The patient remained clinically stable for several years following treatment completion. However, due to the persistence of her cough without notable improvement, further evaluation was warranted. She denied systemic symptoms such as fever, hemoptysis, weight loss, or night sweats. Physical examination was unremarkable, and routine laboratory tests—including complete blood count, inflammatory markers (ESR, CRP), and renal/hepatic function—were within normal limits.

Chest computed tomography (CT) identified a solitary cavitary lesion in the right lower lobe, measuring approximately 75 × 66 × 83 mm, characterized by irregular, thickened walls (Figure 1). No additional pulmonary nodules or diffuse metastatic involvement were detected by CT of the chest, abdomen, and pelvis.

Given the atypical radiologic appearance, a broad differential diagnosis was considered, including pulmonary abscess, tuberculosis, fungal infection, primary cavitary lung carcinoma, and metastatic disease. Diagnostic bronchoscopy revealed no visible endobronchial lesions. Bronchoalveolar lavage (BAL) fluid analysis showed negative cytology for malignant cells. Furthermore, comprehensive microbiological assessments were entirely negative; routine bacterial cultures and smears yielded no growth of common organisms. Mycological evaluations, including fungal smears, fungal cultures, and serum and BAL galactomannan antigen testing, were all negative. Additionally, acid-fast bacilli (AFB) smear microscopy and *Mycobacterium tuberculosis* polymerase chain reaction (MTB-PCR) assays both returned negative results, effectively ruling out an infectious etiology.

Given the non-diagnostic bronchoscopic findings, a CT-guided transthoracic biopsy of the right lung mass was performed. Histological examination confirmed metastatic breast carcinoma involving lung parenchyma. The immunohistochemical (IHC) profile strongly supported a breast primary origin, demonstrating strong and diffuse positivity for GATA3, alongside weak estrogen receptor (ER) expression in 2% of tumor cells, and negative HER2 (score 0) status. Negative TTF-1 and p63 staining argued against, but did not independently exclude, a primary pulmonary adenocarcinoma or squamous cell carcinoma, respectively. In the context of the histomorphologic findings, strong and diffuse GATA3 positivity, and the patient's history of breast carcinoma, the immunophenotypic profile was consistent with metastatic breast carcinoma (Figure 2).

After a disease-free interval of nine years, the patient presented with a solitary pulmonary metastatic recurrence. Given the late relapse and the need for a well-tolerated systemic therapy, she was initiated on single-agent chemotherapy with weekly vinorelbine as first-line treatment for metastatic disease. Subsequent clinical and radiologic follow-up data after initiation of vinorelbine were not available at the time of manuscript preparation; therefore, treatment response and the duration of follow-up could not be reliably assessed.

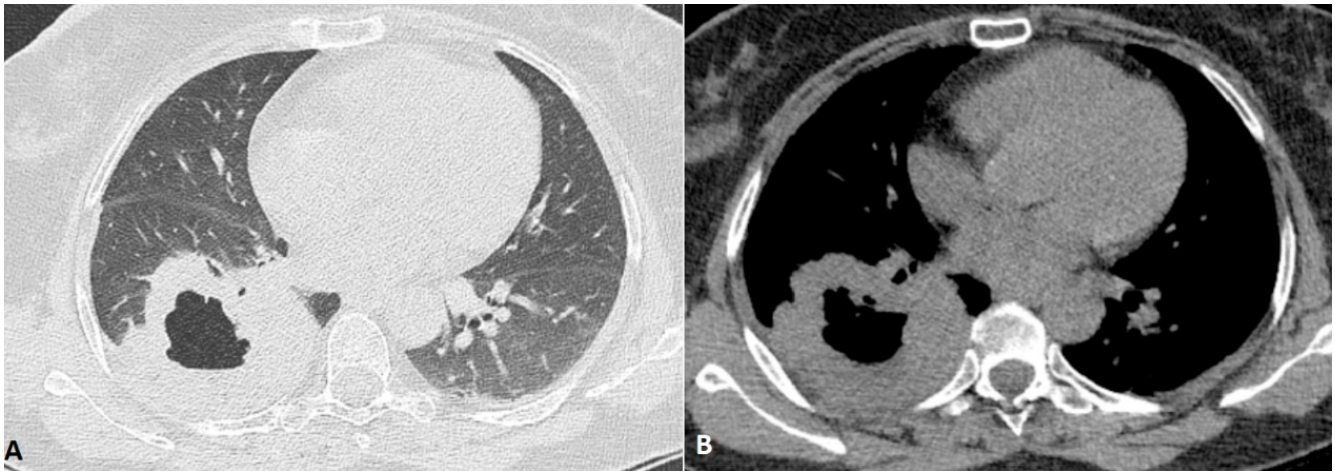


Figure 1. Axial Chest Computed Tomography Image
A, lung window; B, mediastinal window, demonstrating a solitary thick-walled cavitary lesion in the right lower lobe of the lung.

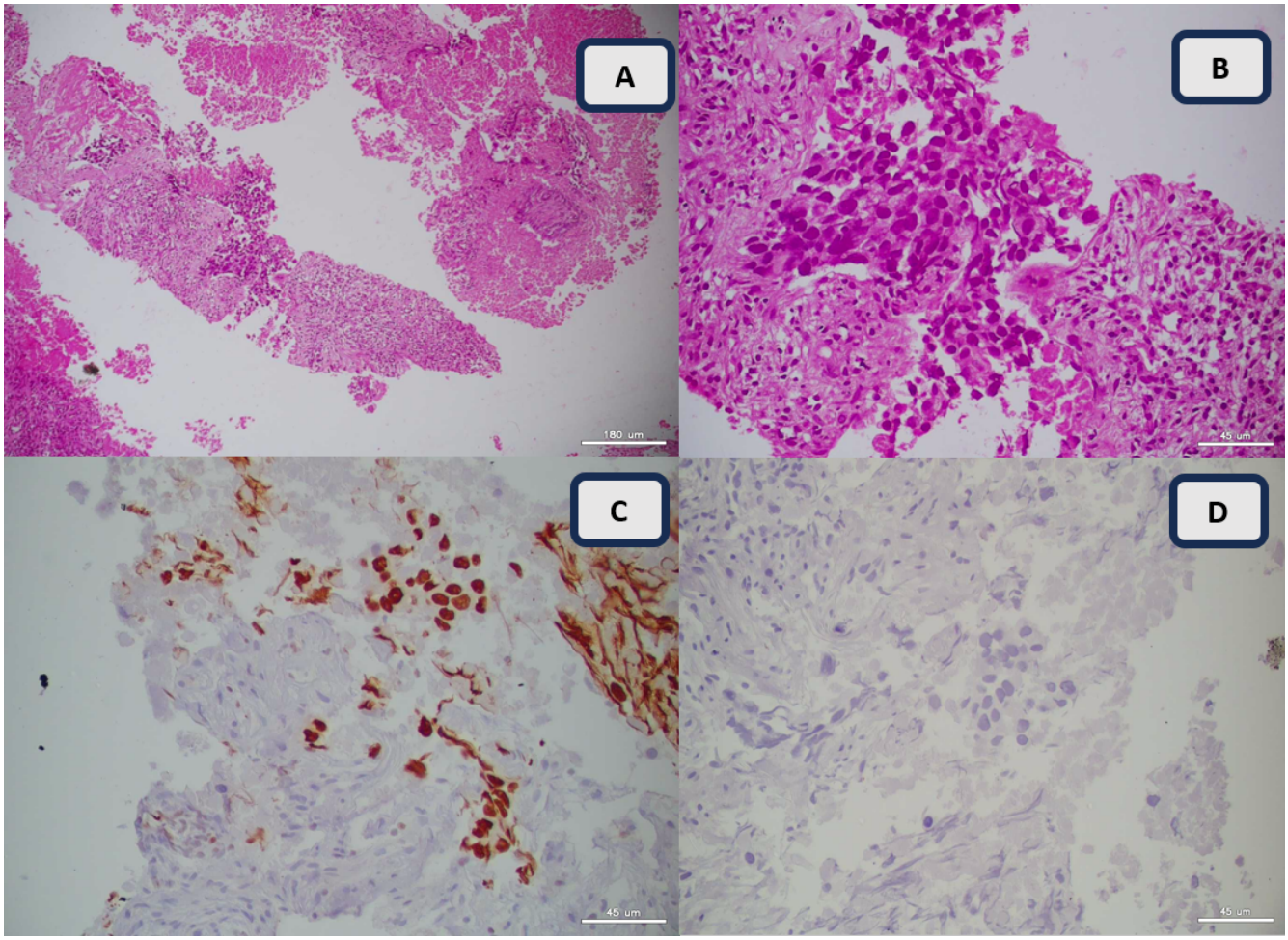


Figure 2. Histopathologic and Immunohistochemical Findings of the CT-Guided Lung Biopsy
A, H&E (low magnification): infiltrative atypical tumor cells and extensive necrosis. B, H&E (higher magnification): enlarged, hyperchromatic nuclei. C, Strong nuclear GATA3 staining. D, Absent TTF-1 staining. Scale bars: A, 180 µm; B–D, 45 µm. Morphology, immunostaining and clinical history supported metastatic breast carcinoma. H&E, hematoxylin and eosin.

This case underscores the rare presentation of metastatic breast carcinoma as a solitary cavitary pulmonary lesion nearly nine years after the initial treatment.

DISCUSSION

Pulmonary involvement is a common feature of metastatic breast carcinoma, with radiologic presentations that are generally well characterized. Most

frequently, these metastases appear as multiple well-circumscribed solid nodules, lymphangitic carcinomatosis, pleural disease, or diffuse parenchymal involvement. The current case is notable for its atypical presentation as a solitary thick-walled cavitary lesion in the right lower lobe, occurring nearly nine years following initial treatment for hormone receptor-positive breast cancer.[3,4] This presentation is clinically significant, as solitary cavitary lung lesions are more often associated with infectious etiologies, primary lung malignancies, or inflammatory conditions, rather than metastatic breast carcinoma.[6,7,9]

Cavitary pulmonary metastases are rare and more often associated with squamous cell carcinomas, sarcomas, and certain gastrointestinal malignancies than with breast carcinoma.[5] Seo *et al.* noted that atypical pulmonary metastases can closely mimic benign disease, requiring careful radiologic-pathologic correlation.[4] Breast-cancer reports remain sporadic, usually involving uncommon histologic subtypes or more extensive metastases.[10] The solitary cavitary lesion in this patient is therefore particularly unusual; published cases differ substantially in clinical and radiologic context (Table 1). None of Chaudhuri's 25 cases of cavitary pulmonary metastases arose from breast carcinoma.[5] Mermershtain *et al.* reported multiple breast-cancer lung metastases, some already cavitary; after paclitaxel/trastuzumab (Taxol/Herceptin), most regressed, while cavitation developed or increased in several remaining lesions.[10] Hashinokuchi *et al.* described multiple small bilateral cavitating metastases from breast invasive ductal carcinoma two years after treatment, presenting with recurrent spontaneous pneumothorax.[14] More recently, So *et al.* reported multiple thick-walled cavitary metastases from triple-negative mixed metaplastic breast carcinoma with squamous and spindle-cell components; some mimicked aspergilloma and were associated with pneumothorax.[15]

This patient developed a single large, thick-walled cavitary lesion approximately nine years after treatment for conventional hormone receptor-positive, HER2-negative invasive ductal carcinoma, without additional pulmonary nodules or diffuse metastases on chest, abdominal, or pelvic CT. Late pulmonary recurrence itself is not unique: solitary metastases have been reported after disease-free intervals of 18 and approximately 20 years, but as solid rather than cavitary nodules.[16,17] The distinctive feature here is the combination of solitary cavitary morphology, a prolonged disease-free interval, and a conventional hormone receptor-positive ductal primary, rather than any feature alone.

The differential diagnosis for cavitary lung lesions is broad, encompassing pulmonary tuberculosis, fungal infections, bacterial abscesses, septic emboli, granulomatosis with polyangiitis, primary cavitary lung carcinoma, and metastatic disease.[6,7] While radiologic features such as wall thickness, irregular margins, surrounding consolidation, and the presence of nodules may assist in refining the differential, these characteristics lack sufficient specificity to establish a definitive diagnosis.[8,9] This diagnostic challenge is particularly pronounced in oncologic patients as infectious and malignant processes may present with overlapping imaging features. In this patient, the combination of persistent cough and a solitary cavitary lesion initially raised suspicion for infectious or primary malignant processes; however, histopathologic evaluation ultimately confirmed metastatic breast carcinoma.

The pathogenesis of cavitation in pulmonary metastases remains incompletely elucidated. Proposed mechanisms include central tumor necrosis secondary to rapid growth, ischemic changes, check-valve airway obstruction, bronchial invasion, or treatment-induced necrosis.[4,11] Tumor histology may influence cavitation propensity, with squamous differentiation being associated with a higher likelihood of cavitary change.[5] In hormone receptor-positive invasive ductal carcinoma, such cavitary metastatic presentations are unexpected, underscoring the importance of histopathologic confirmation.

From a histopathological standpoint, the differential diagnosis of a cavitary lung lesion in a patient with prior breast cancer includes primary lung adenocarcinoma, squamous cell carcinoma, and other metastatic malignancies. In the present case, the immunohistochemical profile—strong and diffuse GATA3 positivity with negative TTF-1 and p63 staining—favored metastatic breast carcinoma in the appropriate clinical and morphologic context. GATA3 is a sensitive marker for breast carcinoma.[13,18], whereas TTF-1 and p63 are commonly used to support pulmonary adenocarcinoma and squamous cell carcinoma, respectively.[19,20] However, because these markers do not have complete sensitivity, negative TTF-1 and p63 staining should not be interpreted as independently excluding a primary pulmonary malignancy.

The metastasis retained low ER expression (2%). Receptor expression and status can differ between primary breast tumors and distant metastases; a systematic review and meta-analysis reported approximately 19% overall ER discordance.[21] The long interval to pulmonary metastasis is also noteworthy. Hormone receptor-positive breast cancer can recur late: Pan *et al.* found that distant recurrences occurred steadily five to twenty years after completion of endocrine therapy in ER-positive disease.[12] Even after prolonged disease-free intervals, new pulmonary lesions warrant thorough evaluation rather than presumptive attribution to benign or infectious causes in patients with this history.

Bronchoscopy and bronchoalveolar lavage remain valuable diagnostic tools when endobronchial lesions or infection are suspected; nevertheless, negative findings do not exclude peripheral metastatic disease. In this case, the absence of visible endobronchial lesions and negative lavage cytology necessitated CT-guided transthoracic biopsy, which established the definitive diagnosis. This case, therefore, illustrates the value of image-guided biopsy when less invasive diagnostic modalities are inconclusive.

Table 1. Previously reported cavitary pulmonary metastases from breast carcinoma compared with the present case

Study	Primary breast pathology	Interval to pulmonary presentation	Pulmonary pattern	Relevant clinical/radiologic features	Comparison with present case
Mermers htain *et al.*, 2002 ([10])	Breast carcinoma; detailed histologic subtype/receptor profile not specified in the report.	Not specified.	Multiple pulmonary nodules, some with cavitation.	Following paclitaxel/trastuzumab (Taxol/Herceptin) therapy, most lesions regressed and cavitation developed or became more prominent in several remaining pulmonary lesions.	Multifocal, treatment-associated cavitation rather than a solitary late cavitary pulmonary metastasis.
Hashinokuchi *et al.*, 2021 ([14])	Invasive ductal carcinoma, ypT4bN1M0, stage IIIB	2 years	Multiple small bilateral cavitating pulmonary lesions	Recurrent spontaneous pneumothorax; metastatic breast carcinoma with pleural invasion confirmed surgically	Bilateral multifocal disease with pneumothorax and a substantially shorter interval
So *et al.*, 2023 ([15])	Mixed metaplastic breast carcinoma with squamous and spindle-cell components; triple-negative	Approximately 3 years after breast surgery	Multiple thick-walled cavitary pulmonary lesions	Some lesions mimicked aspergilloma; associated pneumothorax	Different histologic subtype and multiple lesions with a shorter interval
Present case	Invasive ductal carcinoma, NOS; primary tumor HR-positive/HER2-negative; pulmonary metastasis ER 2%, HER2 0	Approximately 9 years	Single 75 × 66 × 83-mm thick-walled cavitary lesion in the right lower lobe	No additional pulmonary nodules or diffuse metastatic involvement on CT; diagnosis established by CT-guided biopsy	Solitary cavitary morphology after a prolonged disease-free interval in a patient with conventional HR-positive ductal breast carcinoma

This case highlights three key clinical lessons: first, metastatic breast carcinoma can rarely present as solitary cavitary pulmonary lesions, even years after initial therapy. Second, metastatic cavitary lesions mimic infectious or primary pulmonary malignancies, potentially delaying diagnosis and treatment. Third, tissue diagnosis is indispensable when imaging and bronchoscopic findings are non-diagnostic. Awareness of this rare presentation may facilitate timely diagnosis and appropriate oncologic management.

CONCLUSION

Solitary cavitary lung metastasis from hormone receptor-positive breast cancer is an extremely rare finding that can look very much like an infection or a primary lung cancer. This case underscores the need to keep a broad perspective when evaluating cavitary lung lesions in patients with a history of breast cancer, even years after their initial treatment. Negative bronchoscopy and lung washings do not rule out metastatic disease, especially for lesions located in the periphery of the lungs. Therefore, tissue biopsy guided by imaging remains critical for an accurate diagnosis. Being aware of this uncommon presentation can help clinicians recognize it earlier, avoid diagnostic delays, and provide timely cancer care.

ETHICAL CONSIDERATIONS

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

This retrospective, single-patient case report was prepared exclusively from clinical information and investigations obtained during the patient's routine diagnostic and therapeutic care. No research-specific intervention, experimental procedure, or additional diagnostic investigation was performed for the purpose of this report. Formal institutional ethics committee approval was not sought; therefore, no ethics approval number is available. Written informed consent was obtained from the patient for publication of her anonymized clinical information and the accompanying radiologic and histopathologic images.

DATA AVAILABILITY

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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AI DISCLOSURE

ChatGPT (OpenAI) was used solely for language editing, grammatical refinement, and improvement of readability during manuscript preparation. It was not used for data analysis, interpretation of results, generation of scientific conclusions, or creation of study data. All AI-assisted text was critically reviewed and revised by the authors, who take full responsibility for the final content of the manuscript.

AUTHOR CONTRIBUTIONS

SS: Investigation, Writing – original draft. HA: Investigation, Writing – review & editing. SM: Data curation, Investigation. MRG: Conceptualization, Writing – original draft. MA: Supervision, Writing – review & editing.

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