

Mucinous Adenocarcinoma Arising in a Mature Ovarian Teratoma

TANIN ZADEH, DO; KOMEIL MIRZAEI BABOLI, MD; SARA SALEHIAZAR, MD; TRUC TRAN, MD

ABSTRACT

Malignant transformation of a mature cystic teratoma (MCT) is rare, with mucinous adenocarcinoma being an even more uncommon subtype. Accurate diagnosis requires distinction from metastatic gastrointestinal tumors. A woman in her 30s presented with a 19 cm right ovarian mass. She underwent exploratory laparotomy with right salpingo-oophorectomy, left ovarian cystectomy, omentectomy, peritoneal biopsies, and bilateral pelvic and para-aortic lymphadenectomy with intraoperative rupture of the mass. Frozen section suggested immature teratoma, but final pathology revealed mucinous adenocarcinoma arising within a mature teratoma. The tumor showed CK20, CDX2, SATB2 positivity, patchy CK7, and loss of PAX8. All lymph nodes and staging biopsies were negative for carcinoma. Final stage: FIGO IC1. This case highlights the diagnostic and staging challenges in malignant transformation (MT) of a MCT. Thorough sampling, immunohistochemistry (IHC), and clinical correlation are critical to differentiate primary ovarian neoplasms from metastatic disease. Accurate classification is essential to guide appropriate management.

KEYWORDS: Mature cystic teratoma; mucinous adenocarcinoma; ovarian neoplasm; malignant transformation; immunohistochemistry

INTRODUCTION

Mature cystic teratomas are among the most common ovarian germ cell tumors and are generally benign. Malignant transformation occurs in approximately 1–3% of cases, with squamous cell carcinoma being the most frequent malignancy. Transformation into mucinous adenocarcinoma is much rarer, accounting for approximately 5–8% of MTs.¹ Mucinous tumors arising in MCTs often demonstrate gastrointestinal-type differentiation, including positive immunoreactivity for CK20, CDX2, and SATB2, and variable PAX-8 and CK7.^{2–4} This immunochemical profile can mimic metastasis from the gastrointestinal (GI) tract, making integration of histology, immunohistochemistry, clinical findings, and imaging studies essential for accurate diagnosis.

Due to their rarity and overlapping histologic features with metastatic GI tumors, mucinous carcinomas arising

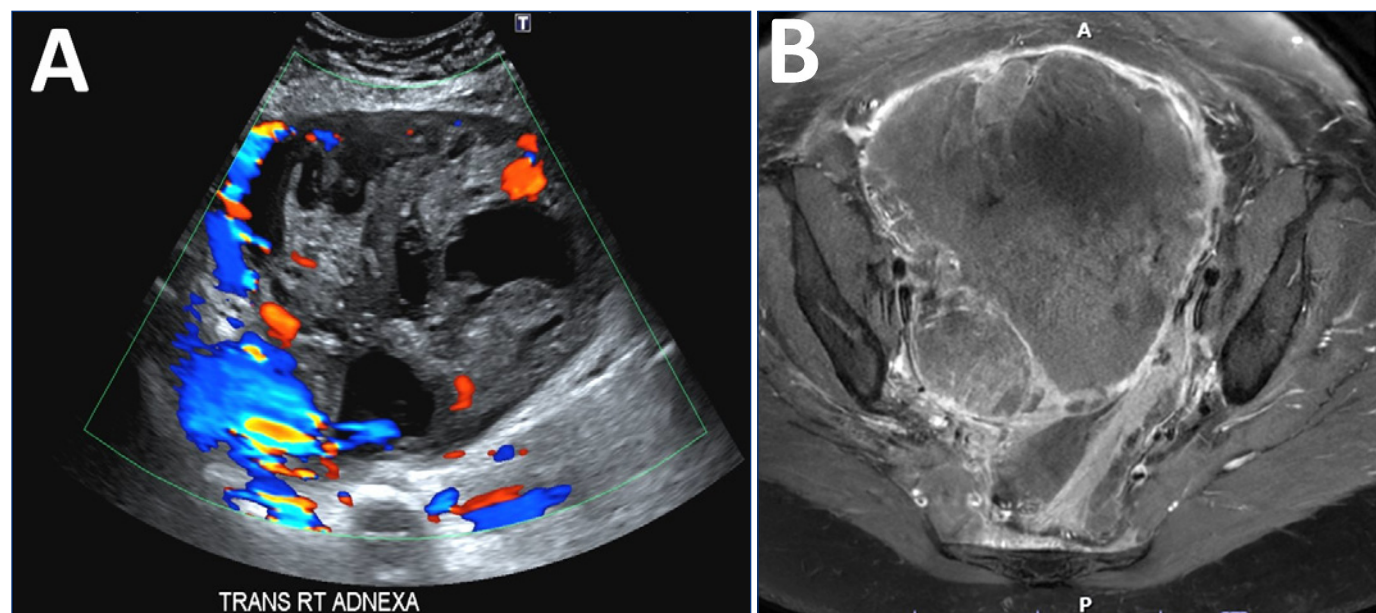
in MCTs are diagnostically challenging. Frozen section evaluation can be particularly limited due to extensive necrosis, mucinous debris, or low tumor cellularity, which may obscure malignant components. Most reported cases occur in postmenopausal women and often present as large adnexal masses, sometimes with signs of rupture or adhesions.^{5,6} However, these tumors can also occur in reproductive-age patients, emphasizing the importance of considering MT in younger individuals as well. A literature review of PubMed for the past 10 years from 2015–2025 has identified less than 10 reported cases of mature teratoma with malignant transformation of mucinous adenocarcinoma.

The diverse gross and microscopic appearance of MCTs is due to the presence of well-differentiated tissues derived from all three germ layers: ectoderm, mesoderm, and endoderm.⁶ Ectodermal derivatives, such as skin, hair, and neural tissue are the most encountered components, with MT typically arising from squamous epithelium, becoming squamous cell carcinoma. However, this process can also involve the endodermal layer, leading to rare cases of adenocarcinoma. Among these, mucinous adenocarcinoma is an exceptionally rare form of MT, often displaying intestinal-type features that can closely resemble metastatic GI tumors.⁶ We present another rare case of mucinous adenocarcinoma arising within a mature teratoma in a woman in her 30s. This case highlights the diagnostic challenges of distinguishing primary ovarian mucinous carcinoma from metastasis, especially when arising in a teratoma.

CASE REPORT

A multiparous woman in her 30s (gravida 2, para 2) presented to the hospital with pelvic pain, right lower back pain, and vaginal bleeding for 10 days. Her other symptoms included constipation, bloating, and early satiety. The initial physical examination revealed a distended and tender abdomen, dark brown blood in the vaginal vault, posteriorly oriented cervix and anteverted uterus. Pelvic ultrasound imaging revealed an ORADS-5 right adnexal cystic and solid lesion measuring about 19 cm [Figure 1A]. Further investigation with pelvic computed tomography (CT) and magnetic resonance imaging (MRI) revealed a large multicystic mass with calcifications measuring 18 × 17 × 13 cm [Figure 1B], arising from the right ovary, suggestive of a dermoid cyst. Preoperative CT

Figure 1. [A] Transvaginal ultrasound showing a 19 cm right adnexal mass with mixed solid and cystic components and both internal and peripheral Doppler flow. [B] MRI of pelvis showing a large multiloculated pelvis with thick enhancing septations, measuring up to 18 cm.



of the chest, abdomen, and pelvis demonstrated no definite evidence of metastatic disease. Tumor markers were notable for CA-125: 63.1 U/mL (normal: <35), CEA: 28.5 ng/mL (normal: <3), and CA 19-9: 81 U/mL (normal: <35). AFP was within normal limits at 4.4 ng/mL (normal: <10).

The patient underwent exploratory laparotomy with right salpingo-oophorectomy, bilateral pelvic and para-aortic lymphadenectomy, infracolic and infragastric omentectomy, and left ovarian cystectomy. Upon entering the peritoneal cavity, ascites was noted and sent for cytologic studies. Severe adhesions were found between the mass and small bowel, pelvic wall, left tube and ovary, cul de sac, and rectal mesentery. Lysis of these adhesions led to rupture of the mass extruding brown fluid and fibrinopurulent material. Frozen sections from the right ovary showed immature teratoma, and sections from the small bowel were negative for tumor.

Grossly, the right ovarian mass measured 19 x 17.5 x 13 cm and weighed 1,174 grams. Serial sectioning revealed hair with solid yellow and necrotic areas in the cyst. Microscopic analysis demonstrated components of both a mature teratoma and mucinous adenocarcinoma. This raised the differentials of (1) malignant transformation of a benign teratoma, or (2) a collision tumor comprising of a mature teratoma and mucinous carcinoma, either of primary ovarian origin or metastatic from the GI tract. The tumor cells were positive for CK20, CDX2, SATB2, and showed patchy positivity for CK7 [Figure 2A-C]. They were negative for PAX-8, GFAP, synaptophysin, and chromogranin. The proliferation index by Ki-67 was high at 80% [Figure 2D]. No tumor was found in the extra-ovarian tissue, and all lymph

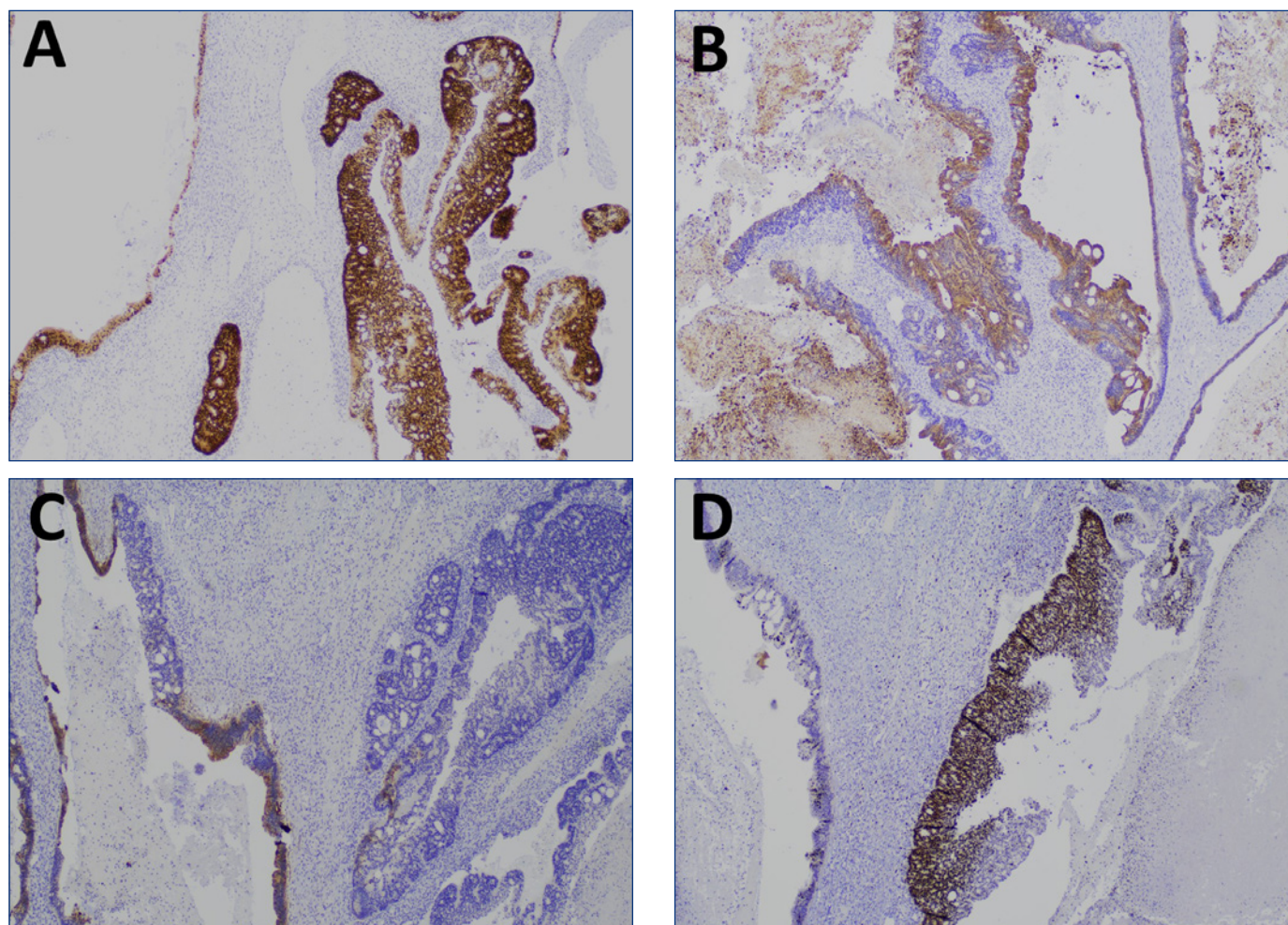
nodes and peritoneal biopsies were negative. The tumor was staged as FIGO IC1 due to surgical spill of cystic contents. Peritoneal fluid was negative for malignancy on cytology. The immunophenotype (CK20+, CDX2+, SATB2+, patchy CK7+, PAX8-) supports intestinal differentiation but does not distinguish between primary ovarian and metastatic GI origin. Grossly and morphologically, the mature teratoma is intermixed with the mucinous tumor, with no intervening normal ovarian stroma. Although metastatic GI carcinoma cannot be entirely ruled out, the pathologic findings and lack of extra-ovarian disease strongly favor a primary ovarian origin with the carcinoma arising from the endodermal component of the MCT.

Her post-operative course was uneventful. Genetic testing revealed no clinically significant mutations. A variant of unknown significance (VUS) was identified but did not influence clinical management. She began treatment with six cycles of chemotherapy, seven weeks after her operation, with CT imaging planned to follow the final cycle. Her CA-125 levels were 19 U/mL at two months postoperatively, 34.5 U/mL at three months, 18.6 U/mL at four months, and 16.7 U/mL at five months (normal: <35).

DISCUSSION

Malignant transformation of mature cystic teratomas (MCTs) is rare, occurring in only 1–3% of cases, and is most frequently observed in postmenopausal women, typically over the age of 50.⁵ The present case is notable given the patient's young age, highlighting that although uncommon, MT can occur in reproductive-age women and should

Figure 2. Immunohistochemistry showing tumor positivity for [A] CDX2, [B] CK20, and [C] CK7, and a [D] high Ki-67 proliferation index.



not be excluded based on age alone. Although malignant changes are rarely recognized preoperatively,¹ our case had early radiologic changes suspicious for malignancy.

The mechanisms underlying MT in MCTs are not fully understood but are thought to be associated with long-standing, untreated tumors that undergo genetic instability over time.^{6,7} Prior studies have shown that MT is more frequently observed in older patients (>45 years) and in large tumors (>10 cm) (8–10). Because any of the tridermal components can undergo transformation, various types of malignancies, including basal cell, sebaceous tumor, carcinoid, transitional cell carcinoma, adenosquamous, melanoma, and leiomyosarcoma have been found to arise from MCTs.^{1,6,11}

Accurate diagnosis is critical, as the immunohistochemical profile of mucinous adenocarcinoma arising in MCTs can mimic metastatic GI tumors. Most reported mucinous carcinomas arising from MCTs display a CK20+/CK7 profile,⁴ corresponding to a lower GI origin; however, one study describes a MCT-associated mucinous carcinoma with CK20+/CK7+ profile.² Our case showed a similar pattern

with strong positivity for CK20 and patchy positivity for CK7. One study analyzing 42 cases of mucinous neoplasms arising in MCTs found universal CDX2 positivity,¹² consistent with the findings in our case. Although SATB2 is a sensitive marker for lower GI tumors and is not typically expressed in the female reproductive tract,^{3,13} its positivity in our case was interpreted in the context of the mature elements of the tumor and clinical findings, supporting a primary ovarian origin rather than metastatic disease. PAX-8 is typically negative in GI tumors and is variable in ovarian primaries.³ A large retrospective study evaluating ovarian and GI tumors concluded that ovarian mucinous tumors associated with teratomas can show a similar immunoprofile to GI tumors, making the diagnosis reliant on the teratoma element.³ Absence of a GI primary on clinical and radiologic evaluation, lack of metastatic disease, and the presence of mature teratoma elements support a primary ovarian origin in this case.

Distinguishing primary ovarian carcinoma from metastatic disease is crucial for guiding treatment, determining

prognosis, and deciding whether ancillary studies or further extra-ovarian work-up are needed. For example, colon carcinoma in a young female patient would indicate genetic testing for Lynch syndrome. Our patient underwent Myriad genetic testing which found only a VUS, which was not believed to have contributed to the disease process.

The standard surgical approach for this type of tumor involves a total hysterectomy, bilateral salpingo-oophorectomy, and surgical staging with omentectomy, appendectomy, lymphadenectomy, peritoneal biopsies, and peritoneal washing.¹⁴ However, younger patients may desire fertility-preserving surgery, in which a unilateral salpingo-oophorectomy with complete surgical staging, as performed in our case, may be considered. According to the National Comprehensive Cancer Network (NCCN) guidelines, management of mucinous ovarian carcinoma is primarily stage dependent. Stage I disease may be managed with observation or adjuvant systemic therapy, depending on the risk factors. Although our patient had early-stage disease, the intraoperative spill and fertility-sparing surgery were contributing factors in the decision to proceed with six cycles of adjuvant chemotherapy. One of the preferred regimens for mucinous carcinoma stage IC is Carboplatin/Paclitaxel every three weeks,¹⁵ which is what our patient received. The prognosis for stage I adenocarcinoma arising from a MCT is relatively good compared to that of later-stage disease.¹⁶ Since adenocarcinomas arising from MT are quite rare, most studies assessing relapse risk are conducted on mucinous ovarian carcinomas without an associated-MCT component. Factors associated with lower recurrence risk include early FIGO stage, lower pathological grade, and no visible residual disease after debulking.¹⁷

CONCLUSION

Mucinous carcinoma arising from MCTs presents a diagnostic conundrum due to its rarity and variable immunohistochemical and imaging characteristics. Ovarian mucinous carcinomas arising in MCTs may demonstrate an immunoprofile that overlaps with GI tumors, including expression of CK20, CDX2, and SATB2, with variable CK7 and PAX-8 expression. Ovarian mucinous tumors associated with teratomas may not have an established dominant immunoprofile due to their rarity; therefore, diagnosis should rely on morphologic findings and identification of the teratomatous component rather than immunohistochemistry alone. Clinicians must integrate systemic imaging (MRI, PET/CT) with tumor marker trends (e.g., elevated CA19-9, CA125) and histopathology to determine tumor origin, tailoring surgical and chemotherapeutic strategies accordingly.

References

1. Park JH, Whang SO, Song ES, Choi SJ, Lee WY. An ovarian mucinous cystadenocarcinoma arising from mature cystic teratoma with para-aortic lymph node metastasis: a case report. *J Gynecol Oncol.* 2008;19(4):275. doi:10.3802/jgo.2008.19.4.275
2. Atsukawa N, Nakai G, Omura S, Yamamoto K, Yamada T, Ohmichi M, et al. Imaging features of mucinous carcinoma arising from mature teratoma showing cytokeratin 7+ and cytokeratin 20+ expression profile: A case report. *Radiol Case Rep.* 2024 Apr;19(4):1288–93. doi:10.1016/j.radcr.2024.01.001
3. Meagher NS, Wang L, Rambau PF, Intermaggio MP, Huntsman DG, Wilkens LR, et al. A combination of the immunohistochemical markers CK7 and SATB2 is highly sensitive and specific for distinguishing primary ovarian mucinous tumors from colorectal and appendiceal metastases. *Mod Pathol.* 2019 Dec;32(12):1834–46. doi:10.1038/s41379-019-0302-0
4. Clark ME, Will MD. Intestinal-Type Adenocarcinoma Arising in a Mature Cystic Teratoma of the Ovary. *Int J Gynecol Pathol.* 2016 Jul;35(4):352–6. doi:10.1097/PGP.0000000000000258
5. Kikkawa F, Ishikawa H, Tamakoshi K, Nawa A, Suganuma N, Tomoda Y. Squamous cell carcinoma arising from mature cystic teratoma of the ovary: A clinicopathologic analysis. *Obstet Gynecol.* 1997 Jun;89(6):1017–22. doi:10.1016/S0029-7844(97)00117-8
6. Abdoli Shadbad M, Derogar R, Shekarchi AA, Akbari F, Jafari Shobeiri M. Mature cystic ovarian teratoma with squamous cell carcinoma transformation: a case report and literature review. *Horm Mol Biol Clin Investig.* 2024 Apr 1;45(1):35–9. doi:10.1515/hmbci-2023-0001
7. Bouri S, Simon P, D'Haene N, Catteau X, Noël JC. P53 and PIK3CA Mutations in KRAS/HER2 Negative Ovarian Intestinal-Type Mucinous Carcinoma Associated with Mature Teratoma. Porpora MG, editor. *Case Rep Obstet Gynecol.* 2020 Jan;2020(1):8863610. doi:10.1155/2020/8863610
8. Hackethal A, Brueggmann D, Bohlmann MK, Franke FE, Tinneberg HR, Münstedt K. Squamous-cell carcinoma in mature cystic teratoma of the ovary: systematic review and analysis of published data. *Lancet Oncol.* 2008 Dec;9(12):1173–80. doi:10.1016/S1470-2045(08)70306-1
9. Rim SY, Kim SM, Choi HS. Malignant transformation of ovarian mature cystic teratoma. *Int J Gynecol Cancer.* 2006 Jan;16(1):140–4. doi:10.1136/ijgc-00009577-200601000-00023
10. Peterson WF. Malignant Degeneration of Benign Cystic Teratomas of the Ovary. A Collective Review of the Literature. *Obstet Gynecol Surv.* 1957 Dec;12(6):793–830. doi:10.1097/00006254-195712000-00001
11. Bacalbasa N, Cretoiu D, Halmaciu I, Diaconu C, Iliescu L, Dima S, et al. Squamous Cell Carcinoma from Abscessed, Mature Cystic Ovarian Teratoma – A Case Report and Literature Review. *In Vivo.* 2020;34(4):2141–6. doi:10.21873/in vivo.12020
12. Hershkovitz D, Vlodavsky E, Simon E, Ben-Izhak O. KRAS mutation positive mucinous adenocarcinoma originating in mature ovarian teratoma: Case report and review of literature. *Pathol Int.* 2013 Dec;63(12):611–4. doi:10.1111/pin.12123
13. Atwi D, Kamal M, Quinton M, Hassell LA. Malignant transformation of mature cystic teratoma of the ovary. *J Obstet Gynaecol Res.* 2022 Dec;48(12):3068–76. doi:10.1111/jog.15409
14. Gadducci A, Guerrieri ME, Cosio S. Squamous cell carcinoma arising from mature cystic teratoma of the ovary: A challenging question for gynecologic oncologists. *Crit Rev Oncol Hematol.* 2019 Jan;133:92–8. doi:10.1016/j.critrevonc.2018.10.005
15. National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology: Ovarian Cancer [Clinical Practice Guideline] [Internet]. National Comprehensive Cancer Network; 2026 [cited 2026 Apr 8]. Available from: <https://www.nccn.org>
16. Miyasaka A, Nishikawa T, Kozawa E, Yasuda M, Fujiwara K, Hasegawa K. Advanced Mucinous Adenocarcinoma Arising from a Mature Cystic Teratoma: A Case Report and Literature Review. *Case Rep Oncol.* 2016 Jun 27;9(2):331–7. doi:10.1159/000447258
17. Hollis RL, Stillie LJ, Hopkins S, Bartos C, Churchman M, Rye T, et al. Clinicopathological Determinants of Recurrence Risk and Survival in Mucinous Ovarian Carcinoma. *Cancers.* 2021 Nov 21;13(22):5839. doi:10.3390/cancers13225839

Authors

Tanin Zadeh, DO, Department of Pathology, Harbor-UCLA Medical Center, Torrance, CA.

Komeil Mirzaei Baboli, MD, Department of Pathology, Harbor-UCLA Medical Center, Torrance, CA.

Sara Salehiazar, MD, Department of Pathology, Yale School of Medicine, New Haven, CT.

Truc Tran, MD, Department of Pathology, Harbor-UCLA Medical Center, Torrance, CA.

Correspondence

Tanin Zadeh, DO
Department of Pathology and Laboratory Medicine
Harbor-UCLA Medical Center
1000 W Carson St, Torrance, CA, 90502
424-306-6400
TZadeh@dhs.lacounty.gov

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