Case Report

Leptomeningeal carcinomatosis and bilateral internal auditory canal metastases from ovarian carcinoma

Martin Krupa MD*, Kathy Byun MD

Department of Radiology, Eastern Virginia Medical School, 600 Gresham Drive, Norfolk, VA 23507, USA

ABSTRACT

Ovarian cancer, a leading cause of death in women, typically spreads locally and rarely metastasizes to the brain or seeds the leptomeninges. We present a case of a 62-year-old woman with a history of treated ovarian cell carcinoma who developed bilateral sensorineural deafness and right-sided facial weakness and on imaging was found to have bilateral internal auditory canal (IAC) masses and leptomeningeal carcinomatosis, pathologically proven by cerebrospinal fluid cytology. We discuss her magnetic resonance imaging and positron emission tomography-computed tomography findings and review the imaging characteristics of IAC metastases. Finally, we review the literature on leptomeningeal carcinomatosis from ovarian cancer and discuss the high incidence of bilateral IAC metastases in patients with leptomeningeal carcinomatosis.

© 2017 the Authors. Published by Elsevier Inc. under copyright license from the University of Washington. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Case report

A 62-year-old woman was diagnosed with pathologic stage IIC high-grade serous ovarian carcinoma with malignant ascites but no lymph node involvement in 2014. She underwent bilateral salpingo-oophorectomy, omentectomy, and adjuvant chemotherapy treatment, which concluded in early 2015. The patient did well until about 2 months prior to presentation when her CA-125 tumor marker began to rise from a baseline of 25 U/mL to 125 U/mL, and 195 U/mL 1 month prior to presentation. At this time, she started developing bilateral sensorineural hearing loss, right-sided facial paralysis, gait instability, and low back pain with radiation down her left thigh.

On presentation, brain magnetic resonance imaging (MRI) was performed and showed hypointense, enhancing soft tissue masses within both internal auditory canals (IACs), with the right mass extending to the cerebellopontine angle (CPA) cistern on the right (Fig. 1). There was also an enhancing lesion in the fourth ventricle; however, no parenchymal brain masses were seen. The patient had no personal or family history of neurofibromatosis type II; however, she did have a baseline history of hearing loss and wore binaural hearing aids. She subsequently underwent staging with fluorine-18 fluorodeoxyglucose positron emission tomography-computed tomography (18F-FDG PET/CT), which showed 18F-FDG accumulation in the bilateral IACs and fourth ventricle (Fig. 2). 18F-FDG PET/CT revealed additional lesions at multiple levels in the spinal canal (Fig. 3A). Her CA-125 tumor marker was now elevated to 655 U/mL.

A diagnostic lumbar puncture (LP) was performed. The cytology on the initial LP sample was negative; however, the
Cerebrospinal fluid (CSF) was noted to have a very bloody appearance, with elevated white and red blood cell counts. The opening pressure was 19 cm water. This finding was surprising given the high suspicion of leptomeningeal carcinomatosis (LMC), and an MRI of the spine was performed, which showed numerous enhancing intradural extramedullary nodules, with the largest one measuring 1.2 cm at the level of L3 (Figs 3B and C). Given these findings, an LP was repeated at a different level. On the second LP, clear CSF was obtained that was positive for metastatic adenocarcinoma. The patient is now undergoing treatment with chemotherapy and is being evaluated for radiation therapy and intrathecal chemotherapy.

Discussion

Ovarian carcinoma is the fifth most common cause of cancer death in women; however, it is often diagnosed late, and more than two-thirds of patients present with stage III or IV disease [1]. Dissemination is mainly within the peritoneal cavity, with hematogenous spread being rare and occurring primarily to the liver and lung. Ovarian metastases to the brain have been described in less than 2% of cases, with the majority localized to the cerebrum and only individual case reports describing meningeal seeding [2].

LMC can be seen in 3%–5% of all tumor cases [3]. Melanoma, lung, and breast cancers are the most common non-CNS solid tumors to seed the meninges. About 23% of patients with melanoma, 9%–25% of patients with lung, and 5% of patients with breast cancer develop LMC [4]. Common locations for leptomeningeal seeding are the basal cisterns, interpeduncular cistern, CPA cistern, along the course of the cranial nerves, and over the convexities. While LMC is defined as metastatic spread of cancer to the leptomeninges, it is a distinct entity from solid parenchymal tumor metastasis to the central nervous system. LMC can be considered as a syndrome with characteristic clinical symptoms, and imaging and laboratory findings [5].

IAC metastasis in the setting of LMC is an extremely uncommon presentation. Almost 90% of the masses in the CPA and IAC are benign vestibular schwannomas [6]. Metastasis to the IAC is rare and accounts for only 0.3% of CPA masses [7]. The most common non-CNS primary tumors to metastasize

![Fig. 1 - Bilateral internal auditory canal (IAC) metastases.](image-url)
Fig. 2 – $^{18}$F-FDG PET/CT images of the head. Coronal (A) and axial (B) $^{18}$F-FDG PET images showing intense tracer uptake in the bilateral IACs. Coronal (C) and axial (D) CT and corresponding $^{18}$F-FDG PET/CT fusion images (E and F) showing the bilateral IAC metabolically active foci. $^{18}$F-FDG, fluorine-18 fluorodeoxyglucose; IAC, internal auditory canal.
to the CPA are also breast, lung, and melanoma solid tumors. Only a handful of individual case reports have been published describing ovarian carcinoma metastasizing to the IAC [8–11]. In at least half of these cases, LMC was confirmed by CSF cytology. However, in all of these cases, the metastases were unilateral. Surprisingly, a recent meta-analysis of 102 cases of metastatic carcinoma to the IAC found that almost 53% of IAC metastases were bilateral. In bilateral cases, LMC occurred at a much higher rate (47.2%) compared to unilateral cases (8.5%) [7]. It is likely that ovarian carcinoma also has a predilection for bilateral metastases; however, the extreme rarity of LMC from ovarian carcinoma makes this a difficult theory to prove.

Definite diagnosis of LMC should be established by morphologic examination of CSF. However, multiple LPs may be necessary because only 50%–60% of cases of LMC have positive CSF cytology on the initial LP. Repeat samples improve the yield to approximately 76% after a second LP [12] and to over 90% after the third LP [13]. Factors that improve the sensitivity of CSF cytological analysis include obtaining large CSF volumes (>10.5 mL), processing of samples in a timely manner, and obtaining CSF samples from a site that is symptomatic, clinically, or radiologically significant [5]. In our patient’s case, the initial CSF study was a false negative; however, due to an unusual amount of mixed blood, the volume of actual CSF collected may have been inadequate. Cisternal punctures have been shown to be more sensitive for detecting LMC compared to LP alone [14]; however, due to the increased risk of subarachnoid hemorrhage from injuring the vertebral artery or other anomalous arteries, these procedures are seldomly now performed [15]. Lateral cervical punctures may be of benefit if LP is nondiagnostic.

Fig. 3 – Leptomeningeal carcinomatosis (LMC) with metastases in the spine. (A) 18F-FDG PET/CT fusion image showing numerous areas of 18F-FDG accumulation in the spine, including a large focal area of uptake at L3 (arrow). (B) Sagittal postcontrast T1WI of the lumbar spine showing a 1.2-cm intrathecal, extramedullary enhancing mass at L3 (arrow). There is another smaller, similar mass at L5 (arrowhead). (C) Axial postcontrast T1WI showing the same L5 enhancing mass.
The diagnosis of IAC metastases on imaging alone is difficult, and in many cases, a metastasis cannot be reliably distinguished from a much more common vestibular schwannoma. Clinical history of rapidly progressive sensorineural hearing loss and facial nerve paralysis suggests metastasis; vestibular schwannomas rarely cause a cranial nerve 7 palsy [16]. Bilateral vestibular schwannomas are characteristic of neurofibromatosis type II and occur in younger patients with no history of malignancy. IAC metastases, in contrast, tend to occur in patients with a prior history of cancer and are typically smaller on presentation (<1.0 cm), as symptoms from metastases arise early. Unfortunately, both metastases and vestibular schwannomas enhance avidly on T1WI. Schwannomas tend to be homogeneous lesions, isointense on both T1WI and T2WI. Metastases, however, are characterized by heterogeneous, thick linear, and extra-nodular contrast enhancement [17]. In addition, metastases are associated with adjacent cerebellar and brainstem vaso-genic edema on T2 and FLAIR imaging, eccentric location to the IAC, and multiple observed CNS lesions [17].

18F-FDG PET/CT is useful for the assessment ovarian cancer recurrence [18]. It is able to find lesions in many instances in which CT alone is negative, and it is able to detect disease recurrence 6 months before findings can be seen on CT [19]. Qualitative visualization of lesions as well as measurement of semiquantitative parameters, such as standardized uptake values, have been shown to have prognostic utility [20]. 18F-FDG PET/CT is limited by the prevalence of false negatives associated with the cystic nature of ovarian cancer and false positives stemming from radiotracer uptake in benign inflammatory cells [19]. 18F-FDG PET/CT can also detect LMC [21]; however, it is likely less sensitive compared to MRI, which offers superior tissue contrast, high-resolution multiplanar reformats, and dynamic contrast-enhanced capabilities. Unfortunately, 18F-FDG PET/CT imaging is typically not helpful for distinguishing IAC metastases from vestibular schwannomas, as both masses show increased 18F-FDG activity [22–24].

The development of LMC in ovarian cancer is likely to become more common as primary tumor control is improved by more effective therapies [8]. In the setting of known malignancy, in a patient with rapid-onset sensorineural hearing loss, IAC metastases should be at the top of a differential diagnosis. Both IACs should be scrutinized as more than half of such cases present bilaterally [7]. Our case illustrates that while still exceptionally rare, bilateral IAC metastases from ovarian carcinoma can occur and should be considered in the appropriate clinical context.

REFERENCES

[1] Mironov S, Akin O, Pandit-Taskar N, Hann LE. Ovarian cancer. Radiol Clin North Am 2007;45:149–66.
[2] Piura E, Piura B. Brain metastases from ovarian carcinoma. ISRN Oncol 2011;2011:527453.
[3] Glesisser B, Chamberlain MC. Neoplastic meningitis. Lancet Neurol 2006;5:443–52.
[4] Pavlidis N. The diagnostic and therapeutic management of leptomeningeal carcinomatosis. Ann Oncol 2004;15(Suppl 4):i285–91.
[5] Le Rhun E, Tailibert S, Chamberlain MC. Carcinomatous meningitis: leptomeningeal metastases in solid tumors. Surg Neurol Int 2013;4:S265–88.
[6] Loo SW, Dean AF, Murray P. Internal auditory canal metastasis mimicking a vestibular schwannoma at presentation—a case report and review of the literature. Int Semin Surg Oncol 2009;6:8.
[7] Chang MT, Michaelides EM. Carcinomatous meningitis: leptomeningeal metastases in solid tumors. Radiology Case Reports 12 (2017) 386–390.
[8] Ortega Candil A, Rodríguez Rey C, García García-Esquinas M, Bonifati DM. Subacute onset of deafness and vertigo in a patient with leptomeningeal metastasis from ovarian cancer. Neurology 2005;64:2396–7.
[9] Le Rhun E, Taillibert S, Chamberlain MC. Carcinomatous meningitis: leptomeningeal metastases in solid tumors. Semin Surg Oncol 2009;6:8.
[10] Chung P, Allerton R. Malignant meningitis secondary to ovarian carcinoma: an unusual occurrence. Clin Oncol (R Coll Radiol) 2001;13:112–3.
[11] Vitaliani R, Spinazzi M, Del Mistro AR, Manara R, Tavolato B, Bonifati DM. Subacute onset of deafness and vertigo in a patient with leptomeningeal metastasis from ovarian cancer. Neurology 1992;42:1239–41.
[12] Cox TC, Stevens JM, Kendall BE. Vascular anatomy in the internal auditory canal. Neuroradiology 2001;43:52–6.
[13] Oldan JD, Patel PS. Positron emission tomography/computed tomography for gynecologic malignancies. Obstet Gynecol Surv 2016;71:545–56.
[14] Sharma SK, Nemieboka B, Sala E, Lewis JS, Zegis BM. Molecular imaging of ovarian cancer. J Nucl Med 2016;57:827–33.
[15] Sala E, Kataoka M, Pandit-Taskar N, Ishill N, Mironov S, Moskowitz CS, et al. Recurrent ovarian cancer: use of contrast-enhanced CT and PET/CT to accurately localize tumor recurrence and to predict patients’ survival. Radiology 2010;257:125–34.
[16] Heimburger C, Bund C, Nam et al. FDG PET in intracranial carcinomatous meningitis. Clin Nucl Med 2016;41:60–1.
[17] Ortega Candil A, Rodriguez Rey C, Garcia Garcia-Esquinas M, Cabrera Martin MN, Couto Caro R, Carreras Delgado JL. Co-existence of a giant cell tumour of the tendon sheath and schwannoma. J Clin Neurosci 2016;30:138–40.
[18] Wang SY, Luo DL, Chen G, Liu ET, Wang SX. FDG PET/CT of intercostal schwannoma. Clin Nucl Med 2016;41:e310–2.