F-18 Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography Imaging for Diagnosing Ovarian Small Cell Carcinoma of the Hypercalcemic Type

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A 19-year-old woman presented with lower abdominal pain. Laboratory results showed elevated levels of ionized calcium, 1.85 mmol/l (1.125–1.250 mmol/l), and total calcium, 3.75 mmol/l (2.1–2.55 mmol/l), but a low level of parathyroid hormone (PTH), 1.2 ng/l (10–57 ng/l). The level of the tumor marker CA-125 was also elevated, measuring 36.3 IU/mL (0–21 IU/mL). Magnetic resonance imaging (MRI) of the abdomen and pelvis revealed the presence of a well-defined, solid, complex adnexal mass (approximately 15×12×9 cm in size). The mass was solid, with an area of heterogeneously decreased signal on T1-weighted images and increased signal

on T2-weighted images (Fig. 1), likely representing necrosis and suggesting the tumor was malignant.

F-18 Fluorodeoxyglucose positron emission tomography/computed tomography (F-18 FDG PET/CT) scan images showed a well-defined, bulky ovarian mass that contained a solid portion with heterogeneously increased FDG uptake (SUVmax 5.1), as well as a central necrotic portion. In addition, there was diffusely increased FDG uptake throughout the vertebral column (Fig. 2a–d). The FDG-avid osseous uptake was shown in the osteolytic lesions on the CT component of the PET/CT (Fig. 2e). These findings suggested that her

Fig. 1 T1-weighted (a) and T2-weighted (b) MR images of the abdomen and pelvis of the 19-year-old woman patient with lower abdominal pain

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Fig. 2 F-18 FDG PET/CT scan images of the same woman patient (a–d) and CT component image (e)

hypercalcemia was associated with PTH-related protein. The patient later had the mass resected at another hospital, and was diagnosed with ovarian small cell carcinoma of the hypercalcemic type (OSCCHT). She returned to our hospital and provided us with pathology reports with the diagnosis of OSCCHT, and laboratory results showing elevated levels of PTH-related protein (PTH-rP) (2,540 pmol/l).

A recent 15-year review of 424 girls and young women presenting with ovarian masses found that germ cell tumors accounted for 50 % of all pediatric ovarian malignancies, whereas sex cord-stromal tumors accounted for 28 %, epithelial tumors for 17 %, and other lesions for 4 % [1]. OSCCHT is a rare and often malignant tumor affecting young women between the ages of 9 and 43 years [2, 3]. OSCCHT is usually unilateral, with a propensity to spread intra-abdominally, and is predominantly composed of solid tissue, with areas of hemorrhage or necrosis. The differential diagnosis is broad, and includes adult and juvenile granulosa cell tumor, primitive germ cell tumor, malignant lymphoma, primitive neuroectodermal tumor, neuroblastoma, desmoplastic small round cell tumor, ovarian small cell carcinoma (pulmonary type) [4], and metastatic small cell carcinoma [5]. Previous reports suggest that two-thirds of OSCC patients have paraendocrine hypercalcemia, whose origin has been attributed to the secretion of PTH-rP by the tumor cells [6, 7]. This

phenomenon suggests that calcium levels may serve as a convenient biochemical marker that can be used for follow-up and monitoring of patients with tumors. This F-18 FDG PET/CT study demonstrated a hypermetabolic unilateral complex mass, composed of solid and necrotic portions, with a concomitant increase in FDG uptake on osteolytic lesions throughout the axial skeleton, suggesting hypermetabolic activity associated with the breakdown of bone. In young women, pelvic neoplasms are often difficult to characterize with imaging, because it is often difficult to classify a tumor as benign or malignant based on its appearance on imaging studies. Therefore, features such as ovarian masses in girls and adolescents, a high calcium level, and the diffuse FDG-avid osteolytic lesions on F-18 FDG PET/CT are probably suggestive of a malignant OSCCHT secreting the PTH-rP.

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Conflict of Interest Soon-Ah Park, Hun Soo Kim, and Jorge Daniel Oldan declare no conflict of interest.

Ethical statement The study was approved by an institutional review board (WKUH 201409-HRE-063) and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. The institutional review board waived the need

to obtain informed consent. The manuscript has not been published before or is not under consideration for publication anywhere else and has been approved by all co-authors.

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