YOLK SAC TUMOR AND \( \alpha \)-FETOPROTEIN: CLINICOPATHOLOGICAL STUDY OF FOUR CASES

Tetsuo ITOH, Toshikazu SHIRAI, Ayako NAKA, and Saburo MATSUMOTO

Department of Pathology, Sapporo Municipal General Hospital*

Clinicopathological findings of four cases of yolk sac tumor (endodermal sinus tumor), arising from the anterior abdominal wall, the testis, and the ovaries, are presented. Irrespective of the differences in age and sex of the patients and in the site of primary tumors, the four cases showed common biological and morphological properties. The sera obtained from the patients were all positive for \( \alpha \)-fetoprotein in agar immunodiffusion test and radioimmunoassay. Histological appearances of the four tumors are essentially similar showing mucinous loose stroma mimicking the magma reticulare, structure resembling the endodermal sinus of Duval, polyvesicular vitelline structure, and periodic acid-Schiff reaction-positive, diastase-resistant hyaline globules. Immunofluorescence study carried out on two cases of tumors of the ovary clearly demonstrated the presence of intra- and extracytoplasmic \( \alpha \)-fetoprotein granules in the tumor tissues. Further, these \( \alpha \)-fetoprotein granules demonstrated by immunofluorescence was found to show similar distribution with the periodic acid-Schiff reaction-positive hyaline globules. Electron microscopic studies also revealed basically similar ultrastructural features, epithelial cell cords, tubules and cysts lined with basement membrane, luminal microvilli, and well-developed Golgi complexes which indicate close similarity to the yolk sac endoderm. These findings suggest that yolk sac tumor is a peculiar germ cell tumor having a property to differentiate to yolk sac which is able to synthesize \( \alpha \)-fetoprotein.

Since Schiller\(^{14}\) described a group of tumors of the ovary as ovarian mesonephroma, many proposals have been made on the nature and histogenesis of gonadal and extragonadal tumors with peculiar histological features such as glomerular-like structure and structure resembling “endodermal sinus of Duval.” Teilum\(^{17,18}\) greatly contributed to the histogenetic understanding of the tumors by demonstrating close histological similarities between the tumors and placenta of the rat. At present there seems to exist a consensus on the origin of the tumors that the tumor arises from germinal cells. However, the relation between histological features and their functional aspect is not sufficiently recognized. In this communication, clinicopathological findings of the four cases of yolk sac tumor (endodermal sinus tumor) arising from the lower abdominal wall involving umbilicus, the testis, and the ovaries are presented and the significance of \( \alpha \)-fetoprotein synthesis by these tumors is discussed.

**MATERIALS AND METHODS**

The materials used were the tumors removed surgically from four patients, as well as autopsy materials of Cases 1 and 3, and ascites cells of Case 4.

**Light Microscopy** In addition to routine Hematoxylin and Eosin stain, periodic acid-Schiff (PAS) stain, Masson's trichrome stain, and Watanabe's reticulin stain were applied to histological sections.

**Electron Microscopy** The tumor tissue fragments obtained from surgical and autopsy materials were fixed in 3% glutaraldehyde in phosphate-buffered solution (pH 7.4) and postfixed with 2% OsO\(_4\). The fixed tissues were embedded in Epon after dehydration with graded ethanol. Ultrathin sections were stained with uranyl acetate and lead nitrate.

**Immunofluorescence Study for Identification of \( \alpha \)-Fetoprotein** A portion of the two tumors of ovary (Cases 3 and 4) obtained immediately after surgical resection was frozen in Dry Ice-acetone or in liquid nitrogen. The cryostat sections of the tumors were fixed in cold ethanol, washed in phosphate-buffered saline (pH 7.2), and then incubated with rabbit anti-human \( \alpha \)-fetoprotein serum for 30 min at room temperature. The sections washed with phosphate-buffered saline were then incubated with fluorescein isothiocyanate-labeled goat antibody to rabbit immunoglobulin for 30 min at room temperature and washed with phosphate-buffered saline. The sections thus prepared were observed under a fluorescence microscope.
The antiserum used for this study were obtained from a commercial source (Behringwerke AG, West Germany). Normal rabbit serum was used for control.

Radiolmmunoassay of $\alpha$-Fetoprotein  Quantitative assay of serum $\alpha$-fetoprotein was conducted by using a radioimmunoassay kit ($\alpha$-FETO-RIAKIT, Dinabbot, Tokyo).

Case Report

Case 1: A 1 year and 10 month old Japanese male infant was admitted on December 10, 1970, for occasional abdominal pain and lower abdominal mass of 2-month duration. Until 2 months before, he was well and showed normal growth since birth. Physical examination and X-ray film of the chest were normal. The abdomen was tender, but surface venous dilatation in the upper abdominal wall was remarkable. A hard mass was palpable in the lower median abdominal wall. Routine laboratory examinations of urine and blood were not contributory. At this moment, $\alpha$-fetoprotein of the serum was not tested. A large tumor, fixed subperitoneally to lower medial abdominal wall, was removed by laparotomy. The tumor was $10 \times 6 \times 7$ cm in size and weighed 400 g. It arose from the abdominal wall involving umbilicus into abdominal cavity and was separated with fibrous connective tissue from the musculature. The capsular peritoneum of the tumor was partially disrupted and soft tumor tissue sprouted out, being covered with blood clot. The cut surface was grayish white, semitranslucent, and partially necrotic with hemorrhage. Histological diagnosis of the tumor was extragonadal yolk sac tumor. The patient received postoperative Telecobalt radiation and chemotherapy with Vincristine. His postoperative course was smooth and he was discharged on January 28, 1971. On April 25, 1971, however, he was readmitted for remarkable abdominal distension. Physical examination of the abdomen revealed ascites and numerous globular tumors. He was treated with Vinblastine and Telecobalt radiation. Although the ascites and tumors regressed temporarily, he became progressively cachectic and expired on August 17, 1971. Tests for $\alpha$-fetoprotein by Ouchterlony's technique of the sera obtained after readmission were positive. One of the sera contained 2.0 mg/dl of $\alpha$-fetoprotein when measured by radioimmunoassay.

Autopsy revealed numerous globular tumors disseminated on the omentum, diaphragm, retroperitoneum, and pelvis, and metastases to the liver and bilateral lungs.

Case 2: The patient was a 1-year-old Japanese male infant who was admitted for right testicular tumor on June 8, 1972. His mother noted enlargement of the right testis one week before admission. Physical examination of the abdomen and chest was normal. Bilateral inguinal lymph nodes were not palpable. Laboratory examinations of urine and blood were not contributory except positive $\alpha$-fetoprotein in the serum. Preoperative diagnosis was embryonal carcinoma of the right testis. On June 15, 1972, castration of the right testis was performed. Histological diagnosis of the tumor was testicular yolk sac tumor. Test for $\alpha$-fetoprotein of the serum obtained 2 weeks after the surgery turned negative on agar immunodiffusion plate. Quantitative estimation of serum $\alpha$-fetoprotein by radioimmunoassay of pre- and post-operative samples were 1.6 mg/dl and 215 $\mu$g/dl, respectively. At present, 14 months after surgery, the patient is well and under observation in another institution. The enlarged right testis was $2.5 \times 1.5 \times 1.0$ cm in size and 18 g in weight. The cut surface was replaced with grayish white and semitranslucent tumor tissue. The epididymis was normal.

Case 3: The patient was a 40-year-old Japanese female. She incidentally noticed a lower abdominal mass which was postulated as uterus myoma by gynecological examination. Routine laboratory examination of urine and blood was not contributory. On laparotomy performed on August 8, 1972, a large tumor was found in the left ovary and removed by hyster-oophorectomy. The tumor was $13 \times 10 \times 8$ cm in size and 650 g in weight. Histological diagnosis of the tumor was a yolk sac tumor of the left ovary. Test for $\alpha$-fetoprotein of the preoperative serum
Yolk Sac Tumor

was positive by Ouchterlony's technique. Quantitative estimation of α-fetoprotein of the sera obtained one day before, and 1 week and 3 months after surgery measured 3.2 mg/dl, 340 µg/dl, and 3.5 µg/dl, respectively. She postoperatively received combination chemotherapy (5-fluorouracil, Endoxan, Mitomycin, and Toyomycin). After 9 months of rather uneventful postoperative course, she was readmitted for ascites and intraabdominal tumors. In spite of treatment by Telecobalt radiation and chemotherapy, she became progressively cachectic and expired on June 21, 1973. The serum α-fetoprotein was not detected by Ouchterlony's technique, but quantitative estimation by radioimmunoassay demonstrated the presence of 320 µg/dl of α-fetoprotein in the serum. Autopsy revealed numerous globular tumors disseminated on the peritoneal surface of abdominal organs and metastasis to the liver.

Case 4: The patient was a 46-year-old Japanese female. She was admitted for remarkable abdominal distension. After tapping ascites, a lower abdominal mass was palpated which was postulated as a tumor of the left ovary. Cytological examination of the ascites found malignant cells with PAS-positive granules. Tests for α-fetoprotein in both serum and cell-free ascitic fluid by Ouchterlony's technique were positive. Quantitative estimation of α-fetoprotein by radioimmunoassay measured 1.35 mg/dl in the serum and 1.26 mg/dl in the ascitic fluid. These findings and the experience of the previous three cases suggested that the tumor of left ovary was a yolk sac tumor. On March 27, 1973, the left ovarian tumor was removed by total hysterectomy. The tumor was 18 × 17 × 15 cm in size and 1,100 g in weight. The cut surface was grayish white and mucinous, and intermingled with hemorrhagic necrosis. The ascites disappeared after surgery and chemotherapy by Mitomycin. The patient has no sign of recurrence at present, 8 months after surgery. Radioimmunoassay of the sera obtained 1, 2, 4, 6, and 18 weeks after surgery revealed the presence of 680, 103, 15, 7, and 0 µg/dl of α-fetoprotein, respectively.

Gross Pathology and Histopathology Grossly, the tumors were solid and encapsulated with fibrous connective tissue except that of Case 2 in which the right testis was replaced by homogeneous tumor tissue. On the cut surfaces, which were myxoid and intermingled hemorrhagic necrosis, no lobular structure was seen. Thus, the four tumors were grossly identical.

Histological appearances of the four tumors were essentially similar independent of age and sex of the patients and of original site of tumor. The stromas were generally loose, myxoid, and scarce in fibrocytes. The fine reticulin fibers formed a loose network. Such stroma resembled the magma reticulare or extra-embryonic mesoderm of the exocoelum. The epithelial tumor cells propagated radially from the outside of dilated blood vessels into the stromas forming cords, tubules, and cysts (Photo 1). These cords, tubules, and cysts frequently communicated with each other and formed complicated and irregular sinuses and channels. The lining epithelial cells of the cysts became flat and seemed mesothel-like in the cysts distant from the blood vessels. These sinuses and channels, which were prominent in Cases 1, 3, and 4, closely resembled the labyrinthine sinus of the rat placenta (Photos 2 and 4). A complicated meshwork of honeycomb appearance which consisted of various sizes of cysts, from vacuolated single cells to vesiculated cysts lined with mesothelioid flat cells, was another structural feature. These vacuolated meshworks, intermixing in various proportions with the labyrinthine sinus structure, were seen through the four tumors, and were prominent in the testicular tumor of Case 2 (Photo 3). Glomerular-like structures or Schiller-Duval bodies which were papillary infolding of the columnar epithel into cysts accompanied with scant stroma and thin-walled blood vessel were also one of the common histological features of the four tumors. The Schiller-Duval bodies developed in either labyrinthine sinus structure or vacuolated meshworks were more frequently seen in Cases 1, 3, and 4 than in Case 2 (Photo 4). Thus, the epithelial tumor cells growing in
the myxoid stromas were not uniform and variegated from mesothelioid cells to columnar cells depending on the structures participated. Nuclear enlargement and hyperchromatism were generally slight, but more or less distinct in the cuboidal and columnar epithelial cells. Though not universal, eosinophilic hyaline globules that were PAS-positive before and after diastase digestion were seen within and outside of tumor cells regardless of histological structure (Photo 5). Intracytoplasmic hyaline globules were generally smaller than those found in the lumen of tubules and cysts. There was a tendency that the globules appeared more frequently in the vacuolar meshwork, and this finding was most prominent in the testicular tumor of Case 2. As will be described later, immunofluorescence study of α-fetoprotein revealed that the eosinophilic hyaline globules found in Cases 3 and 4 were stained specifically with fluorescein-labeled anti-α-fetoprotein immunoglobulin. Frequencies of the five histological features in each case are summarized in Table I.

Table I. Serum α-Fetoprotein and Histological Features of the Four Yolk Sac Tumors

<table>
<thead>
<tr>
<th>Feature</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr.) and sex</td>
<td>1, 10 mo, 6</td>
<td>1, 6</td>
<td>40, 6</td>
<td>46, 6</td>
</tr>
<tr>
<td>Site of primary tumor</td>
<td>abdominal wall</td>
<td>right testis</td>
<td>left ovary</td>
<td>left ovary</td>
</tr>
<tr>
<td>α-Fetoprotein⁴ before excision</td>
<td>not tested</td>
<td>positive⁵</td>
<td>positive negative</td>
<td>positive negative</td>
</tr>
<tr>
<td>after excision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myxoid stroma</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Labyrinthine sinus structure</td>
<td>⬡</td>
<td>+</td>
<td>⬡</td>
<td>⬡</td>
</tr>
<tr>
<td>Polyvesicular vitteline structure</td>
<td>+</td>
<td>⬡</td>
<td>+</td>
<td>⬡</td>
</tr>
<tr>
<td>Schiller-Duval body</td>
<td>⬡</td>
<td>+</td>
<td>⬡</td>
<td>⬡</td>
</tr>
<tr>
<td>Eosinophilic hyaline globules</td>
<td>⬡</td>
<td>⬡</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fate of patient</td>
<td>died</td>
<td>alive</td>
<td>died</td>
<td>alive</td>
</tr>
</tbody>
</table>

⁴ Results obtained by Ouchterlony’s technique. ⁵ Positive after tumor recurrence.

Electron Microscopic Observation Electron microscopic observation of the four tumors revealed essentially identical ultrastructural features. Epithelial tumors cells forming cords, tubules, and cysts were lined with basement membrane, and connected with desmosomes and interdigitiation of cytoplasmic process (Photo 6). Microvilli with central longitudinal filament were prominent on the luminal surface of the tubules and cysts (Photos 7 and 8). Microtubules were occasionally discernible within a sheet-like tumor cell nest. Intracytoplasmic tubules were frequently seen in Case 1 (Photo 9). The cytoplasms were generally clear and distributed with rich ribosomes forming rosettes. Glycogen granules were sparse through the four cases. Fine cytoplasmic fibrils were loosely scattered in Cases 1, 3, and 4. Fibriller fasciculi were prominent in perinuclear area of the cells forming tubules in Case 2. Segmented rough endoplasmic reticula were sparsely distributed and no lamellar or circular array was found. A few elongated rough endoplasmic reticulum with paired cisternae was occasionally observed in Case 1. Mitochondria were not prominent. Golgi complexes were well developed. Various sizes of membrane-bound dense bodies could be seen around Golgi complexes. Because of observation with limited specimens, intra- and extra-cytoplasmic eosinophilic hyaline globules could not be observed.
YOLK SAC TUMOR

Immunohistologic Demonstration of α-Fetoprotein Fluorescein isothiocyanate-labeled goat antiserum against rabbit immunoglobulin applied to frozen sections which were pretreated with rabbit anti-α-fetoprotein serum clearly demonstrated the presence of various sizes of intra- and extra-cytoplasmic granules in the tumor tissues tested (Cases 3 and 4) (Photo 10). When compared with the histological section, these α-fetoprotein granules were consistent with the eosinophilic hyaline globules which were PAS-positive before and after diastase digestion. The tumor and normal liver tissues from a case of hepatoma with positive serum α-fetoprotein were similarly processed and tested as positive and negative controls. While the normal liver tissue showed no specific granular or diffuse fluorescence, α-fetoprotein granules identical with those demonstrated in the two ovarian tumors were observed in the hepatoma. No fluorescence was observed in the control sections which were pretreated with either saline or normal rabbit serum and then incubated with the fluorescein-labeled antibody.

COMMENT

The four tumors presented are clinically heterogeneous, differing in the age and sex of the patients, and in the primary sites of tumor origin, but are homogeneous in the fundamental morphologic appearances and in the α-fetoprotein synthesis. The tumor of the abdominal wall in Case 1 had the same morphological features as those reported under the terminology of sacroccocygeal embryonal adenocarcinoma, intracranial endodermal sinus tumor, and extragonadal yolk sac tumor. The tumor of an infant testis is identical with carcinoma myxomatodes, orchioblastoma, endodermal sinus tumor, embryonal adenocarcinoma, and yolk sac tumor of the testes. The two tumors of ovaries in Cases 3 and 4 also agree with the tumors termed ovarian mesonephroma, endodermal sinus tumor, and yolk sac tumor of the ovary. The terminology, however, has lately concentrated to the following three; embryonal adenocarcinoma, endodermal sinus tumor, and yolk sac tumor, irrespective of the primary site of tumor. This indicates that a common concept on the histogenesis has been established in these tumors from the viewpoint of the histological analogy. The common histological features described in previous reports were those of loose myxoid stroma mimicking the magma reticulare, polyvesicular vitteline structure (vacuolated meshwork), endodermal sinus structure, Schiller-Duval body, and eosinophilic hyaline globules. Schiller-Duval bodies in a group of tumors of the ovary and he postulated them to be of mesonephric remnant origin. However, studies on the plastic reconstruction of the tumor tissue by Kazancizil et al. failed to demonstrate evidence for mesonephric remnant origin. Teilum proposed a hypothesis that this kind of tumors have the definite histological analogy to the placenta of a rat. The term “endodermal sinus tumor” designated by him is based on distinct similarities between endodermal sinus of rat placenta, and the glomerular-like structure and complicatedly communicating cystic cavities of the tumors. Huntington and his colleagues observed differentiation in vivo of embryonal carcinoma cells of the mouse into various tissues such as yolk sac, squamous epithel, muscle, neuroepithel, and gland, and they suggested validity of the differentiation of human germ cell tumor into the yolk sac. Teilum and Huntington confined three types of the tumors, endodermal sinus tumor, polyvesicular vitteline tumor, and infantile testicular tumor, into a category of yolk sac tumor. According to this classification, the three tumors of Cases 1, 3, and 4 can be classified into endodermal sinus tumor and the tumor of Case 2 into infantile testicular tumor. Chretien et al. and Young et al. reported collective studies of the embryonal adenocarcinoma of sacrococcygeal region and prepubertal testis, respectively. The two groups of tumors presented by them were histologically identical to yolk sac tumor. Either authors favored the term “embryonal adenocarcinoma”, while
they thought it to be a germ cell tumor showing differentiation to extra-embryonic endoderm. Thus, histopathological studies of this kind of tumors seem to have reached a consensus in respect to their histogenesis. Human yolk sac is an embryonic constitution appearing only in early gestational weeks. Its biological rôle has not been clearly elucidated. Hasseldahl and Larson observed ultrastructure of the human yolk sac and demonstrated the presence of microvilli, junctional complex, and pinocytotic vesicles which are features of secretory and absorptive epithelia. The electron microscopic findings obtained in the present study showed close ultrastructural similarities to those described by Hasseldahl and Larson. The presence of microvilli in the luminal surface of tubules and cysts, junctional complexes, well-developed Golgi complexes, membrane-bound dense bodies, and basement membrane found commonly in the four tumors suggest secretory property of the tumor cells.

Serum α-fetoprotein in mice with transplantable hepatoma and in human patients with hepatoma demonstrated by Abelev and Tatarinov is now applied to a routine laboratory test for diagnosis of hepatoma. While α-fetoprotein synthesis was elucidated in fetal liver and hepatomas, Gitlin et al. demonstrated synthesis of relatively great amount of α-fetoprotein in the human yolk sac as well as other serum proteins, prealbumin, albumin, α1-antitrypsin, and transferrin. They indicated that the human yolk sac had a definite biological rôle such as serum albumin synthesis in early gestational period preceding to fetal liver. As demonstrated in chorionic gonadotropin synthesis of choriocarcinoma, it is well known that the tumors showing differentiation to a definite tissue or organ have function of that tissue or organ. Therefore, α-fetoprotein synthesis in the yolk sac suggests the fact that yolk sac tumors have an ability to synthesize α-fetoprotein. The four yolk sac tumors described above seem to provide clear morphological and biological evidences to the present concept on the histogenesis that yolk sac tumor is a peculiar germ cell tumor showing differentiation to the yolk sac. In addition

Table II. Serum α-Fetoprotein and Histological Features of the Six Consulted Cases of Yolk Sac Tumor

<table>
<thead>
<tr>
<th>Age (yr.) and sex</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
<th>Case 5</th>
<th>Case 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site of primary tumor</td>
<td>10 mo. f</td>
<td>1, f</td>
<td>3, f</td>
<td>24, f</td>
<td>2, m</td>
<td>2, m</td>
</tr>
<tr>
<td>α-Fetoprotein before excision</td>
<td>negative</td>
<td>positive</td>
<td>positive</td>
<td>positive</td>
<td>tested negative</td>
<td>tested positive</td>
</tr>
<tr>
<td>Myxoid stroma</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Labyrinthine sinus structure</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Polyvesicular vitteline structure</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Schiller-Duval body</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Eosinophilic hyaline globule</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Fate of patient</td>
<td>died</td>
<td>alive</td>
<td>died</td>
<td>died</td>
<td>alive</td>
<td>alive</td>
</tr>
</tbody>
</table>

---

GANN
YOLK SAC TUMOR

to the four cases mentioned, we further confirmed the presence of serum α-fetoprotein in another five cases of six yolk sac tumors which were sent to us for consultation from other institutions. Table II summarizes histological features and serum α-fetoprotein of these six cases. The four tumors originating in the ovaries (2 cases), sacroccocygeal region, vagina, and testis provide additional support to the present study. Since Abelev, it has been known that some of the embryonal carcinoma,15) teratocarcinoma, or teratoblastoma was positive for serum α-fetoprotein. However, there is only a few reports3,20) that pointed out a relationship between serum α-fetoprotein and particular histological structures of the tumors. Ballas3) reported a case of yolk sac carcinoma of the ovary with α-fetoprotein. Tsuchida et al.20) presented 3 cases of yolk sac tumor with positive serum α-fetoprotein, originating from the testes and sacroccocygeal region. In addition to histological reexamination of the past cases, detailed histological examination and demonstration of α-fetoprotein in tumor tissue as well as in serum of patients with germ cell tumors will supply more concrete evidences for α-fetoprotein synthesis of the yolk sac tumors.

(Received January 14, 1974)

REFERENCES


EXPLANATION OF PLATES

Photo 1. Radiating epithelial tumor cell proliferation forming cysts around a blood vessel in Case 1. ×300.
Photo 2. Labyrinthine sinus structure and atypical Schiller-Duval bodies seen in Case 1. ×100.
Photo 3. Vacuolated meshwork surrounding a blood vessel, which consisted of various sizes of vacuoles, microcysts, and tubules, in Case 2. ×300.
Photo 4. Labyrinthine sinus and Schiller-Duval body seen in Case 1. ×600.
Photo 5. Various sizes of eosinophilic hyaline globules within the vacuolated meshwork in Case 2. ×600.
Photo 6. Electron micrograph of the tumor from Case 1. Intracytoplasmic ductules with microvilli, scattered segmented rough endoplasmic reticulum, and dilated vesicles containing dense substance. ×20,000.
Photo 7. Electron micrograph of the tumor from Case 2. A tubulus surrounded with basement membrane. Epithelial tumor cells connect with junctional complexes. Cytoplasmic fibrilles forming fascicles are prominent, particularly in the perinuclear area. ×8,800.
Photo 8. Electron micrographs of the tumor from Case 2. Luminal microvilli are prominent. Golgi complexes are well-developed and surrounded with membrane-bound dense bodies. ×16,600.

Photo 9. Electron micrograph of the tumor from Case 3. Epithelial tumor cells lining the cyst. Microvilli on the luminal surface, junctional complex and dilated rough endoplasmic reticulum are discernible. ×20,000.

Photo 10. Fluorescent micrograph of the tumor from Case 3. Various sizes of intra- and extra-cytoplasmic globules stained specifically with fluorescein-labeled antibody.
YOLK SAC TUMOR
YOLK SAC TUMOR