Neuroblastoma arising in a mature cystic teratoma of the ovary

HAS REID, JD VAN DER WALT, H FOX*

*From the Departments of Histopathology, Enfield District Hospital, Enfield, and *Reproductive Pathology, University of Manchester, Manchester*

SUMMARY A case is described of a neuroblastoma which appeared to arise in a mature cystic teratoma of the ovary. The literature concerning neural tumours of the ovary is briefly reviewed and the grounds for believing that the development of such neoplasms is an indication of the presence of immature neuroepithelial components in a teratoma, rather than a result of malignant change in a fully mature teratoma, are discussed.

We describe here the clinical and pathological features of a neuroblastoma which arose in a mature cystic teratoma of the ovary, this being, we believe, the first authentic example of malignant change of this type occurring in an otherwise fully benign ovarian teratoma.

Case report

An 18-year-old girl presented with complaints of cramp-like lower abdominal pain for eight months, urinary frequency for six months and bleeding per vaginam for 10 days. Eighteen months previously she had born a full-term normal infant and since then had been on oral contraceptives. Menstruation had been previously regular and her only previous illness was acute appendicitis as a child. On examination, a pelvic mass the size of an 18-week gravid uterus was palpable. The uterus itself was of normal size and retroverted. There were no other abnormal physical findings and sonography showed a large left sided multilocular mass. At laparotomy an apparently cystic mass measuring approximately 10 cm in diameter was found replacing the left ovary and a left salpingo-oophorectomy was performed. A "dermoid cyst," measuring 5 cm in diameter, was found arising in the right ovary and this was enucleated with conservation of the right ovary and tube. The patient made a good recovery from surgery and was well on discharge 12 days later.

PATHOLOGICAL FINDINGS

Macroscopic appearances

The left ovarian tumour was a grey-brown, fluctuant mass measuring 10 × 10 × 8 cm. The outer surface was smooth

and free of adhesions and the capsule appeared intact. On cross-sectioning, it was apparent that the tumour was partially formed of a typical mature cystic teratoma, measuring 5 cm in diameter, which contained hair and sebaceous material. The remainder of the tumour consisted of a multilocular, partially cystic structure which enveloped the cystic teratoma.

The central part of this was largely necrotic but the peripheral portion consisted of locules, mostly measuring 1 to 2 cm in diameter, which were separated and lined by friable pale brown tissue. The lesion from the right ovary was a macroscopically typical small mature cystic teratoma.

Light microscopy

Histological sections from the left ovarian mass showed two distinct elements. The mature cystic teratoma identified macroscopically was lined by keratinising stratified squamous epithelium with associated pilosebaceous follicles and occasional apocrine glands. Foci of mucus-secreting columnar epithelium, bone and a tooth were also present. The second element, which closely invested the cystic teratoma, was a densely cellular neoplasm with central areas of cystic degeneration (Fig. 1). The tumour was surrounded by a thick fibrous capsule from which a few fibrous trabeculae entered the neoplastic mass, but generally the large masses of cells were poorly supported by stroma. The tumour was markedly vascular and the thin-walled vessels were supported by delicate fibrous septa which tended to separate the tumour cells into alveolar masses. Areas of haemorrhage were numerous, particularly towards the centre of the tumour. The predominant tumour cell was small with a round or polygonal, darkly staining nucleus with closely clumped chromatin and barely discernible eosinophilic cytoplasm. These cells were interpreted as

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Fig. 1 Low-power photomicrograph showing at the top of the picture the typical squamous epithelium with attached pilosebaceous follicles of the dermoid cyst and at the bottom of the picture the densely cellular neuroblastoma which completely invested the dermoid cyst. Haematoxylin and eosin $\times 23$

Fig. 2 High power detail of rosette showing sympathogonia. Glycol methacrylate, haematoxylin and eosin $\times 576$

Fig. 3 Neuroblastoma showing varying size of cells. A clump of sympathoblasts is present in the middle of the field. Glycol methacrylate, haematoxylin and eosin $\times 576$

Fig. 4 One of the very few areas in which ganglionic differentiation is present. Glycol methacrylate, haematoxylin and eosin $\times 225$

Fig. 5 General low power view of tumour showing rosettes and neurofibrillary substance. Haematoxylin and eosin $\times 225$

Fig. 6 Electron micrograph of tumour cells showing neurosecretory granules. $\times 153\,000$

neoplastic homologues of sympathogonia (Fig. 2). In some parts of the tumour clumps of cells with larger, lighter staining, vesicular nuclei and more substantial eosinophilic cytoplasm were seen. The cell borders were indistinct, producing a pseudosyncytial appearance. These cells were interpreted as being homologous with sympathoblasts (Fig. 3). In a very few areas, large cells with voluminous eosinophilic cytoplasm and a single, round, pale staining, vesicular nucleus containing a prominent nucleolus were present and these were interpreted as evidence of minimal ganglionic differentiation (Fig. 4).

The arrangement of tumour cells was generally haphazard but rosette formation was obvious in most parts of the neoplasm. The rosettes consisted of a ring of round or oval cells with tail-like cytoplasmic processes projecting inwards. In a few areas neurofibrillary material was abundant and formed small eosinophilic strands and islets (Fig. 5). The tumour was confined within the capsule with no evidence of capsular invasion. Tumour emboli were, however, seen in hilar lymphatics.

The right ovarian tumour was a mature cystic teratoma which did not contain any neural elements.

Electron microscopy

Electron microscopic examination was made on formalin-

Postoperative urinary biochemical markers

	VMA ($\mu\text{mol}/24\text{h}$)	HVA ($\mu\text{mol}/24\text{h}$)	NMA ($\mu\text{mol}/24\text{h}$)	MA ($\mu\text{mol}/24\text{h}$)
Normal range	9-36	10-40	0.55-2.73	0.25-1.78
7 weeks post-op	25	21	3.1	0.7
12 weeks post-op	48	26	5.4	1.0
7 months post-op	-	-	7.1	1.1
11 months post-op	245	105	-	-
(3 consecutive days)	310	130	-	-
	188	88	8.7	0.8

fixed tissue. There was considerable loss of cytological and organelle detail but neurosecretory granules were seen in a small proportion of the tumour cells (Fig. 6).

CLINICAL FOLLOW-UP

The patient has so far been followed up for some 12 months as an outpatient. Twenty-four hour urine samples were collected postoperatively and the urinary excretion concentrations of vanillyl methoxymandelic acid (VMA), homovanillic acid (HVA), free and conjugated normetadrenaline (NMA) and free and conjugated metadrenaline (MA) were measured. The results are shown in the Table. The rising concentrations of VMA, HVA and NMA are thought to indicate the presence of metastatic tumour, and at time of writing further diagnostic procedures are planned. Indefinite follow-up will be pursued.

Discussion

Malignant change occurs in between 1 and 2% of mature cystic teratomata of the ovary¹ and whilst in theory any type of malignant neoplasm can arise in a previously benign teratoma, the vast majority which do occur are in practice squamous cell carcinomata, most of the remainder being adenocarcinomata. Neural tissue occurs with considerable frequency in mature cystic teratomata but the development of a malignant neural neoplasm in an ovarian tumour of this type is an event of exceptional rarity. There has, however, been one indisputable example described of a grade 4 astrocytoma arising in a mature cystic teratoma of the ovary² whilst there have been four previous reports of a neuroblastoma developing in an ovarian mature cystic teratoma³⁻⁶. The validity of these latter cases does not, however, withstand critical scrutiny for three of the reported tumours³⁻⁵ would more correctly be interpreted as teratomata containing immature neuroepithelial elements, some of which had a neuroblastomatous appearance whilst the fourth⁶ was an immature (malignant) teratoma which contained, *inter alia*, immature neuroepithelial tissue and gave rise to metastases containing multiple tissue elements, some of which were neural with a neuroblastomatous component. In none of these cases was there any real evidence of malignant change having occurred in a previously fully benign teratoma and in none was a definite tumour mass,

showing the histological features of a neuroblastoma, present.

Recently, however, Aguirre and Scully⁷ have reported five malignant neural tumours of the ovary, four of which appeared to be primary ovarian neoplasms and one which was possibly a metastasis from an adrenal neuroblastoma. Of the four definitely primary ovarian tumours, one was classified as a primitive neuroectodermal neoplasm with ependymal, neuroblastic and glial differentiation and a second as a primitive neuroectodermal tumour with ependymal and glial differentiation and medulloblastoma. The remaining two tumours resembled a glioblastoma multiforme. In one of these cases there was no evidence of any other teratomatous elements whilst in another the ovarian tumour was devoid of non-neural tissue components but gave rise to metastases containing cartilage. The remaining two cases, both classed as glioblastoma, were associated with mature, but relatively inconspicuous, non-neural tissue elements and appeared to have developed in mature cystic teratomata. It is of interest that these latter two cases had a macroscopic appearance similar to that of the tumour reported here in so far as the malignant neural tumour appeared to envelop the cystic teratoma rather than being confined within it. Aguirre and Scully⁷ comment on the diagnostic problem posed by a pure, or largely pure, malignant neural neoplasm arising in the ovary and upon the possible confusion with a granulosa cell tumour.

It would appear therefore that the tumour described here is the first definite example of a neuroblastoma which has arisen in a mature cystic teratoma of the ovary. The purist, however, would maintain, with considerable validity, that a neuroblastoma cannot arise in a fully mature teratoma and the development of a malignant neural tumour indicates that immature neuroepithelial elements must have been present in the otherwise mature teratoma. This view would accord with the age distribution of malignant neural neoplasms of the ovary. Our patient was, as were all those in other acceptable cases²⁻⁷ less than 20 years of age, this being the typical age group in which immature, and hence malignant, ovarian teratomata occur. By contrast, malignant change in a fully mature ovarian teratoma occurs most commonly during the fifth and sixth decades,¹ this age-related pattern lending support to the view that a malignant neural neoplasm can only arise from immature neuroepithelial tissue in an ovarian teratoma.

The prognosis for patients with a malignant neural tumour of the ovary is gloomy, three of the four patients reported by Aguirre and Scully⁷ died, all within four years of surgical removal of the primary neoplasm, whilst the patient described by Shirley, Piro and Crocker² died 11 months after oophorectomy. Ganglionic differentiation in neuroblastomas elsewhere in the body is associated with a relatively better prognosis but the very minimal degree of ganglionic differentiation present in this case is not

thought to be significant. The patient described in this report is currently well but biochemical tests indicate that metastatic tumour is probably present.

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References

- ¹ Fox H, Langley FA. *Tumours of the Ovary*. London: Heinemann Medical, 1981.
- ² Shirley RL, Piro AJ, Crocker DW. Malignant neural elements in a benign cystic teratoma: a case report. *Obstet Gynecol* 1971;**37**:402-7.
- ³ McCullough CD, Hardart F. Neuroblastomatous transformation in a benign cystic teratoma. *Obstet Gynecol* 1963;**21**:259-61.
- ⁴ Mayberger HW, Carlson AS, Lim S. Immature neural elements (neuroblastomatous change) in benign cystic teratoma: malignant or not? *Obstet Gynecol* 1969;**33**:114-7.
- ⁵ Theppisai R, Shuangshoti S, Amatyakul A. Neuroblastoma arising in metastasizing ovarian teratoma. *J Med Assoc Thai* 1977;**60**:396-404.
- ⁶ Shuangshoti S, Tharavej A. Neoplasms of neuroepithelial origin in a cystic teratoma of ovary. *J Med Assoc Thai* 1980;**63**:284-9.
- ⁷ Aguirre F, Scully RE. Malignant neuroectodermal tumor of the ovary. A distinctive form of monodermal teratoma: report of five cases. *Am J Surg Pathol* 1982;**6**:283-92.

Requests for reprints to: Dr HAS Reid, Department of Histopathology, Chase Farm Hospital, The Ridgeway, Enfield, EN2 8JL, England.