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Radiological appearances of dermoid tumours (with emphasis on fat fluid levels)

TAJUDDIN MALABAREY*
King Khalid University Hospital, King Saud University Riyadh, Saudi Arabia.

Summary

Nine cases of dermoid tumours, one in the chest and eight in the abdomen are reported with various radiological findings on plain films, ultrasound and computed tomographic (CT) scans.

The various radiological appearances at ultrasound and CT are described. The incidence and frequency of fat-fluid interfaces on ultrasound and CT scans are highlighted. Since the appearances of fat on ultrasound are variable, CT is therefore more specific in showing in fat-fluid levels. Moreover the dermoid tissue plugs seen on CT and ultrasound scans, with their surrounding fat, are highlighted as the so-called "iceberg" sign or as "target" signs. The paper concludes that the presence of fat fluid levels, a finding not previously emphasized, with a positive "iceberg" or "target" sign on CT or ultrasound scans, are pathognomonic of dermoid cysts.

Résumé

Neuf cas de tumeurs tératoides, une tumeur dans la poitrine et 8 dans l'abdomen, sont rapportés avec tous les résultats radiologiques energistrés sur les films, l'ultrason et la tomographie computeé (TC); les images montrent les composantes variées des tissus présents dans les tumeurs teratoides surtout les calcifications des lipides, des os et des dents. L'incidence et la fréquence des fluides lipioliques interfaces sur l'ultrason et la TC sont mis en vedette.

Puisque les apparences des lipides sur l'ultrasound sont variables, le TC est plus spécifique en montrant les niveaux des fluides lipidiques. Ouelques tampons typiques se sont présentés aussi bien sur l'ultrason que la TC. Ces tampons, avec leur environement Lipidique se présente comme des soi-disant "icebergs" ou "anticathodes" La présences des fluides lipidique (une découverts negligée auparavant) avec des "icebergs" positifs ou des anticathodes sur la TC et l'ultrason sont pathognomoniques des kystes dermoides.

Introduction

The plain film findings of teratoid tumours especially dermoid cysts are classical and well-known due to the easy identification of fat, calcification, bone, teeth and other tissues of ectodermal origin within the tumours. At computed tomographic (CT) scans, these various components are easily identifiable thus making the diagnosis easy[1,2,3]. However, at ultrasonography, the findings are varied due to the inconstant echogenicity of fat. Furthermore, fat-fluid levels were noted in some. In view of the fewness reports of fat-fluid levels in dermoid cysts, a radiological review of the dermoid cysts in our collection was therefore done.

Materials

The medical records of 9 patients both with radiological studies and surgico-pathological confirmation of dermoid tumours were reviewed in retrospect with particular reference to the radiological findings in such cases. The patients consisted of 8 females and 1 male. All the female patients had dermoid tumours in the abdomen: six in the ovaries, one in the adrenal gland and one in the presacral area. The only male patient had a dermoid cyst in the thoracic cavity.

The age distribution of the patients were 5 to 45 years with a mean at 25 years.

Most of the abdominal lesions presented mainly with abdominal pain or swelling of short duration

* Correspondence to be addressed to: Dr Tajuddin Malabarey, Radiology Department (40), King Khalid University Hospital, P. O. Box 2925, Riyadh, 11461, Kingdom of Saudi Arabia

usually in months except case 2 which was accidentally discovered on routine pre-employment chest radiograph. Out of the nine cases, plain film radiography, ultrasound and CT scans were done in one case only, whilst the others had two of these three radiodiagnostic procedures. Plain films revealed calcifications in 5 cases (nodular or flake-like in type), bone and dental tissue in 2 cases (Fig. 1) and fat was in one case.

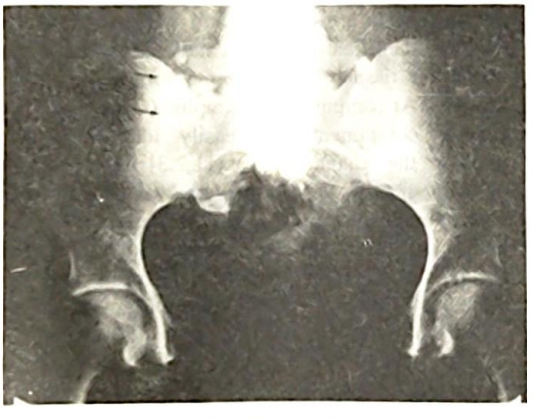

Fig. 1: (Case 5): Plain film of pelvis showing a right lateral curvulinear shell of bone (arrow) and with teeth overlying the sacrum.

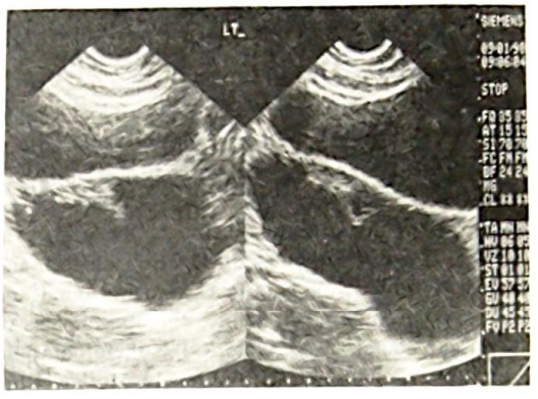

Fig. 2: (Case 7): Ultrasonic scan showing a well-defined anechoic mass with inner nodule on its anterior wall.

The ultrasound scans in 6 cases revealed cystic masses which were anechoic in 1 case (Fig. 2) hyperechoic in 2 (Fig. 3) mixed in 3 others (Fig. 4). Fat fluid levels were seen in 2 of the 3 cases with mixed lesions (Figs. 5 & 6); one of these showed a similar interface on CT scan (Figs. 6 & 7). Echogenic nodules mainly at the interfaces or peripheries and with posterior acoustic shadowing were seen in five cases (Figs. 3, 4, 5 & 6).

The CT scan findings were often quite diagnostic. Well-circumscribed masses were seen in 5 cases except in the retroperitoneal suprarenal dermoid cyst (case 8). Fat was clearly seen in 5 cases (even in small quantities as in the mediastinal dermoid which was not previously seen on plain films) (Fig. 8).

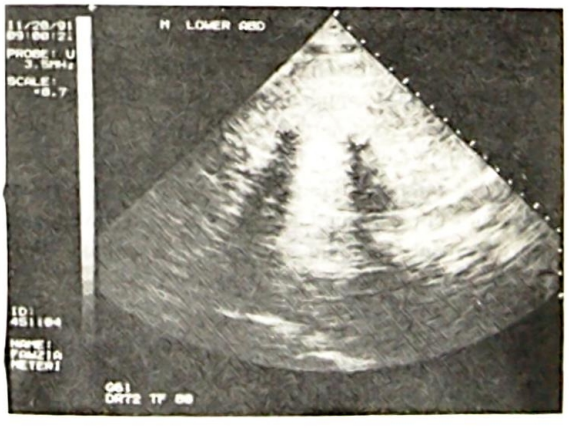

Fig. 3: (Case 4): Hyperechoic cyst with at least two nodules with posterior acoustic shadowing.

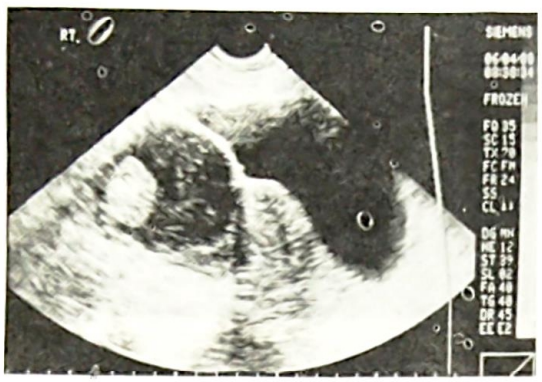

Fig. 4: (Case 1): A cyst with mixed echoes: few bright echoes to the right and hyperechoic to the left. Hyperechoic nodules with posterior acoustic shadowings noted.

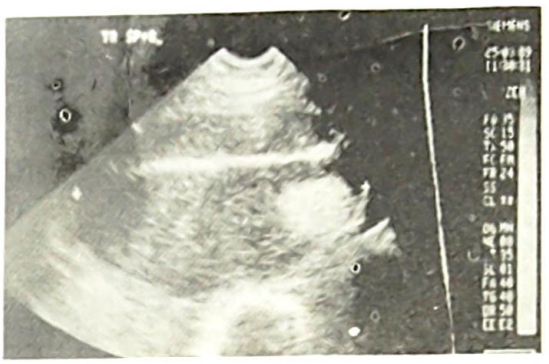

Fig. 6: (Case 5): Ultrasound scan depicting a hypoechoic cyst with a hyperechoic interface. A hyperechoic nodule with posterior acoustic shadowing is seen to the left lower lateral aspect of the cyst. Plain films of same case as Fig. 1 and CT scan as Fig. 7.

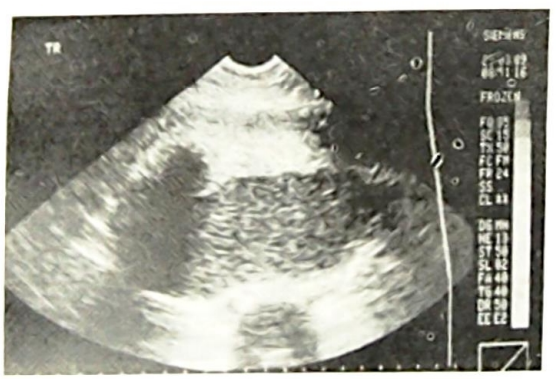

Fig. 5: (Case 6): Ultrasound showing mixed echoes: An upper brightly echogenic area and a lower hypoechoic lower zone demarcated by an interface, above which there is a nodule with posterior acoustic shadowing "ice-berg" sign. This ultrasonic appearance appears inverted when compared to the CT scan in Fig. 5.

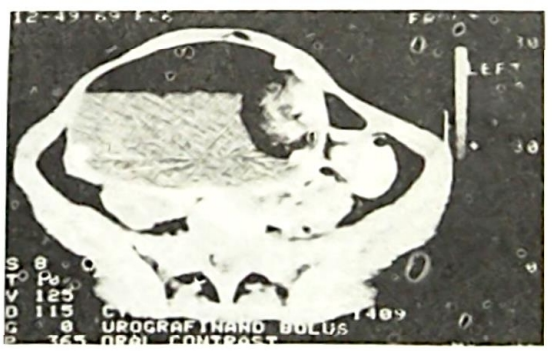

Fig. 7: (Case 5): CT scan showing an upper supernatant fat layering above a cystic lower component and with a high attenuation nodule with teech to the left. The nodule is circumscribes by fat. The entire mass is walled round by shell of high attenuation structures i.e. bone.

Punctuate, nodular or flake-like calcifications were seen in 5 cases (Fig. 9) whilst dental tissue and bone were seen in 2 cases both correlating well with plain film findings. Dermoid plugs were seen in 2 cases at the interface of those with fat-fluid levels (Fig. 10) or on the walls in 3 other cases. (Figs. 7 & 11).

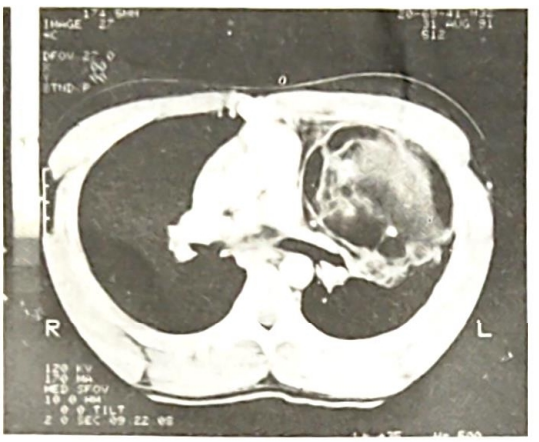

Fig. 8: (Case 2): CT scan of chest showing a mass continuous with the pericardium on the left and containing mixed tissues of fatty, calcific and soft tissue desities.

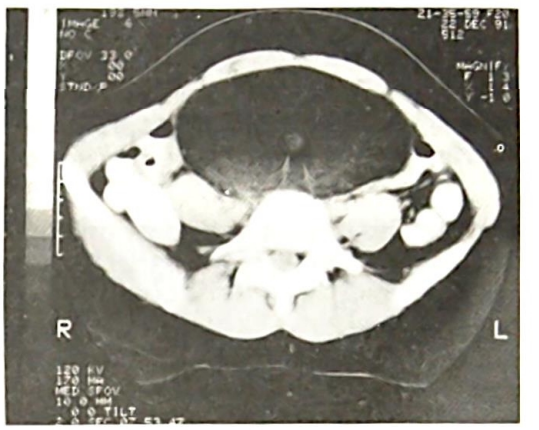

Fig. 10: (Case 4): CT scan showing a fat-fluid interface. A dermoid plug circumscribed by fat is seen in the centre of the lesion (arrow), the "target" sign. (Ultrasound scan same case as Fig. 3: Note that nc fluid level was seen on ultrasound scan).

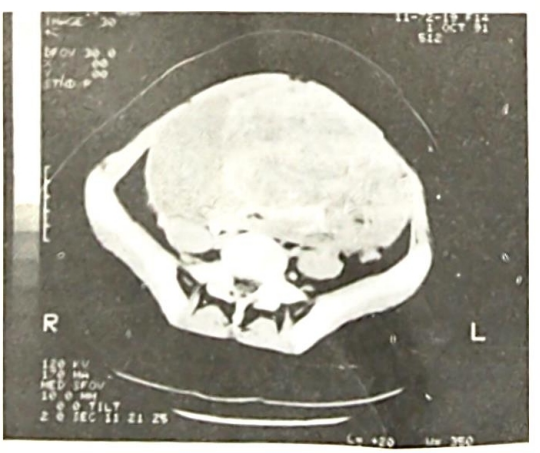

Fig. 9: (Case 1): CT scan showing a large circumscribed mass containing an inner mass walled by calcifications. Nodular and flake-like calcifications are seen in the tumour except on the right aspect which contains relatively less attenuated tissue.

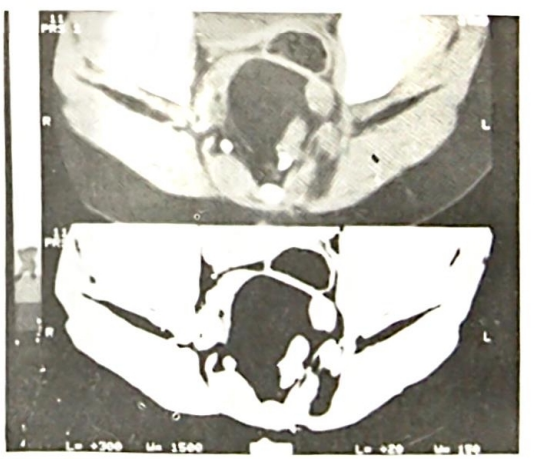

Fig. 11: (Case 9): CT scans: (Upper scan at bone windows, and the lower one at soft tissue window) showing a presacral (post-rectal) mass with central fatty tissue and with soft tissues and calcific nodules on its lateral walls.

Discussion

Teratoid tumours have a common embryologic origin, being congenital in their genesis; arising from totipotent rest cells or dislocated embryologic tissues. It is a tumour composed of multiple tissues foreign to that part in which it arises[3].

Teratoid tumours contain derivatives of one or more of the three germ layers with varying degrees of tissue differentiation and histological organization. The ectodermal layer is represented by structures such as hair, sweat glands, sebacious glands and teeth. The mesodermal germ layer derivates comprise bone, cartilage muscle, adipose, lymphoid, neural and vascular tissues. The endo-derma layer is usually represented by intestinal or respiratory epithelium, pancreatic tissue[4] or thyroid tissue.

When the tumour is cystic, usually unilocular and containing essentially derivatives of the ectoderm, it is often referred to as a dermoid. Even then, fat, a mesodermal derivative, is a common component. Otherwise, when the tumour is of mixed consistencies, (solid and multiloculated cysts) as well as of all derivates of the germ layers, it is referred to as a teratoma[4]. Teratomas are either benign or malignant. Between fifteen and forty per cent of solid teratoids are malignant[4,5]. Squamous cell carcinoma was the most frequent malignant change in less than 1% of cases in the malignant group[6]. All cases were benign.

Teratomas in the mediastinum are almost exclusively in the anterior mediastinum[4]. About 4.7% to 27% of teratomas in the mediastinum are asymptomatic. When symptomatic, the main presentations in mediastinal teratoid tumours are of respiratory obstruction; with chest pain, cough, wheezing and dysponea. Pressure on the pulmonary conus leads to arryhythmis; and rupture in the pericardium causes acute tamponade. Collapse due to perforation into the vessels notably the aorta and superior vena cava have been reported[3]. Infective symptoms due to rupture of the tumour into adjacent organs notably the myocardium and the lungs with fistulae or sinus tract formation is also a feature. The commonest incidence of fistulae is into the bronchial tree[4,5].

Less common signs and symptoms are due to the normal physiological function of the tissue such as the production of thyroid and chorionic gonadotrophin hormones as well as insulin. The tumour contains irrespective of site, such secretions as sebaceous secretions. Fluid contents of these tumours have similarly been shown to have a high cholesterol, lipid and amylase contents[7,8].

Most teratoids occur in a females usually in the ovaries. Twenty per cent of all ovarian tumours are teratoid tumours, and bilateral in 12% of cases[6]. Between seventy and eighty per cent of these tumours present in the pelvis, with some, often of enormous sizes which present as large abdominal masses (Case 1). Most are asymptomatic, but due to increase in size or malignant change, they present with pain, often acute, due to torsion[6,9].

Radiological features

The radiological features of teratoid tumours depict the structural constituents of the tumour. In the plain radiographs dermoid cysts are well-circumscribed mass lesions classically containing calcifications, dental tissue with formed teeth and with or without parts of the skull[1,2] (Fig. 1). In the chest, dental tissue and bone are rarely seen. In a woman of reproductive age, plain films are often omitted to avoid irradiation of early pregnancy. Ultrasound is therefore the examination of choice of such families.

Dermoid cysts radiologically are characterized by the presence of fat, calcifications or and dental tissue[1,2]. The latter two are easily seen on plain films whilst all three structures are more clearly identifiable by the differing attenuation values on CT scans. However one of our cases (Case 1) showed no fat on CT scan. Plain films are classical in their features; but CT scans define these constituent structures in better detail than plain films or ultrasound.

Table 1: Summary of clinical and radiological findings in 9 cases of teratoid tumours

Case No.	Age/ Sex	Symptoms	Duration	Signs	Plain Films	Ultrasound	C.T. Scan	Pathological Diagnosis
1	16F	amenorrhoea	4 months	mass of 36 weeks gestational size	Not done	multiple anechoic & hyperechoic mass within a well defined and extremely large mass (Fig. 4)	large discrete pelvic mass extending to left hypochondrium. Right cystic, but left was solid with flakes of calcifications (Fig. 9)	Right benign ovarian teratoma, 2.3 kg in weight with cystic and necrotic areas. All germ-layer derivatives were present
2	32M	nil	nil		Well defined homogenous mass in Lt. midzone continuous with the Lt. cardiac border		Mass with fatty zones and calcifications within and continuous with pericardium (Fig. 8)	Dermoid
3	34F	left adnexial fossa, pain dysuria	7 months		Central pelvic mass with well formed dental tissue	Discrete hyperechoic mass posterior to bladder and to left of uterus. Echogenic nodule noted in periphery.	—	Left ovarian dermoid with bone, hairs, keratine and sebaceous glands
4	29F	abdominal pain associated with nausea & dizziness	5 years	25 weeks gestation size, non-tender pelvic mass	Not done	Defined hyperechoic mass with few areas of high echogenicity with acoustic shadowing. (Fig. 3)	7.7 x 12.9 x 20 cm mass with fat fluid level. Calcific nidus is present centrally within mass: "target sign" (Fig. 10) Bony tissue noted at periphery.	Left ovarian benign
5	25F	left iliac fossa, colicky pain, dysuria	1 month	firm supra-public mass	Mass with peripheral curvilinear bone density with teeth (Fig. 1)	Cyst with bright echoes and acoustic shadowing from a hyperechoic nodule in the region of left ovary. A hyperechoic interface is seen within the cyst. (Fig. 6)	15 x 8 x 8 encapsulated mass of peripheral bony structures. Fat/ fluid interface present within the mass. There is a nodule of hyper attenuated tissues surrounded by fat to the left. (Fig. 7)	Left ovarian dermoid

6	31F	abdominal swelling	1 month	mobile soft mass of 18 gestation in size	Not done	On the left is 9 x 15 cm discrete mass with bright echoes and a hyperechoic nodule showing posterior acoustic shadowing; and separated by an interface from a hypoechoic zone below (Fig. 5) Calcifications are present at periphery.	Not done	Left ovarian dermoid and with hair and respiratory type epithelium.
7	45F	abdominal pain	2 weeks	nil	Right suprarenal calcifications	defined, hypoechoic cystic mass with debris and hyperechoic nodule to its inner wall. (Fig. 2)	Not done	Dermoid of the right ovary
8	5F	abdominal pain	1 month	nil	Calcifications surrounded by fatty tissue in left suprarenal region	Not done	Longish calcifications in suprarenal region. Calcific density is surrounded by very low attenuation tissue with Hounsfield measurement of fat.	Dermoid
9	6F	sacral pain	3 months	local tenderness	Radiolucent presacral mass with focal calcifications.	Well encapsulated presacral mass upper portion of septated and of soft tissue component.	The lower half contained low attenuation (fat) mass with foci of calcification. The walls demonstrate multiple soft tissue nodules on the lateral walls. (Fig. 11)	Dermoid

The sonographic appearances are variable[9-16] and are dependent on the internal architecture of the lesions as shown in our cases and others. The mixed echogenic lesions are the commonest (Fig. 5) whilst the anechoic ones are infrequent[12] (Fig. 2). The fat in dermoid cysts is sebum, usually liquid at body temperature[10,11], hence the layering effect seen at ultrasound and CT scans in some cases (Figs. 4, 5 & 6). This fat-fluid layering is a rare feature previously reported in only five previous publications [11,12,13,14,15]. Our series shows it occurs in a third of the cases, thus making it a common feature. The sebum supernatant is either echo-free when pure or echogenic when it contains desquamated keratinised epidermis and hair. The echogenicity of fat is a function of the acoustic impedance mismatch between the fat itself and the supportive connective tissue[11]. Four different types of fat-fluid interface can be shown by ultrasound. The first, shows an echo-free supernatant over echogenic fluid (Fig. 7). The second appearance could be obtained when the supernatant fat is echogenic layering above an echo-free fluid material below; an inverted picture of what is seen at CT (Figs. 5 & 7). Thirdly, if the supernatant is as echogenic as the lower fluid content, the interface is not visualized (Case 4, Figs. 3 & 10). The fourth type is when an echogenic interface separates a low echogenic supernatant fat from an equally low echogenic lower fluid content (Fig. 6). The conflicting apperances thus makes CT more specific in demonstrating the interface.

One other characteristic feature of dermoid cysts is the presence of dermoid plugs, that is dermoid tissues at the periphery of the cysts and sometimes projecting into the centre of the cavity (Figs. 2, 3, 4, 5, 6 & 7). Those dermoid plugs, at ultrasound are echogenic with distal acoustic shadowing (Figs. 3 &

5). When such dermoid plugs project above the fat-fluid interface it mimics an iceberg in the ocean; hence the so-called "iceberg" sign (Fig. 5) or the "target sign"[10,17,18]. The "target" sign is best appreciated at C.T. when seen as a small mass lesion seen centrally in a dermoid cyst and surrounded by fat (Fig. 10). These signs have been infrequently reported in 33% of dermoids[10] as in this series (4 out of 9 cases).

Ultrasound aids the predictability or tumour type in teratoid tumours. Anechoic lesions are usually benign lesions whilst those with solid echo patterns, mixed echogenicity, thick septa, or a multilocular pattern are most probably malignant[14]. All our cases are benign. Dermoids are typified by fat-fluid levels and the target sign. These characteristic features should be thought of when scanning ovarian masses.

In conclusion, the plain films still demonstrate the pathognomonic features of dermoid cyst comprising the presence of a nodule on the inner wall of the cysts and of bony or dental tissue in any investigative procedure are the hallmarks of dermoid cysts. CT more often than ultrasound scans demonstrates better the presence of small amounts of fat, fat-fluid interfaces and dermoid plugs. The presence of fat, fat-fluid levels and those of dermoid plugs even in the absence of calcifications, bone or dental tissue should support a diagnosis of a dermoid cyst.

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