Abstract. Aim: Benign cystic teratoma of the pancreas often appears to be potentially malignant in preoperative staging. The final diagnosis is generally obtained after surgical removal. Reliable prediction is mandatory for differential treatment. Materials and Methods: A Medline query was performed for the terms cystic teratoma, dermoid cyst and pancreas. Data were analyzed for patient characteristics, clinical appearance, diagnostic findings, therapy and follow-up. Results: Including our own, 26 cases of pancreatic cystic teratoma were identified. The majority of patients were symptomatic by unspecific gastrointestinal complaints. Up to date, imaging techniques fail at a distinct preoperative diagnosis. Surgical treatment evolved from various drainage and excision procedures into radical resection. Conclusion: Despite the strictly benign nature of cystic teratoma, oncologic resection is mostly inevitable due to difficult preoperative diagnosis. No reliable predictive marker was found to allow for organ- or parenchyma-preserving procedures. Therefore, surgery remains the treatment of choice to exclude malignancy.

Cystic teratoma, also called dermoid cyst, is a congenital developmental abnormality of germ cell origin arising from embryonic residues. By nature, cystic teratoma is a strictly benign, well-differentiated lesion (6). The cystic wall usually consists of stratified squamous epithelium, encapsulating pasty ectodermal keratinous and sebaceous material. However, the appearance may vary owing to the potential for tissue generation from all three germinal layers (ectoderm, endoderm, mesoderm) to different extents (7). Cystic teratoma is commonly found in the ovary and testes, but extremely rare in the pancreas. In the pancreas, it was first described by Kerr in 1918 and assigned to cystic pancreatic lesions by Primrose in 1922 (8, 9). Our latest case was reported in 2010 (10).

Pathognomonic data are lacking clinically, as well as for various imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI), abdominal ultrasound (US) and endoscopic ultrasound (EUS). In numerous reports surgery is applied primarily to obtain a reliable diagnosis, not simply to overcome symptoms or future complications. Radical resection is considered the standard therapy by the majority of authors (11). The aim of the present study was to review the available literature with regard to a specific marker discriminating cystic teratoma from cystic malignoma to allow for differential treatment.

Materials and Methods

A Medline query was performed for the search terms cystic teratoma, dermoid cyst and pancreas to identify all cases known to the literature. Data were collected and analyzed retrospectively according to patient characteristics, clinical presentation, diagnostic findings, therapy and follow-up. Results are discussed below.

Results

The query revealed total of 26 cases of pancreatic cystic teratoma, ranging over a period of 92 years from the first report in 1918 until our latest one in 2010 (Table I). Except for one undefined case, 15 cases (60%) were reported in males, and 10 (40%) were documented in females denoting a ratio of 1.5:1. The mean age at time of presentation was 35.8
years (range: 2-74 years). Out of 24 documented cases, 17 (71%) patients presented with symptoms. In symptomatic cases, abdominal pain was the main complaint (58%), followed by nausea/vomiting (12%) and back pain (12%), as well as abdominal swelling, dyspnea, and liver failure (6% each). Infection of dermoid cyst was observed in only one case presenting with abdominal pain and fever. Tumor size was available in 12/26 cases, with all lesions measuring >2 cm in at least one diameter at the time of diagnosis. There were both small cysts in patients presenting with symptoms, as well as large ones found asymptotically. Twenty-two reports referred to tumor location. The tumor was located in the pancreatic head area in 27.3% (n=6), head/body in 13.6% (n=3), body in 40.9% (n=9) and tail in 13.6% (n=3). In one case, the tumor was found to originate from the uncinate process. All nine cases located within the pancreatic head and head/body area were symptomatic, with a preponderance for abdominal pain (4/9). Modern cross-sectional imaging was widely used from 1990, providing CT findings in 16 cases. Additional MRI was applied in five cases, including our own (Figure 1). Altogether, results were found nondiagnostic for pancreatic dermoid cysts with regard to its differential diagnoses. In only one case, fine needle aspiration cytology (FNAC) was used as a diagnostic tool, but surgery was performed to make the definitive diagnosis on histological examination of the resection specimen. Another three authors took FNAC into account but preferred primary surgery due to tumor size and/or clinical symptoms. Treatment of dermoid cyst of the pancreas consisted of various draining and resection techniques (n=25). External drainage was applied in five cases, the last one reported in 1984. Two of them were resected later due to persistent fistula. Internal drainage (cystogastrostomy) was reported in one patient who was lost to follow-up. Plain enucleation of dermoid cyst was applied to five patients, whereas pancreatic resection was performed in 14 cases. Exemplarily, macroscopic and microscopic findings of the resection specimen in our case are displayed (Figures 2 and 3). Follow-up was reported as uneventful for 12 out of 26 cases comprising periods from 3 month to 14 years. One patient underwent cholecystectomy one year after resection of dermoid cyst. Ten cases were lost to follow-up.

Table I. Reported cases of dermoid cyst of the pancreas.

<table>
<thead>
<tr>
<th>First Author (Reference)</th>
<th>Age (years)/Gender</th>
<th>Location</th>
<th>Size (cm)</th>
<th>Symptoms</th>
<th>Treatment</th>
<th>Follow-up, period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerr (8)</td>
<td>55/F</td>
<td>H</td>
<td>-</td>
<td>Swelling</td>
<td>eD</td>
<td>Partial resection, -</td>
</tr>
<tr>
<td>Dennis (24)</td>
<td>40/M</td>
<td>H</td>
<td>-</td>
<td>Back pain</td>
<td>eD</td>
<td>Persistent fistula, 1 year</td>
</tr>
<tr>
<td>Hoang Su et al. (27)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Back pain</td>
<td>R</td>
<td>Cholecystectomy, 1 year</td>
</tr>
<tr>
<td>Decourcy (28)</td>
<td>2/F</td>
<td>B</td>
<td>-</td>
<td>Vomiting</td>
<td>R</td>
<td>Uneventful, -</td>
</tr>
<tr>
<td>Bittner and Sarrazin (29)</td>
<td>2/F</td>
<td>H</td>
<td>-</td>
<td>Liver failure</td>
<td>R</td>
<td>Uneventful, -</td>
</tr>
<tr>
<td>Iovchev (30)</td>
<td>8/M</td>
<td>B</td>
<td>-</td>
<td>Abdominal pain, fever</td>
<td>eD</td>
<td>Uneventful, 7 month</td>
</tr>
<tr>
<td>Pomosov et al. (31)</td>
<td>6/M</td>
<td>T</td>
<td>-</td>
<td>Abdominal pain</td>
<td>eD</td>
<td>Uneventful, 6 months</td>
</tr>
<tr>
<td>Tobik et al. (32)</td>
<td>34/F</td>
<td>-</td>
<td>-</td>
<td>Abdominal pain</td>
<td>iD</td>
<td>-</td>
</tr>
<tr>
<td>Assawamatiyanont and King (33)</td>
<td>11/F</td>
<td>B</td>
<td>None</td>
<td>Abdominal pain</td>
<td>eD</td>
<td>Uneventful, -</td>
</tr>
<tr>
<td>Lazaro Da Silva and Moreno (34)</td>
<td>21/M</td>
<td>H</td>
<td>&gt;3</td>
<td>Nausea, constipation</td>
<td>eD</td>
<td>Resection, 3 month</td>
</tr>
<tr>
<td>Mester et al. (35)</td>
<td>25/F</td>
<td>H</td>
<td>-</td>
<td>Abdominal pain</td>
<td>E</td>
<td>Uneventful, 14 years</td>
</tr>
<tr>
<td>Vermeulen et al. (36)</td>
<td>46/M</td>
<td>B</td>
<td>-</td>
<td>None</td>
<td>R</td>
<td>-</td>
</tr>
<tr>
<td>Markovsky and Russin (17)</td>
<td>53/F</td>
<td>B</td>
<td>16</td>
<td>Abdominal pain</td>
<td>R</td>
<td>Uneventful, -</td>
</tr>
<tr>
<td>Iacono et al. (37)</td>
<td>26/F</td>
<td>H</td>
<td>&gt;3</td>
<td>-</td>
<td>R</td>
<td>Uneventful, 6 years</td>
</tr>
<tr>
<td>Krainman et al. (38)</td>
<td>6/M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>R</td>
<td>-</td>
</tr>
<tr>
<td>Jacobs and Dinsmore (39)</td>
<td>57/F</td>
<td>H</td>
<td>6.6</td>
<td>Abdominal pain</td>
<td>R</td>
<td>-</td>
</tr>
<tr>
<td>Fernandez-Cebrian et al. (6)</td>
<td>74/F</td>
<td>B</td>
<td>10</td>
<td>None</td>
<td>R</td>
<td>Uneventful, 2 years</td>
</tr>
<tr>
<td>Yu et al. (40)</td>
<td>2/M</td>
<td>H/B</td>
<td>-</td>
<td>None</td>
<td>E</td>
<td>-</td>
</tr>
<tr>
<td>Salimi et al. (41)</td>
<td>16/M</td>
<td>H/B</td>
<td>&gt;3</td>
<td>Abdominal pain</td>
<td>E</td>
<td>Uneventful, 4 years</td>
</tr>
<tr>
<td>Seki et al. (12)</td>
<td>57/M</td>
<td>B</td>
<td>5.9</td>
<td>None</td>
<td>E</td>
<td>-</td>
</tr>
<tr>
<td>60/F</td>
<td>B</td>
<td>2.2</td>
<td>None</td>
<td>R</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Koomalsingh et al. (7)</td>
<td>52/M</td>
<td>T</td>
<td>3.2</td>
<td>Abdominal pain</td>
<td>R</td>
<td>Uneventful, 16 month</td>
</tr>
<tr>
<td>Tucci et al. (11)</td>
<td>64/M</td>
<td>T</td>
<td>8.5</td>
<td>None</td>
<td>R</td>
<td>-</td>
</tr>
<tr>
<td>Zhang et al. (42)</td>
<td>67/M</td>
<td>B</td>
<td>-</td>
<td>Dyspnoe</td>
<td>R</td>
<td>-</td>
</tr>
<tr>
<td>Strasser et al. (14)</td>
<td>44/M</td>
<td>H</td>
<td>7.0</td>
<td>Abdominal pain</td>
<td>R</td>
<td>-</td>
</tr>
<tr>
<td>Own case (10)</td>
<td>40/M</td>
<td>H</td>
<td>6.4</td>
<td>Abdominal pain</td>
<td>R</td>
<td>Uneventful, 1 year</td>
</tr>
</tbody>
</table>

Discussion

Cystic teratoma is a germ cell neoplasm derived from any of the three germinal layers. It is commonly found in the ovary, testes, retroperitoneum, bladder and cranium. The pancreas is extremely rare as a primary site (12). Only 26 cases including a recent one of our own, have been reported in the literature. Incidence has seemingly increased in recent years, which may be attributed to the widespread use of modern imaging techniques. There is a slight predominance for male gender (56%) compared with females (44%). Cystic teratoma of the pancreas is predominantly seen in the second to third decade of life. However, with the youngest case reported in a two-year-old female and the oldest one observed in a 74-year-old male, all age groups may be affected. The latter underscores the strictly benign nature of this pancreatic tumor without tendency for malign transformation. In contrast, malignancy is reported in 7%-10% of cases other than the pancreatic type (13).

The majority (>70%) of patients were symptomatic at the time of presentation (14). Nonspecific gastrointestinal symptoms, including abdominal pain, nausea and indigestion, prevail. A limited number of cases was diagnosed either incidentally by medical examination for other complaints or for cyst-related complications. Cystic teratoma was first considered more prone to infection than other types of pancreatic cyst, but in fact this complication was verifiable in only one case. Cystic teratoma has never been associated with pancreatitis. No correlation was observed between the size of the tumor and presence of symptoms, although data were incomplete with this regard. Cystic teratoma of the pancreas was found in all sections of the organ without predominance of any portion. The overall incidence of symptoms was linked with tumor location in the pancreatic head. It appears that the tumor mass by itself represents the main reason for clinical symptoms on account of its size and/or relation to critical organs/structures.

Routine laboratory values were found to be non-diagnostic and normal unless obstruction of the biliary or pancreatic duct occurs. In contrast, evaluation of traditional serum markers may be misleading. Our own case presented with elevated CA 19-9 levels, suggesting malignancy. This feature was consistent with at least one other report (11). Values may be significantly lower than in other cystic neoplasms of the pancreas. However, we cannot support this with facts due to the small number of reports. Moreover, it is well known that CA19-9 is not organ specific and may be also observed in benign states, e.g. inflammation (15).

The appearance of cystic teratoma of the pancreas is highly variable depending on the proportions of tissue components. The diagnostic approach is, therefore, unsolved (11). Modern imaging techniques do not yield reliable data for a pathognomonic diagnosis to date. Generally, all these modalities are capable detecting a combination of fat, fluid levels and calcification, highly suggestive of mature teratoma (16). However, their limitations are decisive. On abdominal US and EUS dermoid cysts appear as predominantly echogenic masses with a thin capsule (6). Due to overlap of echogenicity, the fatty content cannot be differentiated reliably from soft tissue (14). CT accurately detects fluid, soft tissue, calcification and fat (14, 16). However, the content of the cyst appears variably sebaceous, serous or complex. MRI reveals high signal intensity for fat on T1-weighted images, which may be mistaken for hemorrhagic lesions that can show similar characteristics (14).

FNAC is controversial as a tool for preoperative diagnosis of dermoid cyst (17, 18). In a recent series of 1000 EUS-guided FNAC, a false-positive rate of 0.3%, but a false negative rate of 14.3% was reported. Another series of image-guided FNAC revealed a wide sensitivity of 64%-98% and a specificity of 80%-100%. A negative biopsy should still commit the patient to surgery. Furthermore, FNAC is regarded as obsolete in patients with pancreatic tumors presenting with symptoms or a size more than 2-3 cm due to the high frequency of malignant and borderline lesions found (1, 4). Last but not least, the risk of cancer seeding is noticeable (19).

Cystic teratoma shares common features with other cystic neoplasms of the pancreas. It may be mistaken for lesions of variable biological behavior. At least two other types of benign cyst lined with squamous epithelium have to be taken into account. Firstly, lymphoepithelial cysts (LEC), which are benign uni- or multilocular cysts predominantly found in males in the fifth to sixth decade of life. They are slightly more common than cystic teratoma of the pancreas. The cyst wall is usually thin and lined by well-differentiated stratified squamous epithelium. Subepithelial lymphoid tissue is a feature of LEC but not necessarily that of dermoid cysts. Sebaceous elements and hair follicles are uncommon but not excluded. In cases predominantly composed of epidermal elements cystic teratoma may be difficult to differentiate from LEcs histologically (20). These findings are in line with our own experience since we had the opportunity to encounter both pancreatic dermoid cyst and a case of LEC within a few months. Secondly, epidermoid cysts are almost exclusively seen in the pancreatic tail within an intrapancreatic accessory spleen. They occur in the second to third decade of life. Unlike cystic teratoma, epidermoid cysts are usually lined by non-stratified, squamous epithelia within normal splenic tissue.

From the clinical point of view it is crucial to discriminate cystic teratoma from cystic malignancy. Some are typically incidental findings to be diagnosed in initial stages/ as small lesions. However, recent reports on cystic teratomas <2-3 cm demand accurate preoperative diagnosis as a prerequisite for differential surgical therapy. Firstly, mucinous cystic
neoplasm (MCN) is defined by a dense ovarian-type stroma as part of the cystic wall. The inner lining of these usually large, separated cysts consists of mucin-secreting epithelia. In contrast to cystic teratoma, MCN almost exclusively occurs in the pancreatic tail of middle-aged females. The prevalence of invasive carcinoma is 17.5% for patients >55.
years and/or tumor size >4 cm or presence of nodules (21). Nonetheless, resection is proposed for all cases assuming an adenoma–carcinoma sequence. Secondly, intraductal papillary mucinous neoplasms (IPMNs) are usually asymptomatic incidental findings subdivided into main duct, branch duct and mixed type. Multifocal involvement of the pancreas is observed in IPMN but not in cystic teratoma. Main duct IPMN needs to be resected due to a high prevalence of malignancy, whereas follow up is appropriate for asymptomatic branch duct IPMNs <3 cm with periodical high resolution cross-sectional imaging (22, 23).

Theoretically, surgery would not be necessary for a strictly benign entity like cystic teratoma at all. Nevertheless, surgery is required for all symptomatic patients and patients presenting with an asymptomatic resectable tumor mass larger than 2-3 cm due to the high frequency of borderline and malignant lesions (1, 3, 4). In fact, no clinical observation based on imaging results or FNAC cytology has been reported yet. Therefore, surgery remains the standard. Over the years, resection has emerged as the treatment of choice. It was applied to all cases reported within the last 30 years. Draining procedures are regarded as obsolete. External drainage resulted in chronically draining fistulas or recurrent disease due to the retention of secretory epithelium (24). The results of internal drainage as reported in one patient undergoing cystogastrostomy are unknown because the patient was lost to follow-up. Plain enucleation as described by Pyke and co-workers for pancreatic cystadenoma resulted in complications requiring reoperation in four out of eight cases (25). Radical pancreatic resections, such as partial duodenopancreatectomy and left pancreatic resection, can be regarded as save procedures (5, 26). However, limited surgery is desirable to further reduce morbidity and mortality rates.

We conclude that cystic teratoma of the pancreas cannot be identified preoperatively. In cases of doubtful identity radical oncologic resection is inevitable. A procedure to ensure specific diagnosis is needed to make organ- and parenchyma-sparing resections a feasible option in future.

References


Received December 21, 2011
Revised February 11, 2012
Accepted February 13, 2012