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Tumors of the Spleen

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Splenic tumors are uncommon lesions that can be divided into two main categories: nonlymphoid and lymphoid. The most common nonlymphoid tumors are the vascular tumors, which include benign and malignant hemangiomas, lymphangiomas, and hemangioendotheliomas. The remaining nonlymphoid tumors, such as fibrosarcoma and lipoma, are so uncommon as to be only anecdotally reported. Of the lymphoid tumors, Hodgkin's lymphoma may rarely occur as a primary splenic tumor, but more commonly is seen as part of disseminated disease. The same is true of histiocytic lymphoma and plasmacytoma. Rare benign lymphoid lesions may simulate lymphoid tumors. Of the metastatic tumors to the spleen, melanoma, breast, and lung are the principal lesions, but metastases from many other neoplasms occur. Metastases to spleen are less common than to other parenchymatous organs for reasons yet unknown. The surgical approach to splenic tumors should conform to the principles of good tumor surgery with good access, extirpation without rupture, and correct handling of tissue for study. Partial splenectomy is an acceptable procedure for benign splenic cysts, and possibly for polar hamartomas.

Tumors of the spleen, both primary and metastatic, are rare compared to the incidence of such tumors in other major parenchymatous organs. Why the spleen is relatively resistant to neoplasia is unknown; it has been surmised that such resistance may be related to characteristics of the splenic circulation or to the immunologic functions of the spleen. This review is intended to highlight the major clinical, pathological, and surgical features of splenic tumors, recognizing that the classification has varied with both time and author. The classification used in this report is as shown in Table 1.

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Clinical Features

The pathologic spectrum of splenic tumors is so diverse that no constant clinical features can be fitted to the entire group. The most common finding is splenomegaly, which may be accompanied by left upper quadrant discomfort, pain, or tenderness. If the lesion is localized to only a portion of the spleen, no hematological changes may be present; if the process is diffuse throughout the spleen, the phenomena of sequestration and hypersplenism may be manifested by anemia, granulocytopenia, and thrombocytopenia. If the process is a malignant one and has become systemic, splenomegaly may be accompanied by fever, cachexia, pleural effusion, and other signs of systemic involvement. Massively enlarged spleens (over 3,000–4,000 g) displace and press on adjacent viscera, causing such widely divergent symptoms as dyspnea, shoulder pain, early satiety, and constipation, to mention a few. Finally, any splenic neoplasm may rupture causing an acute intra-abdominal catastrophe.

Diagnostic Tests

No investigation of splenomegaly of undetermined etiology is complete without the use of one or more noninvasive imaging tests that are now available. The oldest of these is the radionuclide liver-spleen scan which still can yield useful information in demonstrating the general topography of a lesion (Fig. 1A), its location, and hepatic involvement, if present. Ultrasonography is less useful in delineating the precise topography of the spleen and splenic disease, although it can be of use in the diagnosis of splenic cysts. By far the most useful imaging test available at this time is the computed tomographic (CT) scan, which yields a wealth of information relating to the size and nature of the splenic lesion,

Table 1. Primary tumors of the spleen.

I. Tumor-like lesions
  A. Non-parasitic cysts
  B. Hamartomas
II. Vascular tumors
  A. Benign
    1. Hemangioma
    2. Lymphangioma
    3. Hemangioendothelioma
    4. Hemangiopericytoma (?)
  B. Malignant
    1. Hemangiosarcoma
    2. Lymphangiosarcoma
    3. Hemangioendothelial sarcoma
    4. Malignant hemangiopericytoma (?)
III. Lymphoid tumors
  A. Hodgkin's disease
  B. Non-Hodgkin's lymphoma
  C. Plasmacytoma
  D. Lymphoma-like lesions
    1. Giant follicular pseudolymphoma (Castleman's tumor)
    2. Localized reactive lymphoid hyperplasia
    3. Inflammatory pseudotumor
IV. Nonlymphoid tumors
  A. Lipoma, angiolipoma and myelolipoma
  B. Malignant fibrous histiocytoma
  C. Fibrosarcoma
  D. Leiomyosarcoma
  E. Malignant teratoma
  F. Kaposi's sarcoma

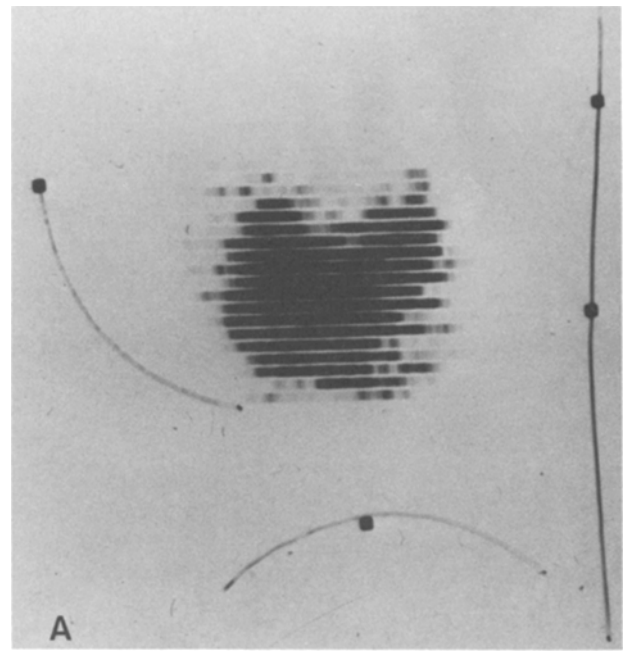
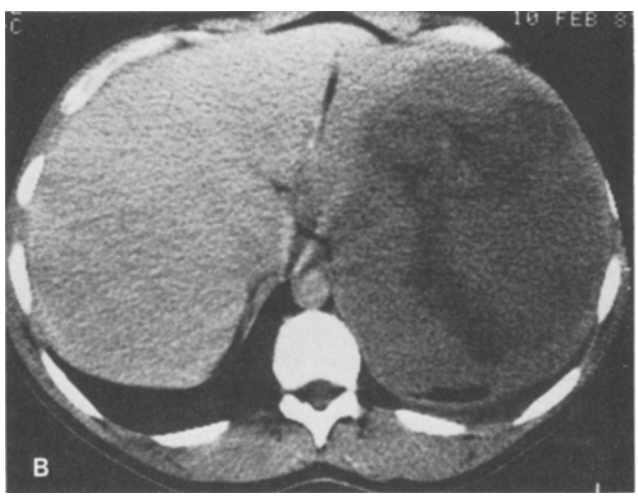
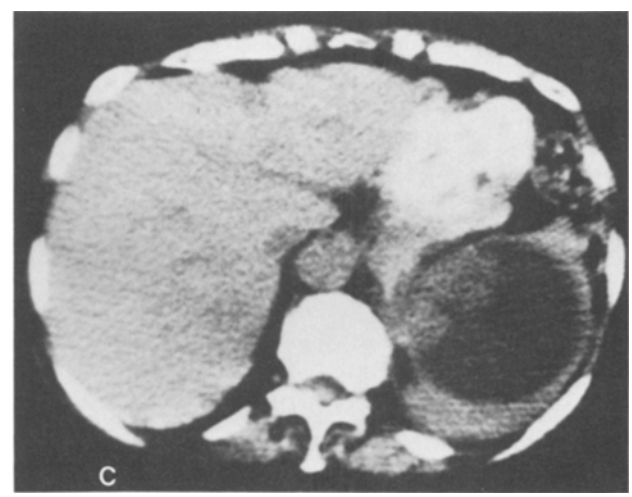


Fig. 1A. Radionuclide scan of solitary non-parasitic cyst, upper pole. **B.** Computed tomographic scan showing massively enlarged spleen (on left) with some central cavitation. Diagnosis, histiocytic lymphoma. **C.** Computed tomographic scan showing large cystic lesion of spleen, with some irregular intracystic projections. Diagnosis, metastatic papillary ovarian adenocarcinoma.





the relationships of adjacent viscera, and the presence of nodal or hepatic involvement and other associated diseases within the pleural and abdominal cavities. Illustrative CT scans are shown in Figs. 1B and 1C.

Magnetic resonance imaging (MRI) for the diagnosis of splenic neoplasms offers the advantages of avoiding radiation exposure, but its use is not yet widespread enough to report on other specific advantages.

Tumor-Like Lesions of the Spleen

Non-Parasitic Cysts of the Spleen

Parasitic cysts are thought to be at least 5–10 times as common as non-parasitic cysts, if worldwide incidence is considered, but are distinctly unusual in most Western countries. There are no accurate data about the true incidence of non-parasitic cysts of the spleen, but only 2 of the 102 cysts studied by

Garvin and King were parasitic [1]. A widely accepted comprehensive classification of splenic cysts was developed by Fowler who studied and wrote about splenic cysts for more than 40 years [2]. Martin's modified and simplified classification is presently used [3]:

I. Primary (or true) cysts, with cellular lining
   A. Parasitic
   B. Non-parasitic
      1. Congenital
      2. Neoplastic

II. Secondary (or false) cysts, without true cellular lining.

The primary (true) cysts most often have a squamous epithelial lining, although some may have a mesothelial-type lining [4]. Less commonly, there may be an endothelial lining, as either a hemangioma or lymphangioma, although these are usually multi-locular.

It is thought that the squamous- or the mesothelial-lined cysts originate as inclusions of mesothelium which are retained in the spleen during embryogenesis and then proliferate and, under certain conditions, undergo metaplasia [5]. Others have described a rarer form of splenic cyst in which the squamous epithelium is keratinized [6] and have suggested that the cysts may not be metaplastic, but may, instead, be neoplastic. Support for the theory of mesothelial origin can be found in a recent study [7] of ovarian epidermoid cysts, in which ultrastructural studies supported the possible origin from metaplastic mesothelium.

Can mesothelial- or squamous-lined cysts also be the result of trauma? A history of trauma can certainly be elicited from patients with squamous-lined splenic cysts. It may be that splenic laceration leads to implantation in the pulp of mesothelial-lined capsular tissue that could subsequently proliferate and form a cyst. The etiopathogenesis of splenic cysts might best be evaluated from a study of the cyst wall rather than the lining.

The secondary (false) cysts (Fig. 2) are more common than the primary cysts [3], but have received less attention because their etiopathogenesis is thought to be well understood. In many cases, trauma has been cited as the contributing factor. It is thought that trauma, with or without capsule laceration, leads to intrasplenic hemorrhage. The hematoma that forms becomes encapsulated. Subsequently, the blood is absorbed and there is persistence of the false cyst wall which may eventually become thick, fibrous tissue with extensive calcification. The presence of calcification, often visible radiographically, is not, however, a reliable feature to differentiate secondary from primary cysts, since the primary cysts may also have calcification.

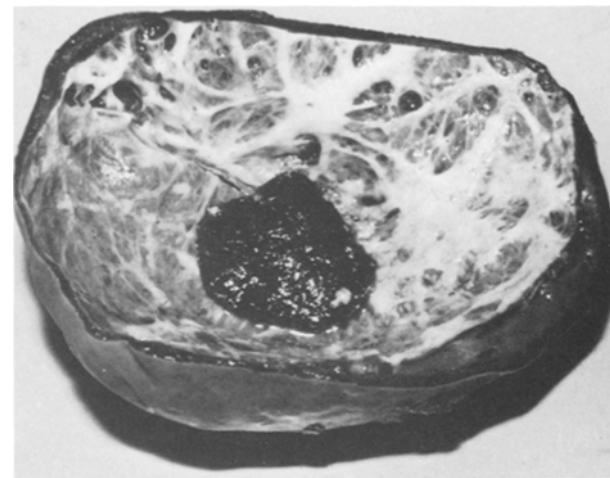


Fig. 2. Bisected non-parasitic splenic cyst, showing typical irregularly reticulated lining. Organized clot seen free in cyst, suggesting traumatic etiology. Cyst excised by partial splenectomy.

Hamartomas

Hamartomas of the spleen are rare, benign, splenic lesions first described as "splenomas" by Rokitansky [8]. Most of the cases have been found in autopsy material, but are recognized with increasing frequency as a greater number of splenectomies are performed. The incidence has been estimated at 3 in 200,000 splenectomies [9], but we believe hamartomas of the spleen are more common. A group of our cases has been recently reported [10].

Splenic hamartomas occur equally in males and females, at all ages, but particularly in older people. The typical appearance is that of a well-circumscribed, often non-encapsulated lesion which macroscopically bulges from the cut surface and usually appears darker than the surrounding spleen (Fig. 3). Microscopically, the lesion is easily recognized because of the distinct border and the slit-like and tortuous endothelial-lined spaces.

Although these lesions are usually encountered as incidental findings at autopsy, imaging techniques currently in use may disclose their presence or they may be palpated on abdominal exploration. Rarely, hamartomas are multiple and widely enough distributed throughout the spleen to cause splenomegaly and hypersplenism. The rupture of a solitary hamartoma with life-threatening hemoperitoneum is among the cases recently reported by the authors [10].

Primary Nonlymphoid Tumors of the Spleen

Vascular neoplasms are the most common primary splenic tumors [11].

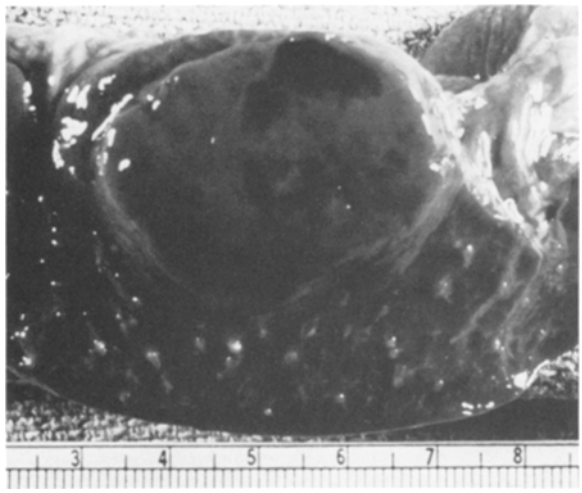


Fig. 3. Typical hamartoma of spleen showing well-circumscribed lesion resembling normal splenic architecture. Note: Bulging on cut surface may simulate neoplasm.

Hemangiomas are usually incidental findings at autopsy or in spleens removed for other reasons. Infrequent clinical manifestations are the presence of a mass, pain [4], and an associated syndrome of consumption coagulopathy [12]. Rupture is uncommon. Hemangiomas are usually visible macroscopically as blood-filled cysts occurring either singly or in groups. Histologically, they are most often cavernous in pattern, but capillary-type hemangiomas may be seen. The usual picture is that of vascular spaces lined by a single layer of bland endothelial cells, without mitoses.

Lymphangioma of the spleen may be single [13] or multiple [14]. Characteristically, the neoplasm consists of small endothelial-lined capsular cysts filled with eosinophilic proteinacious material. Discovery is usually accidental although some patients with lymphangiomatous cysts may present with splenomegaly. A distinctly unusual case of splenic lymphangiomatosis in a 5-year-old girl was associated with a similar process involving her upper body ("cystic hygroma") [15]. A recent report described malignant areas in what was otherwise a typical multicystic lymphangioma [16].

Recently, there has been increased emphasis placed on angiosarcoma of the spleen because of its association with environmental or work-related factors such as thorium dioxide or monomeric vinyl chloride [17]. Nevertheless, hemangiosarcomas of the spleen are uncommon as primary splenic tumors. More often the spleen is affected when hemangiosarcoma develops in another organ, usually the liver [11,17].

Angiosarcoma, hemangiosarcoma, and hemangioendothelialsarcoma are most likely the same tumor. Hemangiosarcoma is the preferred term to distinguish this tumor from lymphangiosarcoma, but angiosarcoma is the term most widely used.

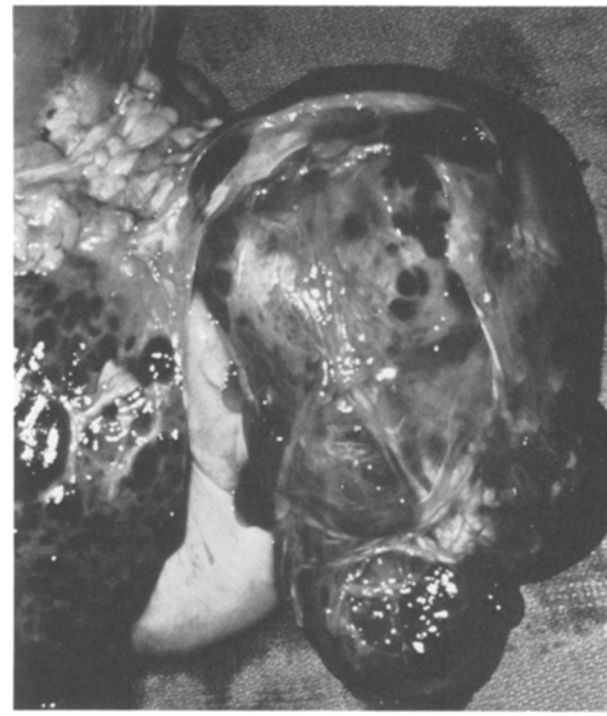


Fig. 4. Hemangiosarcoma, spleen. Liver was also involved. Splenic weight, 950 g.

Hemangiosarcoma of the spleen may present as splenomegaly [18], angiopathic hemolytic anemia [19], ascites and pleural effusions, or spontaneous rupture [20]. Documentation of exposure to thorium dioxide, vinyl chloride, or arsenic is usually not obtained. Prognosis is almost universally poor [21].

In order to establish the diagnosis of primary splenic hemangiosarcoma, the tumor must be confined to the spleen and consist of vascular channels with malignant-appearing, often budding, endothelial cells. Solid, spindle cell areas may be present. The neoplastic and malignant nature of the tumor is not always obvious initially. Macroscopically, the tumor presents as a highly variegated spleen with areas of necrosis, hemorrhage, and, representing tumor, sponge-like nodules in red pulp (Fig. 4). Sometimes involvement is diffuse and tumor may not be grossly appreciable. Splenic angiosarcoma has been experimentally induced [22].

In recent years, Kaposi's sarcoma has become a major health problem in communities with many homosexuals. Kaposi's sarcoma is a spindle cell malignant neoplasm characterized by vascular spaces *not* generally lined by endothelial cells. There is often extravasation of blood in the spindle cell areas, and there may be a variable plasma cell component. We have not seen Kaposi's sarcoma

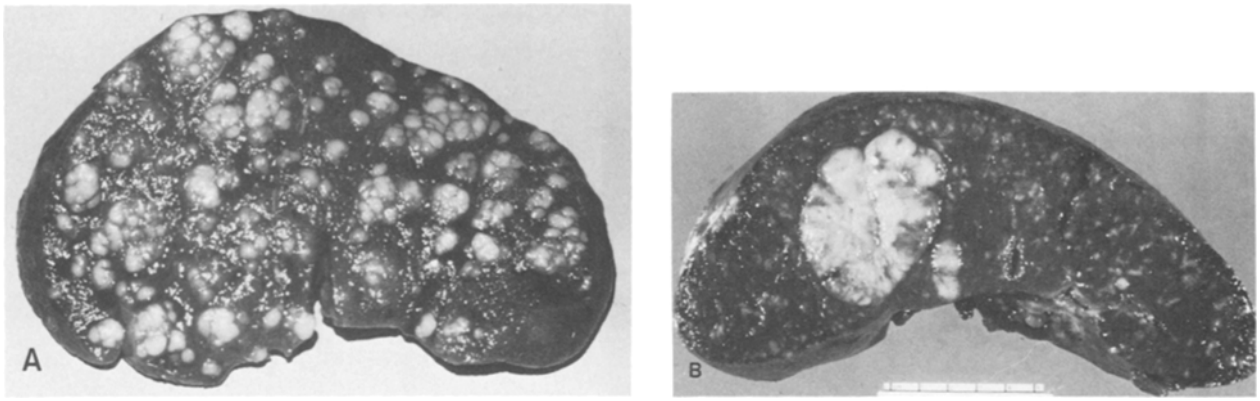


Fig. 5A. Nodular sclerosing Hodgkin's disease, spleen, involving spleen diffusely. Liver biopsy was positive. **B.** Malignant lymphoma (poorly differentiated lymphocytic) showing large intrasplenic mass in addition to diffuse involvement. Liver biopsy positive.

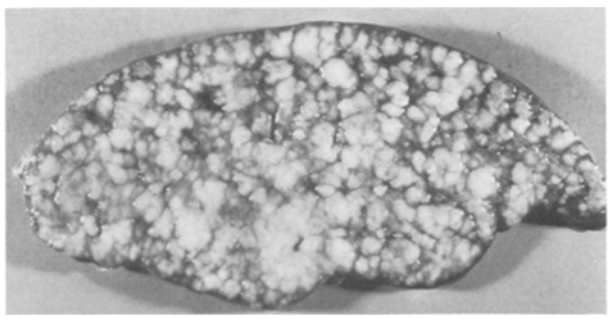


Fig. 6. Histiocytic lymphoma. Spleen demonstrating diffuse involvement. Spleen weighed 2,500 g.

presenting as a primary splenic tumor, but have studied patients in whom the spleen was involved as part of a general sarcomatosis.

Primary Lymphoid Splenic Neoplasms

Although the spleen is often the site of secondary involvement by Hodgkin's disease [23] and the non-Hodgkin's lymphomas [24], lymphoid malignancies are uncommon as primary splenic tumors [4,25]. When lymphoma does involve the spleen, either as a primary or secondary process, the white pulp is involved first. There may be relatively diffuse involvement, particularly in the case of nodular lymphomas (Fig. 5A), or there may be large, irregular tumor masses (Fig. 5B), as in the case of the diffuse, large-cell lymphomas. In contrast, malignant tumors of true histiocytic origin, although uncommon as a group, frequently involve the spleen, and splenomegaly may be the only abnormal physical sign [26]. Involvement is diffuse and unlike the usual lymphoma, tumor masses are not formed (Fig. 6).

Benign lymphoid lesions may also cause splenomegaly and may mimic lymphoma. Reactive lymphoid hyperplasia [27] and inflammatory pseudotumor [28] have been briefly described. Castleman's tumor (angiofollicular lymphoid hyperplasia) may also affect the spleen, either as a solitary lesion or as a part of a diffuse lymphoid hyperplasia syndrome [29]. Castleman's tumor is thought to be a true lymphoid hamartoma, but does not resemble the follicular pattern of splenic hamartoma described by Berge [30].

Primary plasmacytoma of the spleen is exceedingly rare and is not macroscopically recognizable, but is easily identified histologically as a plasma cell neoplasm. The spleen may be involved as a primary, isolated site. Usually, when the spleen is involved as a part of a generalized myelomatosis, there is no dominant tumor.

A splenic inflammatory "pseudotumor" has recently been described [28]. This is an inflammatory cell mass which does not resemble hamartomas, but must be distinguished from lymphoma.

Nonlymphoid Tumors

Lipomas and angiomyolipomas have occasionally been reported [31]. Recently, a number of cases of primary splenic malignant fibrous histiocytoma have also been described [32,33]. This distinct, pleomorphic sarcoma usually occurs in the soft tissues, but has also been found in a number of organs, including the spleen. Massive splenomegaly is usual, and the tumors tend to be quite aggressive. The histogenesis of these tumors is not clear and is controversial [33]. Malignant fibrous histiocytoma may be misdiagnosed as fibrosarcoma or leiomyosarcoma, both of which occur in the spleen [4], but have not been well documented [32]. There is a single report of malignant teratoma, with papillary

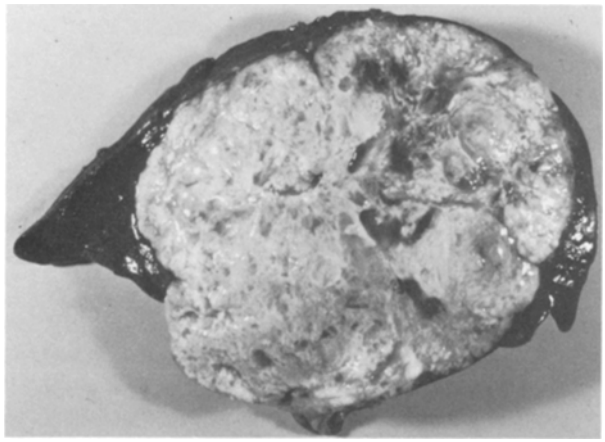


Fig. 7. Large metastasis to spleen from ovarian papillary adenocarcinoma. Spleen weighed 1,500 g.

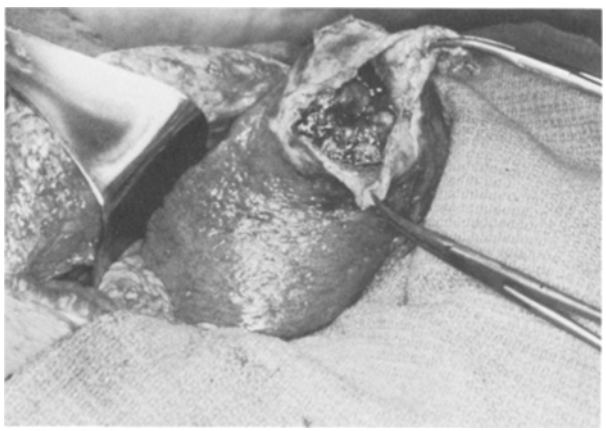


Fig. 8. Cystic metastasis to spleen from ovarian papillary carcinoma. (CT scan shown in Fig. 1C). Cyst was densely adherent to wide portion of diaphragm and ruptured during delivery.

carcinoma, spindle cell sarcoma, and cartilagenous tissue [34].

Metastatic Tumors Involving the Spleen

Splenic metastases are found in as many as 7% of autopsied cancer patients. In Berge's series the spleen was affected almost as often as the brain [35]. Particularly frequent are carcinomas of breast, lung, and melanomas [36] (Fig. 7). Direct extension from retroperitoneal tumors and pancreatic carcinoma [37] may be found. Metastases to the spleen may present as splenomegaly or as spontaneous rupture. A recent patient at our institution entered with painful splenomegaly, left pleural effusion, and imaging evidence of a large splenic cyst. At operation the large cystic mass (Fig. 8) was found to be papillary carcinoma metastatic from a primary ovarian tumor. Virtually every primary tumor has been shown to be able to metastasize to the spleen [35].

Surgical Considerations in Operations for Splenic Tumor

The principles of good tumor surgery must be followed in operations for splenic neoplasms. These include good access (exposure), removal of the intact spleen without rupture of capsule or tumor, removal of adjacent structures when necessary, adequate hemostasis, and correct preparation of tissue for study.

To achieve good access, an incision that is large and versatile enough to allow good mobilization of the spleen without excess trauma is mandatory. Unless the spleen is massively enlarged, the best incision for exposure and delivery of the spleen is the left subcostal incision. If mobilization proves difficult through this incision, a vertical midline component can be added (Kehr incision). Combined with the division of the falciform ligament, this incision opens the left upper quadrant widely and allows excellent exposure of the spleen, diaphragm, retroperitoneum, and all adjacent viscera. When the spleen is massively enlarged, with its lower pole abutting against pelvic structures, a long midline incision is preferable since the hilar structures in these cases are virtually midline and the delivery of the lower pole is facilitated.

The splenic artery should be doubly ligated in continuity as early as possible during the operation to achieve some reduction of splenic size, allow easier delivery, and reduce venous outflow. Veins that can be safely divided and ligated from the anterior approach, which include the vasa brevia as well as vessels to the anterior hilum and lower pole, should be divided before an attempt is made to mobilize the spleen.

Mobilization of the spleen should be gentle with great care taken not to injure the capsule or to break the tumor. For this maneuver, the operator stands on the right side of the table while the assistant widely retracts the costal margin on the left to allow incision of the retroperitoneum parallel to the long axis of the spleen. Areas in which the splenic capsule is most likely to be breached are the upper pole, if the highest vasa brevia are not divided completely, and the lower pole where the constant lienoomental peritoneal folds should be divided before mobilization is begun.

If the spleen or tumor is not separable with ease from the adjacent retroperitoneum or diaphragm, large hemoclips may be placed in a series in the line of dissection, removing parietal peritoneum with the specimen and occasionally, if necessary, a portion of diaphragm. Rarely, when the tumor is mark-

edly adherent to diaphragm, it is necessary to resort to a thoracoabdominal incision.

Control of the large posterior splenic veins should be achieved early once the spleen has been mobilized to the midline and its posterior hilar surface exposed. Any attempt to control these large, fragile, thin-walled splenic veins from the anterior approach is fraught with the danger of venous disruption and major bleeding.

During the final stages of removal of the spleen for tumor, some effort should be made to obtain one or more involved hilar lymph nodes. These are generally identified without difficulty in juxtaposition to the major hilar vessels. Study of these lymph nodes may be extremely useful in the diagnosis and grading of the splenic tumor.

Following the removal of a large spleen for tumor, especially when the latter is adherent to the retroperitoneal or diaphragmatic surfaces, hemostasis may be a problem. Obvious bleeding points may be readily controlled by electrocautery or clamping and ligation. However, a diffuse capillary ooze in patients with impaired coagulation mechanisms is a problem that often confronts the surgeon. A useful maneuver when there is diffuse bleeding from either retroperitoneum or diaphragm is the sutureplication of these structures with absorbable running sutures applied in parallel fashion in the areas of most diffuse bleeding. This maneuver, plus pressure and application of hemostatic agents, such as Avitene®, Surgicel®, or topical thrombin, is generally successful in controlling obstinate capillary ooze from large surfaces. Bleeding edges of divided retroperitoneum may be sutured with a continuous locking suture.

Correct handling of the excised spleen and adjacent tissues is extremely important. A pathologist should be called to the operating room and the specimen demonstrated to him or her. The freshly excised spleen should never be placed in fixative before proper studies have been done by the pathologist; these include touch preparations of the spleen and excised lymph nodes, preparation of tissue for examination by electron microscopy, and the saving of a portion of splenic tissue for frozen storage if further study is necessary.

It is important to include a liver biopsy in the material submitted for histologic study if there is a possibility of disseminated disease. We recommend a generous wedge biopsy of the right and left lobes of the liver, as well as 2 needle biopsies of each lobe performed with a wide-bore Menghini needle.

Drains are not necessary if there is no suspicion of injury to the pancreas. The patient should have received polyvalent pneumococcal vaccine preoperatively, preferably within 2 weeks of the operation. Meningococcal and *Hemophilus influenzae* vaccines may also be available in the near future.

Partial Splenectomy

Partial splenectomy has been successfully performed for cysts of the spleen, as reported by several authors [38]. Rather than sacrifice the spleen for a benign condition with adverse immunologic sequelae, it is possible, especially with splenic cysts, to preserve a good portion of functional spleen while excising the benign cystic process. If the splenectomy is done in controlled fashion similar to the procedure performed for controlled hepatic resection, it is a highly feasible and successful operation [39]. To date, we have excised 10 such cysts ranging in size from 7 to 17 cm in diameter, all without incident. To avoid the possible adverse effects of splenectomy for the staging of Hodgkin's disease, some investigators have recommended partial splenectomy as a means of splenic sampling for purposes of staging the disease. If feasible, such a procedure would be especially useful in children in whom the risks of overwhelming postsplenectomy sepsis is higher. However, studies have shown that sampling of a portion of the spleen, by partial splenectomy, results in a significant negative staging error [40, 41]. Therefore, as long as operative staging for Hodgkin's disease includes routine splenectomy, partial splenectomy is not indicated.

It is conceivable that a clearly defined hamartoma in a polar location of the spleen can be safely excised for diagnostic purposes. We have no experience with partial splenectomy for this condition, nor have we seen any reported. In patients with metastatic tumor to the spleen, if the metastasis is clearly part of a disseminated metastatic process, it is not advisable to remove the spleen. In such cases splenic biopsy is sufficient.

In summary, neoplasms of the spleen are not frequently encountered by the abdominal surgeon, but when present, may require splenectomy for either diagnosis or treatment. The fragile spleen, hidden in its left upper quadrant recess, always presents an interesting and difficult challenge to the surgeon; the presence of a neoplasm accentuates the difficulty and the challenges.

Résumé

Les tumeurs spléniques sont des affections rares qui se subdivisent en deux groupes: les tumeurs lymphoïdes et les tumeurs non-lymphoïdes. Les tumeurs non-lymphoïdes les plus fréquentes sont les tumeurs vasculaires: hémangiomes bénins et

malins, lymphangiomes et hémangioblastomes. Les autres tumeurs non-lymphoïdes: lipome et fibrosarcome sont rarissimes et ne sont rapportées qu'à titre anecdotique. Parmi les tumeurs lymphoïdes, la maladie de Hodgkin se traduit rarement par une tumeur splénique primitive, la splénomégalie étant en revanche le témoin de la dissémination de ce lymphome malin. Il en est de même pour le lymphome histiocytaire et le plasmocytome. Des lésions lymphoïdes bénignes rares peuvent simuler les tumeurs lymphoïdes. Les métastases spléniques des mélanomes des cancers du sein et du poumoun sont fréquentes, celles des autres néoplasmes sont moins fréquents. En fait les métastases du niveau de la rate sont plus rares qu'au niveau des autres organes ce fait restant inexpliqué.

Le traitement chirugical des tumeurs spléniques doit respecter les règles de la chirurgie carcinologique: bonne voie d'abord, exérèse sans rupture de la lésion, manipulation correcte des tissus pour permettre une étude adéquate. La splénectomie partielle s'applique seulement au traitement des kystes spléniques bénins et des harmartomes des pôles de la rate.

Resumen

Los tumores esplénicos son lesiones poco comunes que pueden ser clasificadas en dos categorías principales: no-linfoides y linfoides. Los tumores no-linfoides más comunes son los tumores vasculares, los cuales incluyen hemangiomas benignos y malignos, linfangiomas y hemangioendoteliomas. El resto de los tumores no-linfoides, tales como fibrosarcoma y lipoma, son tan poco frecuentes que apenas son informados en forma anecdótica. De los tumores linfoides, los linfomas de Hodgkin ocurren muy rara vez como tumor esplénico primario, y más bien son frecuentemente observados como parte de enfermedad diseminada. Esto también es válido para el linfoma histiocítico y para el plasmacitoma. Algunas raras lesiones linfoides benignas pueden simular tumores linfoides. De los tumores metastásicos del bazo, el melanoma y los neoplasmas del seno y del pulmón son los principales, pero las metástasis de otros neoplasmas también pueden ocurrir. Las metástasis al bazo son menos comunes que a otros órganos parenquimatosos por razones aún desconocidas. El aproche quirúrgico de los tumores esplénicos debe sujetarse a los principios de buena cirugía tumoral, con buen acceso, extirpación sin ruptura y manejo correcto de los tejidos para estudio. La esplenetomía parcial es un procedimiento aceptable para quistes esplénicos benignos y tal vez para hamartomas polares.

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