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PRIMARY CARDIAC TUMORS: EARLY SURGERY, COMPLETE RESECTION, CHEMOTHERAPY ENHANCES SURVIVAL.

Cardiology

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ABSTRACT

Primary cardiac tumors are rare. The incidence varies between 0.3% to 0.7% .Quarter of all primary cardiac tumors are malignant, of these 75% are sarcomas. Malignant primary cardiac sarcomas that affect right atrium are predominantly angiosarcomas while the left atrium is involved primary in pleomorphic sarcoma like malignant fibrous histiocytoma and leiomyosarcoma. In a young patient it usually carries a dismal prognosis if not diagnosed early and dealt with surgically followed by adjuvant therapy. Without surgical resection, the survival rate at 1yr is only 10%.Retrospective evaluation of the last 60 primary cardiac tumors done by the same surgical team over 28 years was looked into.

KEYWORDS

LAMB, PRKAR1A, TEE, GRE, PET, TAH, TET, AR-VR

INTRODUCTION

A successful resection of a cardiac tumor is certainly a surgical challenge in most situations even in expert hands.Crafoord did the first successful procedure in 1954. Surgical resection followed by chemo/radiotherapy combinations are needed for most situations. The ratio of benign vs. malignant would be 75:25 in most centers. One can safely assume that a quarter of all tumors of the heart are malignant. These are mostly sarcomas and lymphomas.10% of cardiac tumours are metastatic tumors and of these 10% have clinical manifestations at presentation (6). Atrial myxomas predominate in adults and rhabdymyosarcoma in children. Low grade sarcomas and lymphomas are compatible with improved prognosis (7). Pericardial tumors that affect the heart include benign teratomas and malignant mesotheliomas. Tumor distribution noted in our surgical centers is shown in figure 1.Etiology is summarized in table 1.Table 2 shows an easy clinical classification that can be followed.

Clinical picture is a wide spectrum ranging from incidental detection, blood flow obstruction, constitutional symptoms, symptoms of invasion of adjacent structures, embolic episodes, infiltration of wall with features similar to cardiomyopathy, arrhythmias, hemorrhagic effusions, tamponade and varying degrees of heart failure. The symptoms are due to location, size, invasiveness, growth rate and embolic potential of these tumors. The most common clinical presentation is heart failure followed by symptoms caused by peripheral emboli. High index of suspicion with multi imaging modalities often clinches the diagnosis (3, 4).Fibroma can cause AV block and sudden death (5).Extension into systemic venous drainage would result in superior vena cava syndrome. Embolic fragments obtained should always be subjected to histopathological examination. Papillary fibroelastomas are often associated with systemic embolization. Interesting feature of multi centric myxomas which are atypically located occurs in 10% as family clusters as a part of Carney Syndrome (9, 10). NAME (nevi, atrial myxomas, myxoid fibromas, and ephelides) and LAMB (lentiginosis, atrial myxomas, mucocutaneous myxomas, and blue nevi) are sub forms of Carney syndrome (11, 12). A genetically heterogeneous mutation of the tumor suppressor gene PRKAR1A (protein kinase A regulatory subunit1-alpha gene) is noted on chromosome 17q22–24(13). There is an increased risk of cardiac fibroma in patients with Gorlin (basal cell nevus) syndrome, which is characterized by multiple nevoid basal cell carcinomas of the skin, jaw cysts, and bifid rib. Papillary fibroelastomas have a typical sea anemone like appearance. Cardiac hemangioma can occur in the clinical setting of Kasabach-Merritt syndrome, which is characterized by multiple systemic hemangioma associated with recurrent thrombocytopenia and consumptive coagulopathy (22). Though in our experience it has been unicentric, multicentric growths have been reported (14).Unlike lipomatous hypertrophy lipomas are encapsulated tumors. 50% of rhabdomyoma (with spider cells in histology) is associated with tuberous sclerosis, and congenital defects of the heart (15). Sarcomas include angio, fibro, leiomyo and rhabdymyosarcoma. In patients below 45 years Li–Fraumeni syndrome is a differential diagnosis which is an autosomal–dominant condition is now assumed to be a mutation of the TP53 gene on chromosome 17p13.1 (16). Classic nesting (zellballen) appearance of the paraganglial cells is noted in paragangliomas.

INVESTIGATIONS

A simple chest x ray may at times pick up calcification in the tumour to the discerning eye. Echocardiography- TEE, 3-dimensional echocardiography, multidetector cardiac computed tomography (MDCT), cardiac magnetic resonance imaging with gradient recall Echo imaging (GRE) ,coronary angiography, PET scans and biopsy in very selected cases are the various imaging options currently available. Multimodality imaging helps in confirming the diagnosis deciding upon therapeutic options and ruling out the differential diagnosis options like vegetations, pericardial cysts, thrombi, sarcoid deposits, myocardial abscesses, lipomatous hypertrophy of interatrial septum, pseudoneoplasms like inflammatory myofibroblastic tumor, hamartoma of mature cardiac myocytes, calcified amorphous tumor, and mesothelial/monocytic incidental cardiac excrescences. A rare intracardiac blood cyst could also add to the confusion. The possibility

of subtle mass/growth in a patient with unexplained arrhythmia or conduction disturbances should also be kept in mind at the time of echocardiographic study/MRI/MDCT evaluation. Tissue density, source of vascular supply is also identified by imaging modalities. No specific guideline based practice has still been established due to insufficient data being gathered about the same. No survival difference has been noted in the past four decades. Sarcomas, rhabdymyosarcoma and fibrosarcomas are still associated with poor outcomes (8).Table 3 summarizes important points of multimodality investigations.

TREATMENT

Surgical approaches are summarized in table 4.Interdisciplinary interaction is the key. A tertiary cardiac surgical centre with all facilities up to total artificial heart implantation is ideal. Simple tumor resection with clear resection margins is ideal for benign tumors like myxomas. Proper measures to prevent tumor dissemination while using heart lung machine is essential while excising friable tumours. In myxomas the attachment base has to be removed with the tumour and atrial septal defect reconstructed. All chambers should be inspected to rule out multiple tumours (17). Complex tumor resection Complex tumor resection is possible provided the mass is confined to the heart without surrounding invasion. For extensive right heart involvement creation of Fontan physiology is an alternative if pulmonary pressures are conducive for the same (18). Ex situ resection is another option with extensive reconstructive measures. Patch, prosthesis, valve or bioengineered tissues may be needed (19, 20).In a young patient with extensive involvement, total artificial hearts like Carmat or Saispandan which would fit in as a destination therapy device would be ideal with fully implantable system and TET charging[24]. Heart transplantation is an option but concerns of micrometastatis and need for immunosupression are issues to consider. One year survival would be 95% for benign, 50% for malignant and 30% for metastatic which tends to drop by 10% at every 5 year follow up evaluation. Deaths are often due to distant metastasis.

CONCLUSION

Early diagnosis, radical complete resection—combined, postoperative chemotherapy or radiotherapy as indicated would help in better long-term outcome with an acceptable quality of life. Artificial intelligence would be a blessing to facilitate risk categorization and early diagnosis. 3-dimensional printing could precisely depict the extent of the growth help in precise preoperative surgical planning. AI based fluid dynamic evaluation would help to select precise synthetic material for reconstruction. Use of AR VR for procedure planning, surgical procedural and risk explanation is in developmental phase. With good response to low-grade sarcomas (removable ones) and systemic therapy-responsive lymphoma technology helping in early precise diagnosis and therapy planning there is dawn of hope at the horizon. Outstanding models of total artificial heart like Saispandan which is designed as totally implantable device with bearingless motors for destination therapy would be the promise of future especially when micro metastasis and immunosupression is still a serious concern in transplantation options.

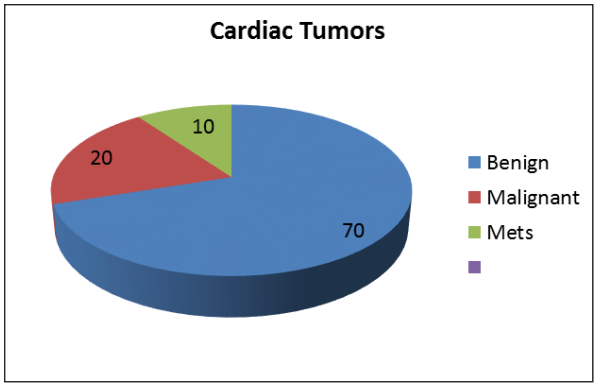

Fig. 1

Table 1

ETIOLOGY OF CARDIAC TUMORS

- Genetics - poorly understood
- Complexes with genetic links (such as Carney complex) –benign
- No demonstrable associations with malignant sarcomas
- Sarcomas 2 groups:
- Specific gene alterations -simple karyotypes
- Nonspecific gene alterations with complex karyotypes.
- Simple alterations—such as rhabdymyosarcoma and Ewing, synovial, and gastrointestinal stromal tumors— chromosomal translocations.
- Pleomorphic sarcomas and leiomyosarcomas are probably the result of nonspecific translocations

Table 2

CLASSIFICATION OF CARDIAC TUMORS

- Benign neoplasms
- Histology & Cellular differentiation
- Muscle (rhabdomyoma), fibrous (fibroma), vascular (hemangioma), fat (lipoma), nervous (pheochromocytoma), and ectopic (teratoma) tissues.
- Myxoma and papillary fibroelastoma do not fit into any of the above categories
- Malignant neoplasms are classified by tissue type as mesenchymal (sarcoma), lymphoid (lymphoma), and mesothelial (mesothelioma)

Table 3

IMPORTANT POINTS IN MULTIMODALITY IMAGING OF CARDIAC TUMORS

- Primary cardiac tumors- multiple imaging techniques- CMR, 3-D(volume) TTE, PET, and cardiac CT - early diagnosis
- Three-dimensional TTE - type of tumor and site of attachment, surface features, and the tumor's spatial relationship
- Cardiovascular MRI-identify, with high specificity, cardiac masses that do not require excision: pseudotumors, thrombi, lipomas, lipomatous hypertrophy, and papillary fibroelastomas.
- Most other cardiac tumors will require tissue diagnosis to aid in the establishment of a treatment plan.
- Size of the intracardiac mass, the mobility of the mass (an important predictor of prognosis and embolic potential), myocardial invasion, and cardiac chamber location.
- These factors will provide the means to diagnosis and prognosis.
- Other important data to collect include the mechanism of tumor implantation, the relationship of the tumor with adjacent structures, the surgeon's route of access to the heart, left ventricular ejection fraction, and the dimensions of the affected chamber.
- Biopsy is best obtained if it can be done safely. This will not only diagnose the tumor but exclude benign masses and other malignant tumors, such as lymphoma, that are best treated nonsurgical.
- DD- vegetations, pericardial cysts, thrombi, sarcoid deposits, myocardial abscesses, and at times lipomatous hypertrophy of interatrial septum, pseudoneoplasms

Table 4

SURGICAL OPTIONS IN CARDIAC TUMORS

- Simple Resection-Patch closure
- Complex Resections- Right heart Ex+Fontan
- Exsitu Resection- Prosthesis, Patch or Valve
- Heart Transplantation
- TAH

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