Cardiac Tumor Characterization

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When we find a tumor, what do we want to know?

– Benign vs malignant
– Invasive vs noninvasive
– Obstructive vs nonobstructive
– Operable vs inoperable
– Tissue type

This always requires multimodality imaging and detective work (and deduction – without pathology there is no certainty!)
35 yo with palpitations
54 yo atypical CP
Myxoma

Lymphoma
Characterization of tumors

• Location
• Morphology and relationships
• Fat suppression
  – Lipomas
• Perfusion
  – Vascular vs nonvasc
• Enhancement
  – Tissue components and characteristic appearance
  – Lipoma, calcium, thrombus, iso-vasc, hyper-vasc
A 30-year analysis of cardiac neoplasms at autopsy.

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Abstract

INTRODUCTION: Cardiac neoplasms are rare and the vast majority are metastatic in origin. Symptoms of cardiac neoplasms (primary or metastatic) usually appear late in the course of the disease and are often ignored because of the more severe effects of the primary malignant disorder or its therapy. Consequently, cardiac neoplasms, especially metastatic ones, are often not discovered until autopsy.

OBJECTIVES: To assess the incidence of cardiac neoplasms at autopsy and to determine the sites of origins of metastatic cardiac neoplasms.

METHODS: The pathology records from consecutive autopsies performed at the University Health Network, Toronto, Ontario, from January 1973 to May 2004 were reviewed. They showed 266 cases of neoplasms involving the heart among 11,432 consecutive autopsies. These cases were then categorized based on their system of origin and further subclassified into specific primary site categories. As well, the type of cardiac tissue affected was noted in 193 cases (72.6%).

RESULTS: The 266 autopsy cases involving cardiac neoplasms represented 2.33% of the total number of autopsies. Among the 266 cases, two neoplasms were primaries, while 264 were metastatic in origin. Metastatic cardiac neoplasms most frequently metastasized from the respiratory system, followed (in order of decreasing frequency) by the hematopoietic, gastrointestinal, breast and genitourinary systems. A minority of metastatic cardiac neoplasms were found to have spread from other systems. Cardiac neoplasms most frequently involved the pericardium, followed (in order of decreasing frequency) by the myocardium, epicardium and endocardium.

CONCLUSIONS: There were 132 times more metastatic cardiac neoplasms than primary cardiac neoplasms found in the present study. The most common sites of metastatic origin were the lungs, bone marrow (leukemia/multiple myeloma), breasts and lymph nodes (lymphoma). Leukemias were more prevalent in the present study than in previous studies. The pericardium was the tissue that was most frequently affected by metastatic cardiac neoplasms.
Malignant metastases

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1. Pulmonary
2. Leukemia/myeloma
3. Breasts
4. Lymphoma

“Pericardium most frequent” – not true in my experience, may not come to clinical attention.
## Benign Tumors

**TABLE 46-3 -- Approximate Incidence Rate of Benign Tumors of the Heart in Adults and Children**

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adults</td>
</tr>
<tr>
<td>Myxoma</td>
<td>45</td>
</tr>
<tr>
<td>Lipoma</td>
<td>20</td>
</tr>
<tr>
<td>Papillary fibroelastoma</td>
<td>15</td>
</tr>
<tr>
<td>Angioma</td>
<td>5</td>
</tr>
<tr>
<td>Fibroma</td>
<td>3</td>
</tr>
<tr>
<td>Hemangioma</td>
<td>5</td>
</tr>
<tr>
<td>Rhabdomyoma</td>
<td>1</td>
</tr>
<tr>
<td>Teratoma</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

*Adapted from Shapiro LM: Cardiac tumours: diagnosis and management. Heart 85:218-222, 2001.*
## Primary cardiac malignancies

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Age/Gender</th>
<th>Symptoms</th>
<th>Location/Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiosarcomas</td>
<td>30-50 yr, M &gt; F</td>
<td>Cardiac mechanical and rhythm disturbances, embolic symptoms, systemic/constitutional symptoms, metastatic disease</td>
<td>90% in right atrium; intramural mass with protrusion into the cavity, infiltrative, frequent involvement of pericardium</td>
</tr>
<tr>
<td>Rhabdomyosarcomas</td>
<td>Children and young adults, M &gt; F</td>
<td>Cardiac mechanical and rhythm disturbances, systemic/constitutional symptoms, metastatic disease</td>
<td>Hypereosinophilia; no chamber predilection; multiple lesions seen in 60%, infiltrative</td>
</tr>
<tr>
<td>Leiomyosarcomas</td>
<td>30-40, M = F</td>
<td>Cardiac mechanical and rhythm disturbances, systemic/constitutional symptoms, metastatic disease</td>
<td>70-80% in left atrium, may involve pulmonary trunk; solitary lesion in 70%, infiltrative</td>
</tr>
<tr>
<td>Lymphomas</td>
<td>62-67 yr, can affect all ages, M &gt; F</td>
<td>Cardiac mechanical and rhythm disturbances, embolic symptoms, systemic/constitutional symptoms</td>
<td>HIV infection, immunocompromised state, posttransplantation; right side of the heart in 68-72%; single lesion in 66% and multiple lesions in 34%, may cause pericardial effusion</td>
</tr>
</tbody>
</table>
Tumors by location

RA/SVC
- Thyroid ca: 1
- Inflammatory pseudotumor: 1
- Total: 2

RA
- Myxoma: 5
- Thrombus: 2
- Melanoma: 1
- Adrenocortical ca: 1
- Total: 9

RA/IVC
- Hypernephroma: 7
- Rhabdomyoma: 1
- Hepatoma: 1
- Total: 9

TV
- Fibroelastoma: 1

RV
- Myxoma: 2
- Echinococcus cyst: 1
- Thrombus: 1
- Melanoma: 1
- Total: 5

LA
- Myxoma: 24
- Thrombus: 6
- Sarcoma: 3
- Rhabdomyoma: 1
- Total: 34

LAA
- Fibroelastoma: 1

MV
- Fibroelastoma: 3

Aortic valve
- Fibroelastoma: 5

LV
- Thrombus: 3
- Fibroma: 2
- Met breast ca: 1
- Total: 6
Tumor Characterization

- Location
- Morphology and relationships
- Fat suppression
  - Lipomas
- Perfusion
  - Vascular vs non
- Enhancement
  - Tissue components and vascularity
Case 1 – 57 yo man

- Presents to ED
  - Cough, dyspnea, atypical chest pain
- Hx CABG, HTN
- CXR, MPI normal
- Echo ordered
MRI characterization - invasive
Perfusion and delayed enhancement
FINDINGS:
Malignant tumor.

The patient has a tumor that is characteristic of a malignancy. It is large and multilobular. On the surface of the anterior right ventricle, it measures 9 cm laterally and 6 cm anterior posteriorly. The tumor has invaded through the right ventricular wall and spans a good deal of the base of the right ventricle and right atrium. It is also invasive into the left ventricle basilar region. The tumor does not enhance with gadolinium early but is relatively delayed after the ventricular myocardium on first pass imaging. On delayed enhancement imaging, it has an extremely heterogenous pattern with portions of the tumor being hyperintense and portions being extremely dark. This is reportedly one pattern seen in lymphoma. However, this is not a specific finding. Incidental note is made of a tumor mass in the superior portion of the left mediastinum adjacent to the transverse aorta in the anterior region. Further information could be obtained by a CT scan of the thorax.

Atria: The atria are roughly normal in size.

Myocardial function: The diastolic portion of the myocardial contraction pattern is grossly abnormal due to the massive nature of the tumor. Global systolic function is roughly normal and could not be reliably measured due to the size of the tumor. Left ventricular ejection fraction is 55%, end-diastolic volume is 93, end-systolic volume is 42.

Pericardium: There is a moderate sized circumferential pericardial effusion without evidence of tamponade. There is a well defined discrete substantial amount of fluid that separates the heart and would make percutaneous pericardial centesis a feasible option. There is no evidence of large tumor mass in the pericardium.

ASSESSMENT:

Large invasive tumor mainly located on the anterior surface of the right atrium and right ventricle with invasion into the bodies of those chambers and extension around the inferobasal region of the heart including the left ventricle. The heterogenous nature of the enhancement suggests that this could be a lymphoma but other tissue types cannot be excluded. In addition, there is a superior mediastinal mass of substantial size and this should be further investigated with a CT scan if possible. The patient is reportedly sensitive to iodinated contrast so that should be taken into account.

Interpreted By: Raff, Gilbert L, MD
Dictated by: Raff, Gilbert L, MD
Electronically Signed By: Raff, Gilbert L, MD on 3/10/11 1:06 PM
1 yr later: p radiation and chemoRx
Case 2 – multiple ED visits

CHIEF COMPLAINT: Per translation through the daughter, "I have been having neck and head pressure. Also some pressure under my breast bone. I do not feel well sometimes so I came to the hospital."

HISTORY OF PRESENT ILLNESS: Mrs. , a 54-year-old Chaldean female who speaks little English, so her history is gathered through interpretation of her daughter who is at the bedside. Apparently she has been having multiple episodes of not feeling well. She complains of pressure in her neck and in her head as well as a squeezing pressure. She also points to under her breast bone bilaterally where she had some pressure. It does not radiate to her arms or back. Presumably, the chest pressure does radiate to the neck and to the head. She denies any nausea, sweats, fever, cough, vomiting, diarrhea. She says the neck and head pressure come and go. She does have a history of high blood pressure and high cholesterol for which she takes prescription medication. When she is given a prescription medication, she does feel better. She was seen at William Beaumont Hospital in May in 2009 for some elevated blood pressure and chest discomfort. At that time, she refused admission and was discharged home to follow up with her primary care physician. During that time, she did not have any tests done in terms of stress test or echocardiogram because she refused admission. However, this time she is admitted to the hospital and she will be slated for stress MPI with Dobutamine later today.
Read as negative
ECG
ECP Plan

- Admit to RO AMI
- Cardiology consult
- Stress MPI
- Echo
Impressions:
There is a small pericardial effusion. A solid mass of approximately 5cm in diameter is noted within the visceral pericardium compressing the distal half of right ventricle. Does not appear to infiltrate the myocardium. Relatively homogeneous echogenicity. The left ventricular chamber size is normal. The visually estimated ejection fraction is 65%. There is normal left ventricular ejection fraction.
CTA
Perfusion and enhancement
Case 2 Summary

- Large avascular mass noninvasive spherical mass in pericardial space
- Complex internal structure – thick wall
- No enhancement, no blood supply
- Usually hematoma but no trauma
- Chaldean origin – echinococcous is endemic
- No answer yet!
Case 3

• 82 yo man transferred from another hospital
• Recurrent pulmonary emboli
• Echocardiogram done there to exclude RVE discerned a possible mass in the main PA
Cardiac MRI orthogonal views
Low vascularity – mainly thrombus?
Pulmonary Artery Intimal Sarcoma Masquerading as Pulmonary Embolism
Andrew O. Zurick III, Veronica Lenge De Rosen, Carmela D. Tan, E. Rene Rodriguez, Scott D. Flamm and Paul Schoenhagen

_Circulation_ 2011. 124:1180-1181
doi: 10.1161/CIRCULATIONAHA.111.026807
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Copyright © 2011 American Heart Association. All rights reserved. Print ISSN: 0009-7322. Online ISSN: 1524-4539
A. Two-dimensional transesophageal echocardiography reveals an echogenic mass present in the right ventricular outflow tract and proximal main pulmonary artery.

Zurick A O et al. Circulation 2011;124:1180-1181
Computed tomographic chest post contrast reveals a large mildly expansile mass in the main pulmonary artery that extends into the right and left pulmonary arteries.
Magnetic resonance imaging of the chest.

Zurick A O et al. Circulation 2011;124:1180-1181
Case 3 - Summary

- Review with referring physician
  - Patient elderly
  - Tumor most likely sarcoma
  - Not resectable
  - Rx with anticoagulation
Summary: Dx of tumors

• Location
• Morphology and relationships
• Fat suppression
  – Lipomas
• Perfusion
  – Highly vascular vs myovascular vs avascular
• Enhancement
  – Tissue components
Thank you for your attention!