Composite Tumors in Abdominal-Pelvic Imaging
Radiologic & Pathologic Correlation

Paul Tung DO, Michael Mousa MD, Mohammad Helmy MD,
Roozbeh Houshyar MD, Chandana Lall MD
Disclosure

Authors do not have any financial or other relevant disclosures.
CONTENT ORGANIZATION

• Definition of Composite and Collision tumors & differentiation of the two
• Genetics of COMPOSITE neoplasms
• Illustration of specific examples of composite tumors
  o -Hepatobiliary Composite & Collision Tumors
  o -Genitourinary Composite & Collision Tumors
  o -Pelvic Composite & Collision Tumors
• Importance of an accurate imaging diagnosis in appropriate management
• Conclusion
• References
Definition: Collision tumors

**Collision tumors** refer to two distinct neoplasms, usually of different biological behavior and histology, which coexist within a single organ.

In contrast to *composite tumors*, collision tumors remain histologically distinct. Although rare, it is important to clinically recognize these tumors since if biopsy of only the benign component is performed, this can have adverse consequences.
Composite tumors: Comprised of two tumors of different origins, pathology & phenotype in close proximity with actual histologic intermingling of tumor cells.

Presence of two different cell types can lead to perplexing imaging findings, which at times, makes the diagnosis challenging and may necessitate biopsy in more than one part of the tumor for accurate pathologic confirmation.
Pathogenesis of Collision & Composite tumors

COINCIDENCE
Two primary neoplasms integrating due to proximity & contiguity

Two tumors originating at one location due to ALTERED cellular microenvironment & COMMON carcinogenic stimuli

MICROENVIRONMENT CHANGES created by the first tumor leads to the development of the second tumor
Hepato-Biliary Composite Tumors

- The commonest composite tumor is a combined hepatocellular (HCC) and Cholangiocarcinoma (CC). This is a primary liver tumor showing dual hepatocellular and biliary epithelial differentiation. Presents as a diagnostic dilemma & misdiagnosis based on imaging can have drastic consequences.

- Studies have suggested that combined HCC-CC is genetically more similar to CC than HCC with common carcinogenesis pathways altered in HCC-CC and CC.

- CT guided biopsy should target specific suspected components with a note to the pathologist to conduct special staining for both tumor types. Final Diagnosis is on H&E stain + IHC markers.

**Immunohistochemistry (IHC) markers:**

- Biliary markers: Keratin 7 & 19
- HCC markers: CD10, polyclonal CEA
Classification systems of combined HCC-CC tumor:

1. Tumor demonstrates peripheral enhancement in early phase with hyper-enhancement in the central portion of the tumor and peripheral washout in the delayed phase.

2. Tumor can demonstrate enhancement on the arterial phase and then washout on the delayed phase, following the HCC tumor pattern of enhancement.

3. Tumor can demonstrate enhancement patterns of both HCC and CC, with the HCC component showing early enhancement with delayed washout and the CC component showing delayed enhancement.

- **CLUE:** Simultaneous elevation of CA19-9 & AFP

- **CLUE:** Presumptive Imaging of HCC & Ca19-9 elevation or imaging of CC with AFP elevation
Composite HCC-Cholangiocarcinoma

65 year old woman with abdominal pain. Multiphasic CT abdomen demonstrate a large heterogeneously enhancing mass in the left hepatic lobe with progressively enhancing peripheral component.

Pathology was cholangiocarcinoma (blue arrow) Briskly enhancing peripheral component corresponded to classic HCC (yellow arrows). The enhancement characteristics suggested HCC-CC. Alpha fetoprotein was > 65,000 & CA19-9 was elevated.

Histopathology shows admixture of classic HCC (black arrow) and gland forming Cholangiocarcinoma (white arrow)
59 M with H/O chronic Hepatitis B & AFP elevated to 3141 ng/ml with elevated CA 19-9. Progressively enhancing component within the liver lesion with imaging features of HCC-CC.

**PATHOLOGY**
H & E stain at 4x & 10x magnification shows classic sinusoidal HCC component (black arrow) & gland forming cholangiocarcinoma component (white arrow).
64 year old Asian male with cirrhosis and liver mass. Small arterially enhancing focus (yellow arrow) with progressive peripheral enhancement in the portal and delayed phases (black arrow). This was a pathologically proven composite, **HCC-CC**.
57 year old male with **composite HCC** and **CC**. Multiphasic CT abdomen & pelvis demonstrate a large heterogenously enhancing mass in Segment VI, with enhancement characteristics suggestive of mixture of HCC and CC. The mass shows a distinct delayed enhancing component which was pathologically cholangiocarcinoma (yellow arrow) and a briskly enhancing component with definite washout representing the HCC component (red arrows). Alpha fetoprotein was elevated over 140,000 and CA19-9 was moderately elevated.

**Immunostains:**
- Biliary stain: + for keratin 7 + for MOC-31 & Hepatocellular stain: + for Hep-Par
A 62-year-old female with a history of clear cell bladder cancer, melanoma, and basal cell carcinoma presented with a collision of focal nodular hyperplasia and poorly differentiated carcinoma. Multiphasic CT shows a 3 cm left lobe liver lesion with brisk enhancement (red arrow) on the arterial phase enhancement, followed by 3 minute delayed washout laterally (white arrow) and contrast retention medially (yellow arrow).

**Biopsy Area 1 (YELLOW ARROW)**
FNH and steatohepatitis. No malignancy.

**Biopsy Area 2 (WHITE ARROW)**
Poorly differentiated carcinoma.
**Renal Collision Lesions:**

<table>
<thead>
<tr>
<th>Collision renal tumor</th>
<th>Collision of simple and complicated cysts is common.</th>
<th>Collision of solid and cystic lesions is less frequent.</th>
<th>Collision of solid renal lesions is a rarer event</th>
</tr>
</thead>
<tbody>
<tr>
<td>A single mass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>comprising of two</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>distinct, synchronous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>primary neoplasms or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a primary and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>metastatic lesion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>occurring by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>incidence in one</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>anatomic location in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the kidney</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Collision Tumors

CYSTIC
These include a combined cystic lesion with different components

BENIGN + BENIGN
Collision of solid benign tumors like angiomyolipomas (AML’s) and hamartomas

BENIGN + MALIGNANT
Solid tumor collision of a benign and malignant entity eg renal cell carcinoma (RCC) subtypes with AML

MALIGNANT + MALIGNANT
Typically collision lesions involving 2 solid tumors of renal origin. A combined renal and non-renal origin collision is rare
A 56 year old woman with collision of simple and hemorrhagic cyst. (A, B) Axial T1WI in and opposed phase (C D) T2WI and post contrast T1WI, show two cystic lesions with varying MR signal and lack of enhancement (arrows and arrowhead)
52 year old woman with composite Angiomyolipoma (AML) and Clear cell renal cell carcinoma (RCC).

Fig A: The initial CT scan showed a fat containing mass with features of AML. However, there is an enhancing component on the medial aspect of the mass (arrow), not appreciated on initial interpretation, consistent with CC-RCC component.

Fig B: A subsequent surveillance CT 2 years later, shows marked growth of the RCC component, which in part may be related to rich vascularity and nutrients provided by the AML.

Case courtesy of Cooky Menias, Mayo Scottsdale, Az.
Collision Cyst and Neuroendocrine tumor

34 year old woman with composite solid neuroendocrine tumor (NET) within cystic less cellular component. History of left flank pain and hematuria. Multiphase CT images (A and B) post contrast cortico-medullary and nephrographic phases, demonstrate an enhancing nodule (arrows) within a less enhancing area (arrowheads). Fig C. Histopathology: Hematoxylin eosin stain revealed a NET with central densely packed cellular elements (arrow) and the periphery shows less cellular areas (arrowheads), corresponding to imaging findings.
True composite tumors in the kidney are a rare finding & should be differentiated from the more common scenario of two synchronously occurring renal tumors.

- Important differentiating feature is the presence of normal renal parenchyma separating two tumors of different histology without admixing on a cellular level.

- The merging of two different tumor types with different pathology, vascularity and physiology leads to an appearance & enhancement pattern not typical for any one lesion.
47 year old man with composite clear cell renal cell carcinoma (RCC) with chromophobe components

**Fig A**: CT imaging with IV contrast - heterogeneously enhancing right renal mass with nodular more intensely enhancing peripheral areas consistent with clear cell RCC component (arrow) and less enhancing areas (arrowheads) consistent with chromophobe tumor.

**Fig B**: Histopathology: Hematoxylin eosin stain, shows larger peripheral clear cell RCC (white arrows) and nests of chromophobe tumor, which show blue staining with colloidal iron (arrowheads)
Histopathology, hematoxylin eosin stain, peripheral clear cell RCC (black arrow) and nests of central papillary RCC forming a papillary pattern (red arrow). Imaging details on NEXT SLIDE.
57 year old man diagnosed tumor, renal cell carcinoma (RCC) with clear cell and papillary components

Fig A-D: Renal MRI with Gadolinium
Large right renal mass with heterogeneous intermediate T1 signal (A), **mainly low T2 signal** (B) typical for Type 1 papillary RCC, with progressive **nodular peripheral enhancement** (D) consistent with clear cell RCC component [arrows]

Fig E and F: **Diffusion weighted images** (DWI) at B 800 and ADC map, demonstrate **restricted diffusion** of the clear cell RCC component [arrowheads]
67 year old male with composite CC-RCC with Sarcomatoid focus. The sarcomatoid area centrally shows differential signal & restricted diffusion. Axial T1W1 shows the small hemorrhagic sarcomatoid focus within the right renal mass (red arrows). NOTE: The majority of the lesion was CC-RCC with a small sarcomatoid focus present (red arrow).
67 year old man with large left renal mass. **Imaging**: Heterogeneously enhancing renal mass. CT with contrast-enhancing peripheral areas c/w clear cell RCC (arrow) & poorly enhancing central area. **Pathology**: Chromophobe cells on left of slide c/w RCC (white arrow) & classic spindle cells on the right- **Sarcomatoid** elements (black arrow)
Tumor to Tumor metastasis

- Co-occurrence of two or more primary malignancies at one site

- RCC is the most common recipient (40-70%) & lung cancer is the most common donor (40-50%)

- Concept is based on “seed and soil theory” proposed by Paget (Lancet published in 1889)

- *Recipient tumor is the true tumor & the two tumors exist as a composite lesion*
79-year-old man with history of lymphoma. US evaluation for hematuria shows a solid heterogenous echogenic mass, which prompts CT work up. CT imaging shows a solid heterogenous mass with discrete enhancing solid areas at the periphery (yellow arrows) with less enhancing central area (blue arrows).

**PATHOLOGY:** Clear cell RCC centrally with peripheral lymphoma deposits growing at periphery of the RCC

**DIAGNOSIS:** RCC + CLL

**TUMOR TO TUMOR METASTASIS**
43 year old female with composite of papillary serous neoplasm developing in collision a mature cystic teratoma (MCT). There is a large ovoid mass in the right ovary containing a fat containing lesion compatible with teratoma (yellow arrow) and a large multiseptated cystic mass component is compatible with the papillary serous neoplasm (blue arrow)
66 year old female with composite of squamous cell carcinoma (SCC) developing in a mature cystic teratoma (MCT). There is a large ovoid mass in the right ovary containing a fat fluid layer, focal calcification and an ovoid soft tissue and fat containing mass. The solid areas were compatible with SCC. Suspicious features are postmenopausal age, large MCT (~15 cm), and solid components.
Conclusion

- Differences between abdominal & pelvic Composite and Collision tumors have been reviewed in these illustrative cases with Imaging-Pathologic correlation.

- **Composite tumors** have a common cellular origin with intermingling of cells on histology while **Collision lesions** are simply adjacent abutting lesions in the same organ.

- Presence of two different cell types can lead to perplexing imaging findings, which at times, makes the diagnosis challenging and may necessitate a biopsy for confirmation.

- Although rare, it is important to clinically recognize these tumors since biopsy of only the benign component can have adverse consequences.

- The appearance of collision and composite tumors is atypical for any single histopathologic tumor type, but rather an exceptional imaging appearance, at times combining characteristics of both tumors.


