Hi, this is Dr. Jeff Klein, editor of RadioGraphics and welcome to the RadioGraphics audio summary podcast. Each issue, I will be highlighting a few of our articles that I think are important.

**MRI for Radiation Therapy Planning in Human Papillomavirus–associated Gynecologic Cancers**


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HPV-associated cervical, vaginal and vulvar cancers are treated primarily with radiation therapy. MR is integral to proper patient selection and treatment planning, as detailed in this women's imaging paper in the current issue of RadioGraphics. Following a brief review of the association of HPV and gynecologic cancers, the article reviews the epidemiology, risk factors and clinical presentation of these malignancies, followed by a discussion of target and dose concepts for the use of external beam radiation therapy and brachytherapy; this includes the definitions of gross tumor volume (typically that which can be seen, palpated or imaged), clinical tumor volume (which is gross tumor volume plus a margin of suspected subclinical microscopic disease), and planned tumor volume, which accounts for inconsistencies and organ motion. Next is the review of the role of MR in planning treatment; it is proven superior to CT and clinical exam in this regard, and as such has been incorporated into guidelines by European Society for Radiotherapy and Oncology (ESTRO). Details on pelvic MR protocols for treatment planning, assessment during therapy, and post-treatment surveillance are given and are summarized in Table 1. The article details normal and pathologic MR imaging findings and then provides correlation between FIGO stage-specific features for cervical, vaginal and vulvar malignancy and MR findings in Figures 8-14. This is followed by a discussion of the radiotherapy protocols used to treat each of these three malignancies. MR is also used to assess brachytherapy implant placement and this subject is reviewed in detail. MR plays an important role in the detection of disease progression or recurrent disease which is seen as hyperintense mass on T2-weighted MR imaging. Emerging evidence supports the use of diffusion-weighted imaging and dynamic contrast enhancement for assessing treatment response in cervical cancer. Finally, there remain challenges in the use of MR in this setting including magnet access following brachytherapy implantation, geometric distortions in images, organ motion for treatment planning and protocol standardization.

**Bands in the Heart: Multimodality Imaging Review**


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In their multimodality review of bands in the heart, Dr. Prabhakar Rajiah and colleagues from Texas, Iowa, New York, Ohio, and Mexico divide these structures into normal structures or normal variants, aberrant structures, or pathologic entities. The article provides a review of the various imaging modalities utilized to evaluate the heart including echocardiography, MR and CT. Beginning with normal structures or variants, the crista terminalis within the lateral right atrium is nicely illustrated in Figures 2-4 in the article. The taenia sagittalis or sagittal bundle divides the right atrium into anteromedial and posterolateral compartments as seen on axial images and is so named because of its wormlike appearance. The Chiari network is seen in 2-14% of the population and appears as a web-like structure in the right atrium near the IVC ostium; it has a high association with a patent foramen ovale, seen in 83% of patients. A comadine ridge reflects an infolding of the left atrial wall between the left superior pulmonary vein and left atrial appendage, while a moderator band is a prominent muscular ridge in the RV extending from the interventricular septum to the anterolateral free wall of the right ventricle. The final normal structures illustrated are the papillary muscles and chordae tendineae. Aberrant structures that can be encountered on cross-sectional imaging include aberrant papillary muscles, which can be clinically significant when associated with hypertrophic cardiomyopathy and in certain cases can cause left ventricular outflow tract obstruction. Similarly accessory chordae tendineae may be asymptomatic or result in mitral valve prolapse or regurgitation; this has also been associated with Down or Noonan syndrome and trisomy 18. Accessory mitral valve tissue is rare and can be asymptomatic or associated with left ventricular outflow obstruction and related symptoms. Aberrant ventricular bands or false tendons are fibrous or muscular structures within the ventricular chambers and are generally of no clinical significance. Pathologic conditions reviewed include double chambered right ventricle, also known as sub-infundibular stenosis, which can be congenital and is highly associated with VSDs or is seen after VSD repair, and double-chambered left ventricle, which is congenital. Cor triatriatum is a congenital anomaly where the atrium is divided by a septum into two chambers; the clinical relevance relates to the degree of obstruction; Figures 23 and 24 in the article show examples on echocardiography, MR and CT. Subaortic stenosis is a congenital anomaly producing obstruction of the left ventricular outflow tract. Finally, Shone complex is comprised of multiple left-sided obstructive cardiovascular lesions including supravalvular left atrial ring, parachute mitral valve, subaortic stenosis and aortic coarctation; Figure 26 and Movie 8 show an example.
Image-guided Preoperative Localization of Pulmonary Nodules for Video-assisted and Robotic Assisted Surgery


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This article from the thoracic interventional radiology groups at four North American institutions describes 5 image-guided techniques utilized in the preoperative localization of small and subsolid lung nodules undergoing resection using minimally-invasive surgical techniques such as VATS. The article begins with a discussion of patient assessment prior to pulmonary nodule localization. For those localization procedures that require the radiologist to minimize the time between the localization and resection, which include methylene blue or technetium injection or hook-wire placement, greater coordination between health care teams is necessary. The review of these procedures begins with methylene blue staining of the pleura overlying the nodule, with 3 ml injected through a 22-gauge needle into the nodule and up to the pleural surface during needle withdrawal. For technetium 99m macroaggregated albumin injection, 0.2 – 0.4 mCi of the agent is injected directly into the nodule; there are regulatory requirements for its use in some states. Contrast can be added to the solution to aid in post-injection visualization. Hook wire localization involves placement of a needle through the nodule via the shortest intercostal pathway and deployment of the hook by allowing the hook wire to expand and engage upon withdrawal of the guide needle. It is important not to fix the deployed wire to the skin as this may lead to the wire pulling out of the lung during lung deflation. Fiber-coated microcoil placement to mark the deep and superficial edges of the nodule involves more precise measurement of the coil when loaded into the introducer needle to achieve proper deployment in the lung. Figure 11 illustrates how microcoils are deployed while Figure 12 shows a CT image of a properly-deployed microcoil. Radio-opaque gold fiducial markers positioned into or close to a nodule can be placed via a 19-gauge introducer needle similar to that used for coaxial lung biopsies. An advantage of fiducial marker placement is the ability to perform a biopsy via the introducer needle thereby obviating the need for frozen section intraoperative examination of resected nodules.

Image Features of Succinate Dehydrogenase–deficient Pheochromocytoma-Paraganglioma Syndromes


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Paragangliomas (abbreviated PGL) and pheochromocytomas (abbreviated PC) are neuroendocrine tumors that can arise anywhere from the skull base to the pelvis (Figure 1 provides an illustration of their distribution in the body) and while often asymptomatic can produce symptoms from mass effect or due to excess catecholamine production. It is recognized that 40% of all paragangliomas or pheochromocytomas are linked to germline mutations, with most of these mutations in the subunits of succinyl dehydrogenase or SDH enzyme. Table 1 shows the five different PC-PGL syndromes, their specific genetic mutations, and the specific tumors seen in each syndrome. The article provides a detailed review of the genetic basis of these SDH deficiency syndromes and also discusses tumors such as renal cell carcinoma, GISTs and pituitary tumors that can be associated with these PC-PGL syndromes. The article discusses the use of anatomic and functional imaging in the diagnosis and surveillance of affected individuals. There is an extensive review of specific SDH-associated tumors beginning with head and neck paragangliomas that develop at four typical sites; the carotid body, jugular foramen, along the course of the vagus nerve and within the middle ear cavity. Characteristic imaging features on US, CT, MR and FDG- and DOTATATE-PET scans are illustrated in multiple case examples. Thoracic paragangliomas typically arise in the middle or posterior mediastinum, while abdominal paragangliomas are distinct from adrenal medullary pheochromocytomas and arise in the Organs of Zuckerkandl in the region of the inferior mesenteric artery; the bladder wall is a well-recognized but uncommon site for these tumors. Pheochromocytomas typically arise from the adrenal medulla, demonstrate avid contrast enhancement on CT, and have a variable appearance on MR depending on size. Radionuclide imaging options include metaiodobenzylguanidine or mIBG which is specific but relatively insensitive for pheochromocytomas aside from larger adrenal lesions, and may play a role in theranostics for those with mIBG-avid malignancies. A range of PET tracers includes 18F-FDG which outperforms mIBG and anatomical imaging for the detection of metastatic disease. Gallium-68 DOTATATE is emerging as the gold standard for functional imaging of neuroendocrine tumors aside from adrenal pheochromocytomas due to normal physiologic adrenal uptake. The article concludes with a brief discussion of the role of imaging in treatment planning including the use of imaging in active surveillance of slow-growing head and neck paragangliomas. The final section touches on challenges of lifelong screening of SDH mutation carriers.
Interpreting Radiographs with Concurrently Obtained Patient Photographs
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In this fascinating Informatics article in the current September 2019 issue of the journal, Dr. Srini Tridandapani and colleagues describe the implementation of a technology at a large university hospital that automatically obtains point-of-care patient photographs at the time of portable radiography. The goals of this pilot study were to help identify wrong patient errors, provide quality improvement information, and to aid in the interpretation of the radiographic studies. The setup is as follows: a camera is mounted on the portable radiography machine x-ray head and is exposed simultaneously with the radiograph. The camera communicates with an integration server via Wi-fi with a time stamp and machine identifier which also appear in the DICOM header of the radiograph. Once the server queries the PACS for corresponding studies with the same time stamp and machine identifier, the DICOM header is retrieved by the server, the BMP photograph is converted into DICOM format, and the photographs sent as a separate series in the appropriate study; the entire workflow is illustrated in Figure 1. The article then describes the impact of this system on quality control issues, first by helping to identify that the wrong patient was associated with a particular examination. Other quality issues attributable to access to the photographs include providing information on patient positioning, documenting proper lead shielding of patients, and addressing questions of laterality. In assisting with the interpretation of radiographic studies, radiologists can assess physical findings that can aid in the detection of abnormalities (an example is a foot ulcer in a patient with foot radiographs obtained to exclude osteomyelitis), help assess the relative supine vs upright position of patients being assessed for free air, and provide information regarding monitoring and support devices and patient vital signs that can help in differential diagnosis. Unnecessary phone calls to assess for tubes and lines no longer visible on the radiographs can be obviated by reviewing the photographs for their presence or absence on the patient. The availability of the photographs represents a new way to physically assess patients and correlate the external (photographic) with the internal (radiographic) appearances. The paper concludes with a section on the historical use of photography in medicine.

Clinical, Imaging, and Pathologic Features of Conditions with Combined Esophageal and Cutaneous Manifestations
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In this multi-institutional study the authors detail a variety of disorders that affect the skin and esophagus which radiologists may encounter in practice. Given the similar developmental origins of these two organs with both lined by stratified squamous epithelium, the association of cutaneous and esophageal manifestations is not unexpected. The article has a consistent structure, with a clinical vignette describing the affected patient followed by an in-depth discussion of the specific entity. The first section describes infectious diseases such as Herpes Simplex Virus infection, Candida esophagitis and HIV esophagitis and various HIV-associated cutaneous manifestations. Bullous diseases include epidermolysis bullosa, which produces upper-third esophageal strictures and pemphigoid disorders including bullous pemphigoid which are associated with upper esophageal webs and strictures. Connective tissue diseases include systemic sclerosis or scleroderma with its characteristic dilation of the distal esophagus with normal upper esophageal motility and an aortic or aperistaltic lower 2/3rds of the esophagus; distal reflux esophagitis and esophageal strictures can eventually develop. Moving to inflammatory diseases, lichen planus causes purple itchy skin papules and long segment esophageal narrowing from stricture. Crohn disease can produce cutaneous lesions and rarely affects the esophagus, but when seen can produce ulcerations, strictures, thickened folds, and intramural sinus tracks and fistulas. Genetic conditions such as Cowden syndrome or multiple hamartoma syndrome produces a nodular-appearing esophagus with small round or oval mucosal plaques or nodules at esophagography. Malignant conditions include primary or metastatic melanoma and a rare paraneoplastic condition called Acrokeratosis paraneoplastica that produces pruritic and painful erythematous hyperkeratotic plaques along the hands, feet, nose and ears in association with an aerodigestive malignancy. It is most commonly seen in squamous cell carcinoma including that arising in the esophagus. Finally, drug-induced esophagitis due to medications such as doxycycline may be associated with phototoxic skin eruptions on sun-exposed skin. Tables 1 through 7 provide summary material on each of the 7 groups of diseases reviewed in this article.

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