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Transcatheter Aortic Valve Replacement (TAVR) is percutaneous placement of prosthetic aortic valve under angiographic guidance. It is considered useful for patients with severe aortic valve stenosis, especially those at higher risk for open heart surgery. Recently, TAVR has also been offered to patients at intermediate or low risk for conventional surgery.

ECG-gated multislice CT plays an essential role in TAVR planning. It evaluates the aortic valve, aorta and iliofemoral arteries to ensure the selection of appropriate candidates, prosthesis types and treatment approach. A remarkable advantage of using ECG-gated CT for measurements of the aortic valve complex is its high reproducibility with excellent inter- and intrareader correlations.

The UCI CT protocol for TAVR consists of a combination of ECG-gated cardiac CT scan and whole-body CT angiography which allows for evaluation of the aortic valve, aortic root and coronary arteries and the luminal size. It also assesses tortuosity of the aorta and iliac or subclavian arteries for the TAVR procedure access planning. High spatial and temporal resolution of state-of-the-art multislice CT scanners at UCI with 256 detectors and 0.27 second gantry rotation, and ECG-gating enable state-of-the-art evaluation of the aortic annulus. This CT scanners’ highly reliable depiction of the aortic valve and root anatomy allow for the appropriate selection of the valve prosthesis size which is of fundamental importance to prevent potentially postprocedural complications such as prosthesis embolization or para-valvular regurgitation.

The acquired TAVR CT protocol images are then postprocessed and analyzed by our subspecialty fellowship trained cardiothoracic radiologists using FDA approved dedicated cardiovascular imaging software. CT data are reconstructed into high-resolution axial, coronal and sagittal images and postprocessed multiplanar and 3D images with a structured report containing crucial measurements to aid the interventional cardiologist and surgeons during patient selection and procedure planning.

In the TAVR cardiac CT protocol, UCI cardiothoracic radiologists identify the reconstructed cardiac phase with the largest annular dimensions without motion artifacts from the multiphasic datasets to ensure precise measurements and appropriate device sizing. To accomplish this, they use retrospective ECG-gating scan with radiation dose modulation during systolic phase of the cardiac cycle, allowing for lower total radiation exposure. The imaging plane for the measurements is carefully selected because of the changes in the orientation of the annular plane throughout the cardiac cycle. Radiologists measure the aortic annulus luminal contour within plane at the most basal attachment points of the cusps of the three aortic valve leaflets. Important measurements

**Figure 1:** TAVR planning CT reconstruction with measurement of left main coronary origin height. Purple line = aortic valve annulus plane; blue line: coronary height.

**Figure 2:** Perpendicular plane reconstruction image through the aortic valve annulus with measurements of diameters, area, and circumference.
include the annular area, diameters and perimeter which are larger in the systolic phase. The systolic assessment of the aortic annulus has been recommended in the recent guideline for avoiding unintended under sizing of the aortic valve prosthesis. Other important findings and measurements are the heights of the ostia of the coronary arteries, calcium score of the aortic valve and calcifications of the left ventricle outflow tract (LVOT).

In TAVR, CT is also the gold standard imaging modality for evaluation of the coronary arteries. Candidates of TAVR are usually older and have several risk factors of coronary artery disease. The ECG-gated CT scan allows for evaluation of coronary artery stenosis which is important in cases of severe aortic valve stenosis for the appropriate selection of treatments and precise risk assessment in TAVR candidates. Both, the cardiac ECG-gated CT and whole-body CT angiography components of the study are performed in seconds with a single intravenous administration of contrast media.

At UCI Medical Center, our mission for optimal care of TAVR patients goes even further, as we review every TAVR patient candidate clinical status and CT studies during a weekly multidisciplinary conference with our TAVR team of cardiologists, cardiovascular surgeons and cardiothoracic radiologists to ensure optimal patient selection and treatment planning. Teamwork between cardiothoracic radiologists, interventional cardiologists and cardiothoracic surgeons is essential for great outcomes in a TAVR program.

Our subspecialist diagnostic and interventional radiologists are essential to our multidisciplinary team approach to patient care at UCI. As the only academic radiology department in Orange County, UCI Radiology continues to innovate and excel in medical imaging research and clinical care. We believe that artificial intelligence (AI) is an essential component of radiology and it will enhance patient care by improving image acquisition and diagnosis. In this newsletter, we explore how our nationally-renowned faculty are designing and applying AI algorithms to stroke research to improve patient outcomes. We also highlight some of the advanced services in cancer diagnosis and treatment, cardiac valvular disease and musculoskeletal imaging that are being offered at UCI Radiology. Although a pandemic is expected to bring things to a halt, our Radiology Team works harder than ever and remains focused on bringing state of the art medical imaging to our patients.

Vahid Yagmai, MD, MS, FSAR
Professor and Chair
High-resolution MRI of the wrist with 3T MRI:
State-of-the-art imaging of wrist ligaments

Hiroshi Yoshioka, MD, PhD

MSK section at Department of Radiological Sciences at UCI Medical Center is providing state-of-the-art high-resolution MRI of the wrist. This advanced imaging that uses 3T MRI scanners includes isotropic 3D fast spin echo (FSE) proton density-weighted sequence with or without fat suppression, obtained with a 7 cm field of view (FOV), 0.35 mm voxel size, and approximately 5 minutes scan time.

55 year old female: TFCC injury (MR arthrogram at 3T)

Originally, this isotropic 3D FSE sequence was developed by research collaboration between Philips Healthcare and UCIMC radiologists. It is now available as part of routine clinical imaging for our patients at UCIMC. Many peer-reviewed scientific articles have been published by UCI physicians showing the advantages of this high resolution scanning. Isotropic 3D MRI of the wrist allows us to evaluate small complicated ligaments and other structures of the wrist, especially the triangular fibrocartilage complex (TFCC), otherwise difficult to see with other techniques. The TFCC is a fibrocartilage–ligament complex which stabilizes the distal radioulnar joint of the wrist, transmits axial load between the carpus and the ulna, and stabilizes the ulnar aspect of the carpus. The most common mechanism of injury is a fall onto an outstretched hand. Patients at the greatest risk for TFCC injury are athletes involved in high demand sports such as tennis players and gymnasts. The patient presenting with wrist pain of ulnar structural origin may present with either diffuse pain referred across the wrist or focal ulnar-sided pain. Pain is exacerbated by activities or positioning involving ulnar directed wrist deviation and forearm rotation. MR wrist arthrogram is often used to image the TFCC, allowing for improved visualization of the closely grouped ligamentous structures following distention of the joint with injected contrast. When evaluating isotropic 3D images, we use a real-time multiplanar reconstruction (MPR) function at workstation, which is able to more accurately demonstrate a focal tear of the TFCC and other subtle pathologies.

References
Stroke is one of the leading causes of death worldwide. Morbidity is high, with over half of stroke victims left chronically disabled. Dr. Jennifer Soun, an Assistant Professor in Radiological Sciences at UCI, is working closely with the Center for Artificial Intelligence in Diagnostic Medicine (CAIDM) and the stroke interdisciplinary team consisting of neurologists, neurointerventionalists, and radiologists to help validate and deploy AI-based tools for stroke triage.

Recent clinical trials in the extended time window have shown promising outcomes for thrombectomy, with the approximate number needed to treat for revascularization to show clinical benefit as less than 3. Thus, establishing criteria to allow for more patients to benefit from treatment is of strong clinical interest. In recent years, there has been a shift from the singular paradigm of “time is brain” to a model incorporating various physiologic factors such as collateral status, which likely is a major determinant of revascularization rates, tissue fate, and extended window eligibility. However, current grading systems rely on heterogeneous non-standardized methods and subjective visual inspection which limit uniform application of collateral assessment in stroke treatment decision-making. Our group has recently developed a comprehensive deep learning-based cerebrovascular tracing tool for detection of proximal vessel occlusion. We plan adapt the algorithm to quantify collateral assessment on CT angiography (CTA) and identify phenotypic collateral patterns predictive of imaging and clinical outcomes (Figure 1).

Our group has also developed AI tools to detect intracerebral hemorrhage (ICH). One particular area of interest is in ICH expansion which has been shown to be an independent predictor of mortality and functional outcome, with each milliliter of expansion increasing the chance of functional dependence by up to 7%. However, detection of ICH expansion can be inaccurate and subjective based on current methods, and thus may misguide treatment decisions. One deep learning AI-based tool that UCI radiologists created is able to detect acute intracranial hemorrhage expansion with >99% accuracy and outperforms a traditional ABC/2 estimative approach (Figure 2). In addition, the AI-based tool is much faster at estimating ICH volume compared to a human reader. This work was presented at the 2020 International Stroke Conference, and our next step is application in the ER and inpatient setting in a prospective study.

These AI tools leverage the accuracy, speed, and quantitative nature of deep learning approaches to noninvasively and objectively characterize various components of the stroke triage pathway. In the future, UCI radiologists hope to deploy these tools in the clinical work setting to aid in treatment selection and improvement of clinical outcomes.
There are over 50,000 new cases of RCC diagnosed each year in the United States. Many of these masses are detected on routine imaging performed for other reasons. There has been increasing interest in treatment of these small lesions due to advancements in percutaneous ablation techniques. Cryoablation has emerged as a viable alternative to surgical techniques like partial nephrectomy in many cases. Preservation of normal renal parenchyma is an advantage of cryoablation. In addition, these minimally-invasive ablations can be performed on patients who are not surgical candidates. In general, there are fewer serious complications and morbidity as compared to surgery while maintaining favorable outcomes.

The ideal treatment candidate would have a small RCC less than 4 cm in diameter that is confined to the kidney. Lesions near the hilum or the central collecting system are not ideal for a percutaneous approach due to the difficulty in placing the ablation probes safely and achieving a negative margin. Other potential patients are those that have a solitary kidney or those with syndromes like Von Hippel-Lindau. These patients are often ideal for cryoablation because of the ability to preserve as much normal renal parenchyma as possible. Sometimes larger lesions can be treated if a patient is a poor surgical candidate due to age or other comorbidities. However, tumors greater than 4 cm can result in post ablation hemorrhage. New techniques involving pre-ablation embolization followed by cryoablation in the same setting are being performed by Interventional Radiologists with good results.

The cryoablation itself is usually carried out as an outpatient procedure. The cryoablation probes are placed with ultrasound and CT guidance. Once the probes are in place, 2 freeze-thaw cycles are performed. The repeated freezing and thawing disrupts the cell membrane and leads to cell death. An advantage of cryoablation is that the “iceball” can be visualized with non contrast CT during the procedure in order to monitor the ablation zone. The probes are then removed and a small bandage is applied to the puncture site. Most patients are able to go home 4 hours after the procedure and are back to normal activity within a couple of days.

Cryoablation is currently offered by our subspecialized interventional radiologists at UC Irvine.
In the United States, prostate cancer is the second most common cancer in men and it is estimated that over 190,000 men will receive a diagnosis of prostate cancer, while more than 33,000 men are expected to die from prostate cancer in 2020. The most commonly utilized screening tool is the serum prostate-specific antigen (PSA) along with digital rectal examination. However, PSA can be inaccurate due to confounding issues related to benign prostatic hyperplasia and prostatitis. The ability to accurately identify clinically significant prostate cancer is crucial to adequate management of prostate cancer.

Magnetic resonance imaging (MRI) of the prostate is a reliable tool for detection and staging of prostate cancer. Multiparametric prostate MRI allows us to accurately visualize suspicious prostate lesions and facilitate targeting of those lesions for biopsy, thus improving the accuracy of prostate cancer diagnosis. Additionally MRI allows for localization of tumor prior to localized therapies. MRI is also a useful tool for surveillance imaging to assess indolent tumors or patients with prior localized therapies.

During the past 10 years, there have been significant technical advances in prostate MRI and marked standardization of prostate MRI interpretation and reporting. The current state of the art deployed at UCI includes advanced imaging techniques on 3 Tesla MRI's, which have undergone extensive quality control. Our protocols do not require endorectal coils, which have shown low patient satisfaction. We also utilize the latest in prostate reporting standards, PI-RADS version 2.1.

Common indications for prostate MRI include, elevated serum PSA, elevated PSA with prior negative transrectal prostate biopsy, abnormal digital rectal exam, and suspicious genomic profile. Prostate MRI in biopsy naïve patients has been associated with improved care resulting in decreased overdiagnosis of indolent disease while improving the detection of clinically significant prostate cancer.

At UCI, our board certified abdominal radiologists combined have over 20 years of experience with prostate MRI. We have partnered with urology and pathology for radiologic and pathologic lesion analysis. Our radiologists also regularly attend genitourinary tumor board and play a vital role in patient care. Additionally, our faculty have initiated and been involved with multiple prostate MRI research projects, yielding presentations at national and international scientific meetings as well as multiple publications. We are at the forefront of prostate MRI research applying advanced artificial intelligence techniques to improve detection and classification of prostate cancer.

At UCI, prostate MRI is routinely utilized for the care of prostate cancer patients. We utilize combined systemic and MRI targeted biopsies with a high degree of success in identifying clinically significant prostate cancer. Prostate MRI is an important component of patient selection for active surveillance of patients with low risk prostate cancer. Our high resolution prostate MRI’s are also able to accurately assess local staging of prostate cancer and verify the organ confined status of the cancer. MRI assessment of pelvic lymph nodes is utilized for tumor localization in radiation therapy planning.

Irene Tsai, MD

The World Health Organization reports that breast cancer affects approximately 2.1 million women each year and is the leading cause of cancer-related deaths amongst women. Breast cancer accounts for 25% of all cancer cases in women and is the most frequent cancer in women worldwide, with higher rates in more developed countries. Breast cancer incidence also increases with age.

Screening mammography has been shown to decrease breast cancer mortality rates across many study designs. The American College of Radiology (ACR), Society of Breast Imaging (SBI), National Comprehensive Cancer Network (NCCN), and American College of Obstetrics and Gynecology (ACOG) all recommend annual screening mammography beginning at age 40 (see Table 1). Commencing screening mammography at age 40 and continuing mammography annually has been shown to save the most lives. All major organizations agree that the benefits of mammography outweigh any perceived harms at all ages, with one such perceived harm being false positive screening mammograms (call-backs).

One advancement that has been shown to help reduce false positive screening mammograms is Digital Breast Tomosynthesis (DBT), which was approved for clinical use in conjunction with conventional digital mammography by the FDA in 2011. In DBT, the breast is positioned in the same manner as conventional digital mammography. However, instead of a single exposure, multiple very low-dose projection images are obtained while the X-ray tube moves through an arc of 10°–20°. The images are then processed into a stack of 1-mm-thick tomographic images, allowing the radiologist to scroll through and examine the breast tissue layer-by-layer. This allows for the detection of breast masses that otherwise may have been hidden by superimposed breast tissue (Figure 1).

Multiple studies have shown that conventional digital mammography combined with DBT improves the detection of invasive breast cancers by approximately 40% and decreases recall rates (fewer false positives) by approximately 15% compared to conventional digital mammography alone. These findings apply to women of all breast densities in all

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**Figure 1:** 3D Digital breast tomosynthesis allows for identification of an otherwise mammographically occult breast cancer.

(a) 2D Digital mammography demonstrates no definite suspicious mammographic finding in the superior breast. A speculated axillary mass is incidentally seen.

(b) 1-mm thick tomosynthesis slices demonstrate an irregular speculated mass in the superior breast that was not apparent on conventional 2D mammography due to overlapping breast tissue.

(c) Enlarged image further demonstrates the speculated mass.

(d) Correlative ultrasound confirmed the presence of an irregular, hypoechoic solid mass with angular margins. Ultrasound guided core needle biopsies of this mass and the axillary mass yielded invasive lobular carcinoma in both locations.
<table>
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<tr>
<th>Organization</th>
<th>Age to begin screening</th>
<th>Interval for screening</th>
<th>Age to stop screening</th>
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<tbody>
<tr>
<td>ACR</td>
<td>40</td>
<td>Annual</td>
<td>• ACR: Continue screening as long as life expectancy 5-7 years and good health (with willingness to undergo additional testing)</td>
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<tr>
<td>ACOG</td>
<td></td>
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<td>• ACOG: 75+, Shared decisions</td>
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<tr>
<td>NCCN</td>
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<td>• NCCN: Consider therapeutic decisions and comorbidity</td>
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<td>NCBC</td>
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Table 1 ACR: American College of Radiology, ACOG: ACOG American Congress of Obstetrics and Gynecology, NCCN: National Comprehensive Cancer Network, NCBC: National Consortium of Breast Centers

Figure 2: (Left) Gottschalk Medical Plaza. (Right) The Digital Breast Tomosynthesis (DBT) newly installed at UCI Gottschalk location.

In this unprecedented time of COVID-19, women across the world have been faced with delaying breast cancer screening. In fact the American Society of Breast Surgeons (ASBrS) and the American College of Radiology (ACR) released a joint statement in March 2020, recommending that medical facilities “postpone all breast screening exams...until the pandemic is under control and then be re-evaluated on a weekly basis based upon each community’s impact by the current pandemic”.

As the pandemic evolves and women grow more anxious about delaying potentially life-saving screening exams, rest assured that UCI Radiology is maintaining stringent protocols to ensure patient safety. Face masks are mandatory for all staff and patients in every imaging location. Additionally, all staff members and patients are screened daily, with symptom assessment performed, as well as forehead temperature screening prior to entering any facility.

Each mammography unit as well as exam room is thoroughly sanitized between each patient, and hand washing stations and hand sanitizers are readily available throughout the department.

Please feel free to contact us for more information regarding screening mammography and DBT or for any questions regarding our mission to keep patients safe during this unprecedented time.

UCI Health Gottschalk Medical Plaza
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(949) 824-8626
Monday - Friday 8:30 a.m. - 5:00 p.m.

UCI Health Imaging
Patient Contact & Scheduling Center
(714) 456-7237 or (714) 456-RADS
Monday - Friday 7:00 a.m. - 5:30 p.m.
Deniz Akay Urgun, MD
Cardiothoracic Imaging
Dr. Urgun completed her residency in Diagnostic Radiology from Istanbul Haydarpasa Training Hospital, before completing her fellowship in Body MRI at the University of Texas Southwestern Medical Center. She then completed her fellowship in Cardiovascular and Thoracic Imaging at UCI. Dr. Urgun’s special interests are Cardiovascular Imaging, Cardiac MRI, and 3-D Post-processing.

Edward Kuoy, MD
Neuroradiology Imaging
Dr. Kuoy completed his residency and subspecialty neuroradiology fellowship at UCI. Dr. Kuoy has an interest in head and neck imaging.

Christina Boyd, MD
Vascular & Interventional Radiology
Dr. Boyd completed a surgical internship at the University of Arizona before her diagnostic radiology residency at Morristown Medical Center in New Jersey where she was the chief resident physician and received the Roentgen research award. She then completed her Interventional radiology fellowship at UCI.

Karen Tran-Harding, MD
Abdominal Imaging
Dr. Tran-Harding joins us having completed her fellowship training at UCI in Abdominal Imaging. Prior to this, she attended the University of Kentucky for her residency. Dr. Tran-Harding brings with her a passion for advancing Women’s Health and will be combining her former training in Ob-Gyn with her outstanding imaging acumen.

Simon Long, MD
Vascular & Interventional Radiology
Dr. Long completed his residency at Louisiana State University, and fellowship in vascular and interventional radiology at the University of Texas Southwestern in Dallas.

His clinical interests include minimally invasive image guided interventions, including but not limited to trauma, vascular and non-vascular oncological, hepatobiliary, and cosmetic interventions.

Irene Tsai, MD
Breast Imaging
Dr. Tsai completed her diagnostic radiology residency at UCLA, where she also subsequently completed her subspecialty fellowship in Breast Imaging. Following her training, she served as Assistant Clinical Professor at UCLA in the Breast Imaging and Acute Care Imaging sections. She also served as Program Director for the UCLA Breast Imaging Fellowship. Her clinical interests include breast MRI, high risk screening, and imaging guided breast interventions.

Liangzhong (Shawn) Xiang, PhD
Research Scientist
Dr. Xiang comes to UCI from Oklahoma University (OU). He completed his postdoctoral fellowship trained in medical physics at Stanford Medical School before he joined Oklahoma University, and was awarded the DoD Prostate Cancer Postdoctoral Fellowship at Stanford University (2012-2015). Dr. Xiang and his laboratory were the first to report x-ray-induced acoustic computed tomography (XACT). His research has led to over 60+ peer-reviewed publications, 12 patents, 30+ presentations. Recently, he received the NIH MERIT award (R37), and Research Scholar award from American Cancer Society. His students have been awarded SPIE Education Scholarship (2019, 2018), SPIE Travel Scholarship (2016), and Trainee Research Prize from the RSNA (2015). Dr. Xiang has served as conference chairs in AAPM annual meeting (2019) and International Conference on Information Optics and Photonics (CIOP 2018), SPIE Student Chapter advisor, associate editor of Medical Physics journal, and grant reviewer for NIH, DOE, Russian Science Foundation (RSF), and Helmholtz Association of German Research Centre.
At UCI Health, our team is dedicated to a research-driven approach to exceptional patient care. When it comes to innovations in clinical and research programs, our patients are the ones who make it all possible. If you are considering a gift to support the Department of Radiological Sciences or adding UCI Health as a beneficiary of your estate, we look forward to working with you to accomplish your philanthropic goals. Please contact us today to learn more about joining us in building a brilliant future together.

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