GE HealthCare

Using advanced X-ray applications to improve care delivery for patients with complex lung conditions

Introduction

At University Hospitals of Cleveland, the increasing complexity of our patients' conditions have paralleled the growing sophistication of the surgical and therapeutic interventions used to treat them. The successful integration of GE HeathCare's digital radiography applications in our ICU and clinics has helped to enable the improved delivery of care for patients with complex conditions.

To best illustrate this integration, this case study follows the care path of a patient with severe lung disease. From early diagnosis to therapeutic intervention, lung transplantation surgery, and postoperative care in the ICU, GE HealthCare's advances enabled accurate detection of the clinically important disease.

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History

A 65-year-old male presented to his pulmonologists with progressive dyspnea. As a long-term smoker, his pulmonary function tests revealed severe obstructive pulmonary disease. The patient also has a history of dyslipidemia and prostate cancer.

Critical Care Suite

To improve the patient's dyspnea, the patient underwent Bronchoscopic Lung Volume Reduction (BLVR). The interventional pulmonologists placed endobronchial values via bronchoscope within the left upper lobe (LUL) bronchus. As standard of care for patients following bronchoscopic intervention, a portable chest radiograph was performed to exclude postprocedural complications. GE HealthCare's Clinical Care Suite's (CCS) integration in our portable AMX™ 240 Gen 2 helped exclude postprocedural pneumothorax (Figure 1). University Hospitals' recent publications[1,2] have described improved detection and response time of patients with pneumothorax when using the AMX (Figure 2) as particularly important during the COVID-19 pandemic.

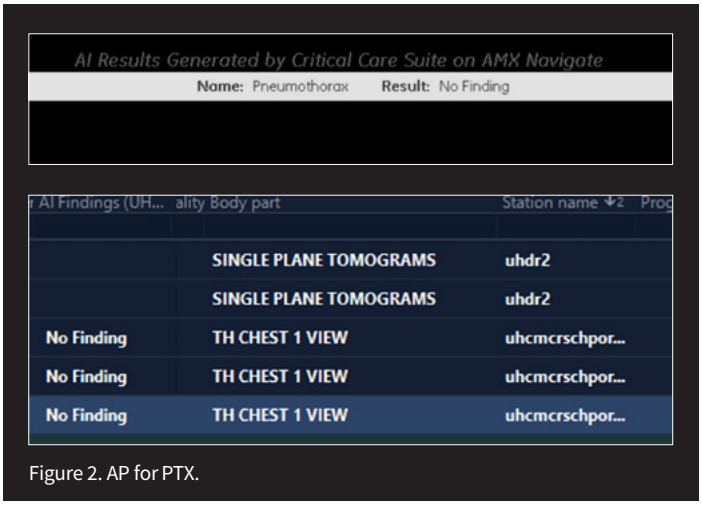

Figure 2. AP for PTX.

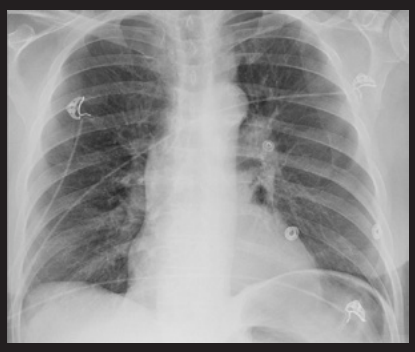
Figure 1. AP.

What is Critical Care Suite?

Critical Care Suite (CCS) is a collection of on-device AI algorithms that integrate seamlessly with your existing X-ray workflow, enhancing productivity, and alleviating the overwhelming demand that urgent X-rays are placing on radiology teams. CCS can help triage critical conditions, like pneumothorax, with high accuracy in the moments that matter.

CCS detects nearly all large pneumothoraces (96% sensitivity), and identifies 3 out of 4 small pneumothoraces (75% sensitivity). Limits false alerts (94% specificity), with an Area Under Curve (AUC) of 0.96[3].

Critical Care Suite can also help reduce significant hospital costs caused by missed pneumorthoraces and associated complications.

Dual energy radiography

Following the exclusion of pneumothorax on the patient's portable radiograph, our patient underwent a PA and lateral radiograph. At UH Cleveland Medical Center, the standard of care for any patient with suspected cardiothoracic disease is the evaluation of dual energy radiography. The utilization of GE HealthCare's Dual Energy Subtraction application to improve detection of implanted devices was clearly demonstrated on our patient.

On the dual energy subtracted bone image, we clearly see the location of the BLVR stent in the LUL bronchus (arrow). In collaboration with our colleagues in the Biomedical Engineering Department at Case Western Reserve University, we have also demonstrated significantly improved visualization of cardiovascular calcifications in patients undergoing Dual Energy Subtraction radiography.[4] (Figures 3,4)

In addition to improved stent visualization, the patient's Dual Energy Subtraction "bone image" demonstrated improved visualization of left coronary artery calcification (arrows). Correlation to the patient's recent chest CT further demonstrated dual energy visualization of both lung and cardiovascular disease in our patient.

What is Dual Energy Subtraction?

Dual Energy Subtraction acquires two images at different energy levels in less than 160 milliseconds to help to eliminate obstructions from overlying bones, while providing additional information on calcifications in chest exams.

Three images are generated: a standard x-ray, a soft tissue image, and a bone image.

Dual Energy Subtraction can help improve the assessment of chest pathology, helping you deliver the highest quality of care to your patients.

Figure 3. PA on the Definium™ demonstrates progressive LUL volume loss after endobrochial valve placement.

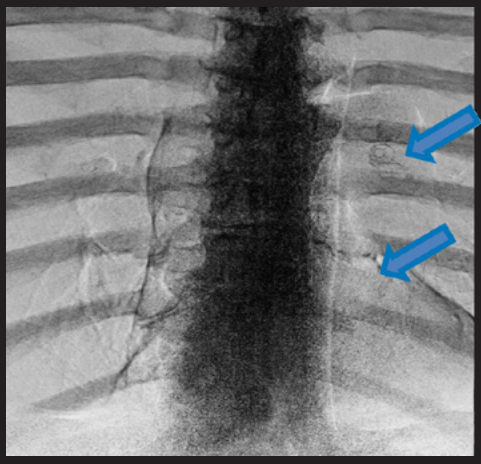

Figure 4. Dual Energy Subtraction radiograph "bone image" demonstrates improved visualization of both the LUL endobroncial valves as well as the coronary artery calcium in the patient's left anterior descending (LAD) artery.

Digital tomosynthesis

While BLVR often improves patients' respiratory symptoms, there is a risk of barotrauma following BLVR, and a growing literature[5,6] on pneumothorax following BLVR. In particular, following pulmonary intervention, we will often utilize another additional significant technological advance in GE HealthCare's digital radiographic capabilities: VolumeRAD™ digital tomosynthesis.

While digital tomosynthesis has demonstrated improved detection of pulmonary nodules, we have also demonstrated digital tomosynthesis' improved detection of airway disease, bronchial stents, and occult pneumothorax. (Figures 5,6).

In our patient, the volumetric acquisition and superior depiction of the lung parenchymal was made possible with digital tomosynthesis, clearly demonstrating an extremely rare sequela of BLVR: delayed development of a large pneumatocele in the patient's stented LUL. No pneumothorax was identified, and the patient was closely monitored without the need for immediate intervention.

What is VolumeRAD digital tomosynthesis?

VolumeRAD captures multiple cross-section images of the anatomy in a single sweep on an equipped GE HealthCare X-ray system, and provides multi-level image slice data similar to a CT at very low doses.

VolumeRAD can reduce the time to diagnosis and elevate the patient experience as a standard of care with given clinical indications, or with an exam performed at the same time, location, and equipment immediately after an inconclusive X-ray.

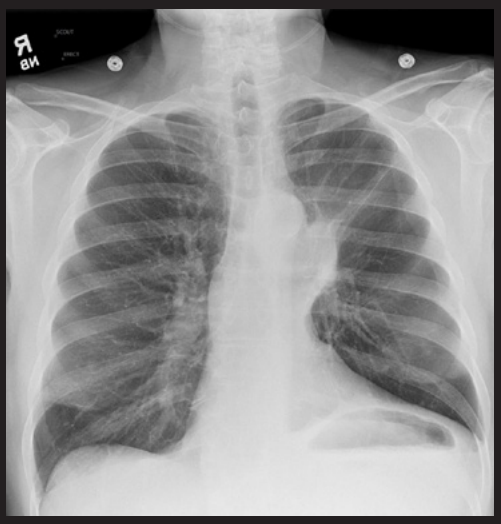

Figure 5. Post-procedure radiograph following endobrochial valve placement using the Definium 8000.

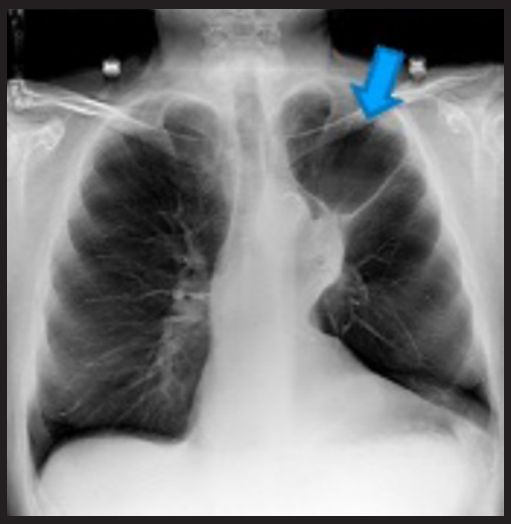

Figure 6. Tomographic image from the Definium 8000 demonstrates focal hyperlucency in the LUL most consistent with a post procedural pneumatocoele.

Critical Care Suite post-lung transplantation

While the patients BLVR procedure provided symptomatic relief, his dyspnea continued and lung transplantation was planned for definitive long-term treatment.

The patient underwent a successful bilateral lung transplant. Following the procedure, GE HealthCare's Critical Care Suite (CCS) enhanced instantaneous visualization of the patient's endotracheal tube, a critical finding in the intubated postoperative patient. Further postoperative monitoring with CCS AI enabled visualization of subtle bilateral pneumothoraces in the early postoperative period. As seen in Figure 7, the CCS provided crucial information for the pulmonary and critical care teams monitoring the post-lung transplant patient. The real-time imaging monitoring of our ICU patients via the CCS AI has become a new "standard of care" for our ICU patients.

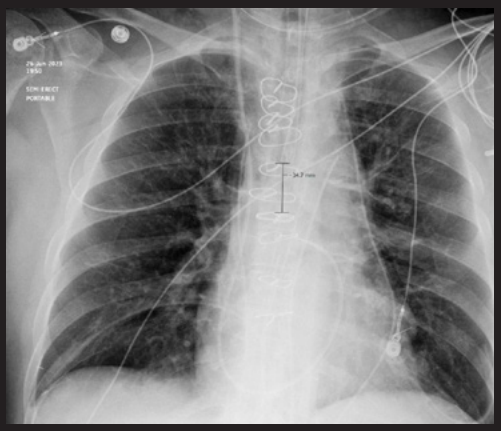

Figure 7. Immediate postprocedural portable radiograph performed on AMX unit.

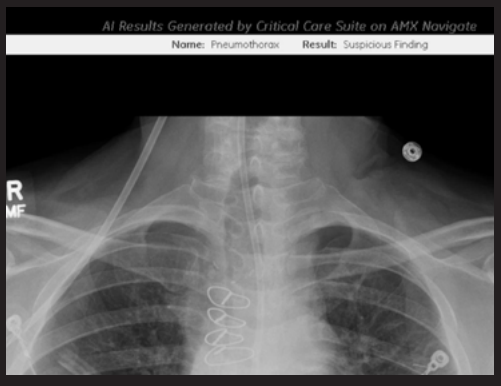

Figure 9. Monitoring radiograph using CCS AI for pneumothorax detection demonstrates small biaoical pneumothoraces.

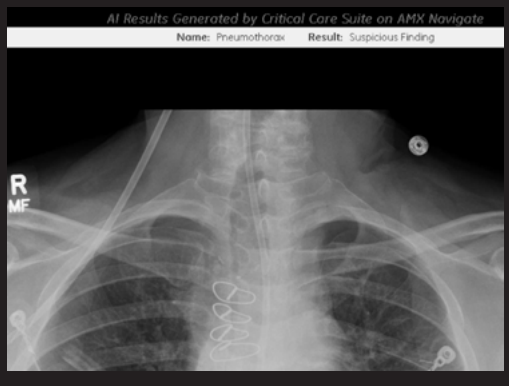

Figure 8. CCS AI demonstrates ET position.

What is CCS for endotracheal tube (ETT)?

CCS provides an accurate and automated measurement of ETT position on the X-ray device within seconds of image acquisition. In 94% of cases, the ETT tip-to-carina distance calculation is accurate to within 1.0 cm[7]. The vertical distance between the tube tip and the carina is automatically calculated and displayed on device.

A major complication is the accidental migration of the tube tip into a mainstem bronchus. If unrecognized, this can lead to hypoxemia and collapse of the contralateral lung, hyperinflation of the intubated lung with resultant tension pneumothorax, and cardiac arrest. With automated measurement, misplacements can be quickly corrected.

Conclusion

This case study has presented an imaging pathway paradigm for our patients with clinically significant cardiopulmonary disease. From the expanded detection of cardiopulmonary disease with Dual Energy Subtraction and VolumeRAD digital tomosynthesis to the advances in real-time monitoring capabilities made possible with the CCS AI platform, GE HealthCare has made impactful, clinically important advances in the imaging care path of our patients. We look forward to further collaborations with our GE HealthCare colleagues as we work to advance the care of our patients.

To learn more about the solutions discussed in this case study and how they can make an impact on your patient care, visitgehealthcare.com/products/radiography or contact your GE HealthCare Sales representative.

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About GE HealthCare

GE HealthCare is a leading global medical technology, pharmaceutical diagnostics, and digital solutions innovator, dedicated to providing integrated solutions, services, and data analytics to make hospitals more efficient, clinicians more effective, therapies more precise, and patients healthier and happier. Serving patients and providers for more than 100 years, GE HealthCare is advancing personalized, connected, and compassionate care, while simplifying the patient's journey across the care pathway. Together our Imaging, Ultrasound, Patient Care Solutions, and Pharmaceutical Diagnostics businesses help improve patient care from prevention and screening, to diagnosis, treatment, therapy, and monitoring. We are an $18 billion business with 51,000 employees working to create a world where healthcare has no limits.

Follow us on Facebook, LinkedIn, Twitter, Instagram and Insights for the latest news, or visit our website gehealthcare.com for more information.

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7. GE HealthCare data on file (DOC2296463).

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