GE HealthCare

Reducing false positive findings and the need for unnecessary CT scans with Dual Energy Subtraction

Introduction

Based in the north of England, Leeds Teaching Hospitals NHS Trust (LTHT) is one of the largest healthcare trusts in the United Kingdom, treating over 1.7 million patients per year across seven hospital sites throughout the region. The Trust is a tertiary-level centre for multiple specialities as well as the primary education site for the University of Leeds Medical School.[1]

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The radiology department at LTHT employs over 800 staff members and completed approximately 800,000 exams in the previous year[1]. The Trust performs 370,000 plain radiographs per year, approximately 150,000 of which are chest radiographs, making it one of the busiest radiology departments in Europe[2]. The Trust is a centre for training, attracting dedicated education and training resources with a pioneering national radiology academy with up to 80 specialty registrars in the training scheme at any given time[3]. There are over 350 radiographers working in the Trust, including 180 working within X-ray. The radiology team plays a crucial part in patient treatment and management, with involvement in specialised diagnostic imaging, vascular, and non-vascular intervention for a wide variety of specialized multidisciplinary teams[1].

>800

Number of staff members employed.

800,000

Approximate number of exams completed in the previous year[1].

370,000

Number of plain radiographs performed by the Trust per year.

350

Number of radiographers working in the Trust.

Definium™ 6000

Definium 656 HD

Dual Energy Subtraction at LTHT

There are two GE HealthCare radiography systems within LTHT that have Dual Energy Subtraction installed. In 2008, a Definium™ 6000 was installed in a specialist Chest Clinic at Leeds General Infirmary. More recently, a Definium 656 HD was installed in a dedicated chest room in the Bexley Wing radiology department in the Leeds Cancer Centre based at St James's University Hospital. In addition to standard PA DE radiographs, this machine also performs lateral dual energy radiographs and digital tomosynthesis.

Case 1

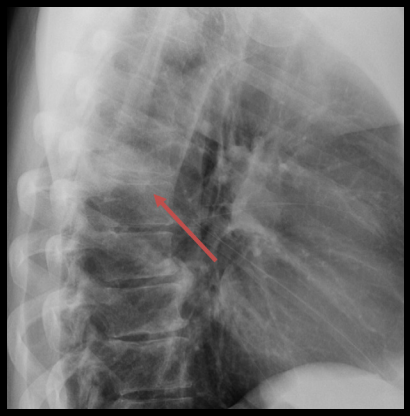

Figure 1A. Single energy lateral radiograph with opacity projected over the mid thoracic spine.

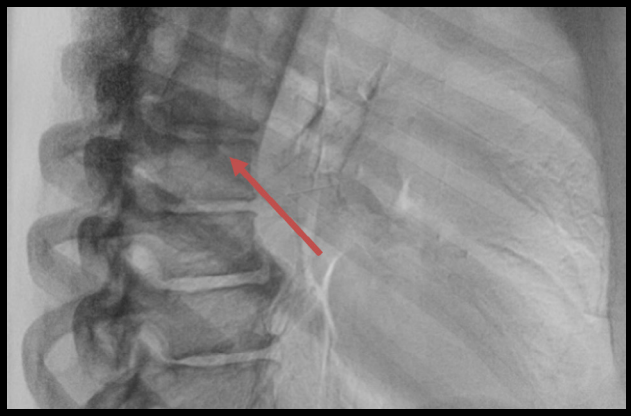

Figure 1B. Bone window of a dual energy lateral radiograph confirming osseous origin likely osteophyte with composite shadowing.

The role of Dual Energy Subtraction chest radiography in our department

We have a long experience with dual energy radiographs which we have employed primarily as a problem-solving tool within chest radiography. Specifically, dual energy radiography is used to evaluate indeterminate findings identified following standard chest radiographs and aid subsequent management. The most common example would be further evaluation of an indeterminate opacity which might represent a lung nodule or composite opacity due to a calcified chest wall abnormality. In a locally performed audit of nodules identified on chest radiographs which led to a fast-track CT thorax, 54% of nodules which had a bone structure covering more than half of their diameter were found to be false positive findings on the subsequent CT. The ability of dual energy imaging to reliably demonstrate that an indeterminate opacity is composed of calcified material reduces our requirements for further evaluation with CT. Given the well-documented predilection of potential lung cancers to develop within the lung apices[4-6] a site of maximum osseous overlay, dual energy is a reliable method of differentiating between nodules requiring follow up and those which can be disregarded. The department currently performs approximately 500 dual energy radiographs for this purpose each year.

Case 2

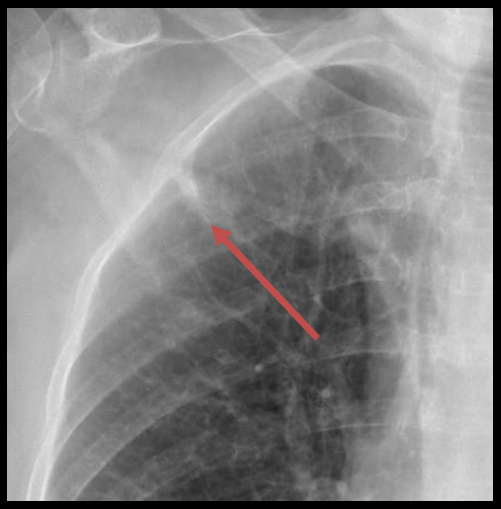

Figure 2A. Single energy radiograph with indeterminate right apical opacity.

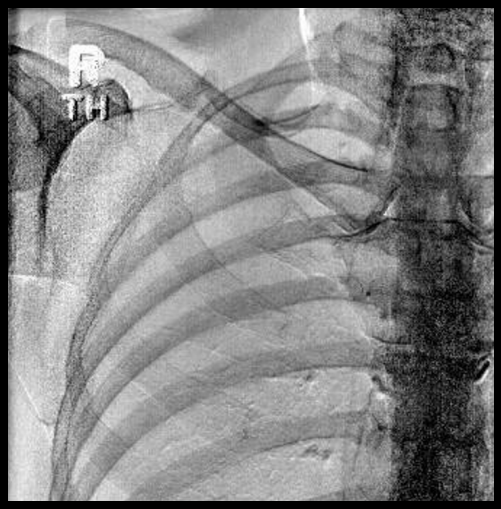

Figure 2B. Bone window of dual energy demonstrating no osseous abnormality.

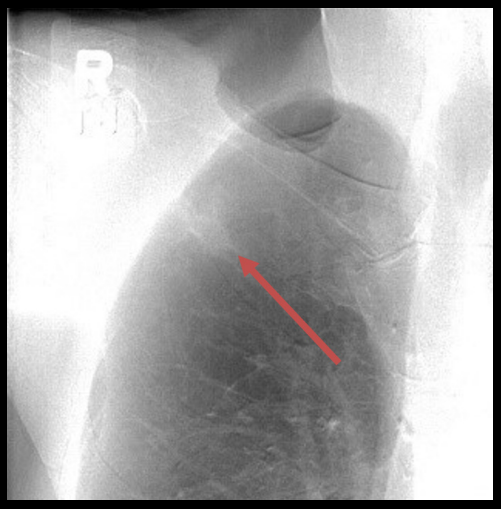

Figure 2C. Soft tissue window of dual energy demonstrating soft tissue/lung nodule.

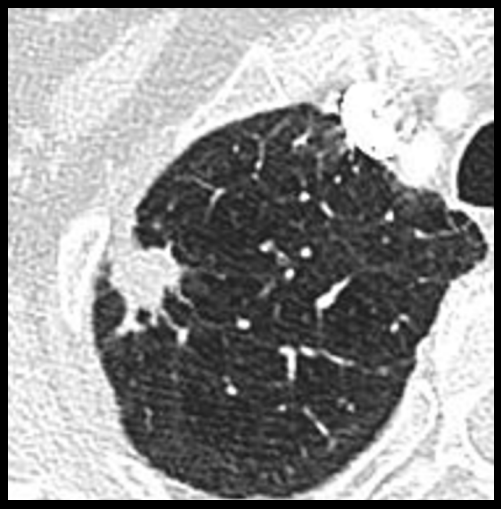

Figure 2D. CT findings confirming right apical nodule.

In a locally performed audit of nodules identified on chest radiographs which led to a fast-track CT thorax, 54% of nodules which had a bone structure covering more than half of their diameter were found to be false positive findings on the subsequent CT.

Case 3

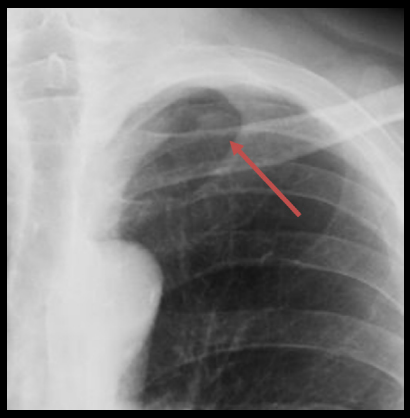

Figure 3A. Single energy radiograph with indeterminate left apical opacity.

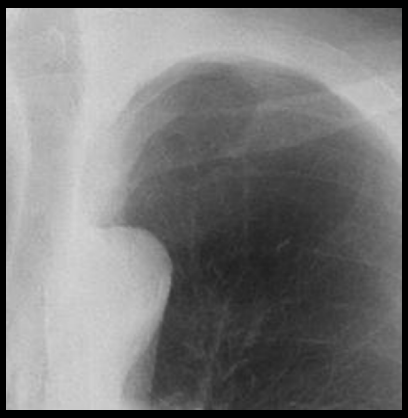

Figure 3B. Soft window of dual energy radiograph demonstrating no lung abnormality.

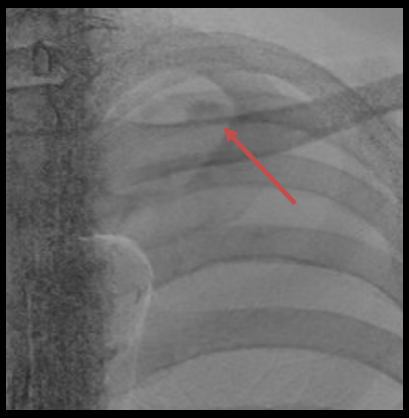

Figure 3C. Bone window of dual energy radiograph demonstrating osseous origin.

In July 2022, we began using Dual Energy Subtraction as the initial exam to confirm the position of small calibre vascular lines. Some lines are difficult to reliably visualize with standard radiography, and we have recognized the greater contrast dual energy imaging has provided between catheter and surrounding anatomical structures.

Case 4

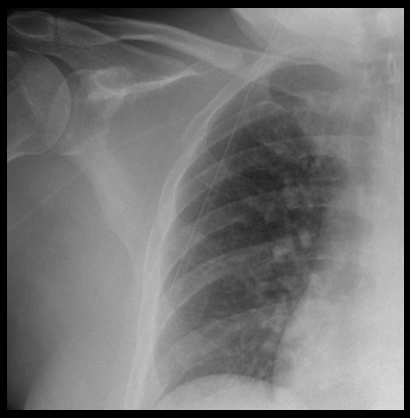

Figure 4A. Single energy radiograph after PICC insertion with tip not readily appreciable.

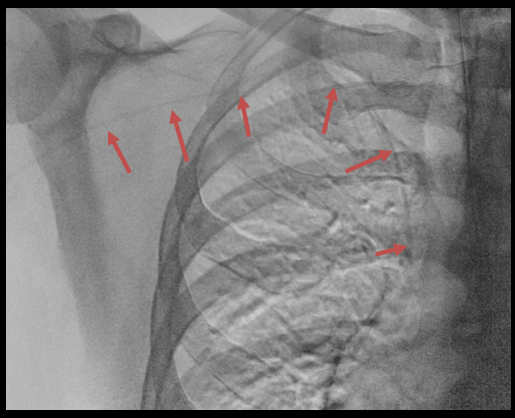

Figure 4B. Bone window on dual energy radiograph demonstrating the tip clearly at the superior vena cava.

How was Dual Energy Subtraction integrated?

The latest of the Trust's Dual Energy Subtraction systems was installed in September 2021. Four radiographers initially received training from an Application Specialist from GE HealthCare. This involved practical training in dual and single energy radiographs and digital tomosynthesis exams on a chest phantom. Following Medical Physics approval, the department began using the equipment for patients in April 2022.

Both student and qualified radiographers who are new to Dual Energy Subtraction are trained locally by the radiographers who regularly use the equipment, and there is wider departmental education on its use via the local audit meeting. There is currently a core group of approximately 15 radiographers at each site who work primarily with the Dual Energy Subtraction machines.

Reporting staff members have received training on both optimizing dual energy imaging and reporting at dedicated educational meetings since the initial introduction of the equipment, and clinical reporters are now familiar with the techniques and confident in reporting and suggesting dual energy imaging. Dual energy imaging is also part of the local curriculum for registrars, and they are exposed to multiple dual energy studies throughout their training while also learning the physics behind dual energy imaging in their professional exams. Dual Energy Subtraction is now routinely applied in daily practice and can be reviewed on PACS workstations.

Dual Energy Subtraction benefits

The advent of routine Dual Energy Subtraction use has led to a reduction in our false positive findings when reporting indeterminate single energy chest radiographs. Crucially, the use of dual energy in initially indeterminate cases can reduce the number of subsequent CT chest exams with a reduction in both time and radiation dose to the patient.

Our Trust's local diagnostic reference level (LDRL, taken from the mean of room medians) for a dual energy chest radiograph is 0.023 mSv. This is a small dose compared to 2 mSv for a low dose CT chest[7]. The exams are performed on a walk-in basis and can resolve many indeterminate findings far more quickly compared to CT. A local Trust audit of our dual energy radiographs in 2019 demonstrated that just 3% had an indeterminate result, necessitating a subsequent CT to further problem solve.

The cost to the department is also reduced significantly with the introduction of Dual Energy Subtraction. The tariff for a chest radiograph was £52 in 2021 compared to a non-contrast CT chest with a cost of £163, rising to £247 with the addition of contrast[8].

Dose from a dual energy X-ray exam is about 89% less than a low dose CT, .023 mSv compared to 2mSv.

Looking to the future

Yorkshire and the Humber have a high incidence of lung cancer compared to other regions in England[9], and lung cancer remains the leading cause of cancer mortality in the UK.[10] The chest radiograph is the initial test recommended in the UK by the National Institute of Health and Care Excellence.[11] The limitations of the standard chest radiograph are well-recognized, with up to 1 in 5 lung cancers present not identified[4]. Both dual energy and tomosynthesis improve visualisation of the lungs by removing overlying anatomical structures and, therefore, have the potential to improve the detection of cancer. In the longer term, we aim to move to a position where these advanced forms of radiography are performed as the initial exam in individuals at increased risk of cancer rather than as a problem-solving tool.

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

GE HealthCare

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.

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