Obesity and Medical Imaging

Introduction

Obesity is an epidemic in the United States with over 65% of U.S adults being diagnosed as overweight or obese.[6] See Chart 2 for Body Max Index (BMI) ranges. The obese patient population currently presents a challenge to the field of radiology. Patient size is one of the factors that radiologic technologists are not in control of. Medical imaging can tell us valuable information about the patient. If patient size is a challenge, the radiologic technologist may not be getting enough information about the patient for the Radiologist to obtain an accurate diagnosis and treatment plan. It is essential to find solutions to the problems that arise while imaging the obese patient population to avoid the need for additional exams and care.

Obesity's Impact on Diagnostic Imaging

With the steady increase in obesity, there is also a significant linear increase in the reports that claimed the quality of the images collected are 'limited due to body habitus'.[8] While imaging the obese patient population, several different problems may occur. Some of the common problems include X-ray beam attenuation, scatter, low image contrast, long exposure time, motion artifact, and difficult patient positioning. These imaging complications can make image diagnosis challenging and can lead to an incorrect or missed diagnosis.[3] The most common artifact encountered while imaging the bariatric population is quantum mottle or image noise. Quantum mottle on an image is acquired from an insufficient number of photons reaching the detector. Quantum mottle significantly increases with an increase in patient part thickness because of greater photon attenuation.[5] Image 2 demonstrates the effects of quantum mottle on a radiographic image.

Other Modalities Affected by Obesity

X-ray is not the only modality patient size is affecting. It affects modalities such as ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI).[2] Chart 1 shows the challenges that the various imaging modalities face when imaging the obese patient population.

Modality	Challenges With Obese Population
Ultrasonography	Subcutaneous fat attenuates the sonographic signal by 0.63 dB/cm and may place the area of interest outside of the focal depth of the probe. This can lead to low-quality visualization of abdominal organs, masses, and fluid collections, which may result in higher rates of non-diagnostic percutaneous biopsies and bleeding complications.[2]
Computed Tomography (CT)	Older equipment had a standard design to accommodate patients up to 450 lbs and had a gantry aperture measuring 70 cm or less. Newer equipment is capable of accommodating patients weighing up to 680 lbs and have an aperture as large as 90 cm.[5] If patients do not meet these requirements, CT images will not be an option for imaging.
Magnetic Resonance Imaging (MRI)	Limitations in MRI for obese patients comes from the fixed aperture or bore diameter and the table weight limit. The industry standard weight limit for older MRI equipment is typically 350-550 lbs and 550-680 lbs for newer equipment. The maximum aperture diameter for older equipment is 55-70 cm and 55-90 cm for newer equipment. [4]

Chart 1. Challenges faced in ultrasonography, CT, and MRI while imaging the obese patient population..[2 4 5]

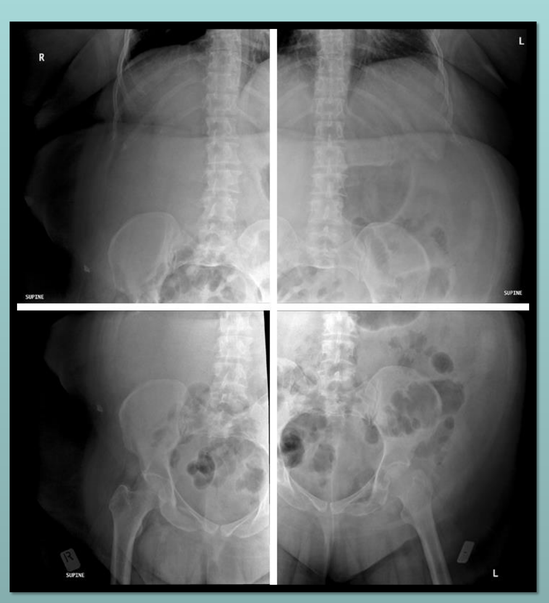

Image 1. Abdominal radiograph of a morbidly obese patient with the use of multiple cassettes.[1]

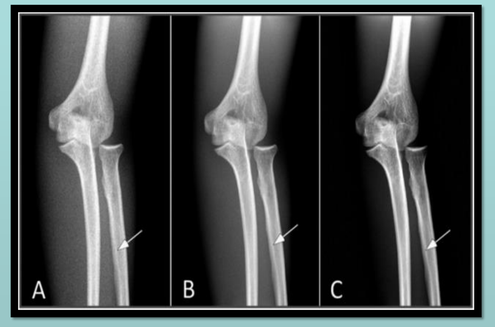

Image 2. Image A demonstrates quantum mottle resulting from too few photons striking the imaging plate. Images B and C show increasing mAs values and decreasing quantum mottle. [7]

Body Mass Index	
Normal	18.5 - 24.9
Overweight	25.0 - 29.9
Obese	30.0 to 39.9
Morbidly Obese	≥ 40

Chart 2. Body Mass Index (BMI) ranges.[6]

Solutions for Imaging Obese Patients

Finding solutions for imaging obese patients is critical for appropriate diagnosis and for reducing the amounts of repeated exams.[3] Solutions to improve general radiography images of obese patients include increasing kVp, increasing mAs, using a grid, using multiple cassettes to cover the anatomy of interest, and some post-processing functions may be useful as well.[3] Image 2 demonstrates the use of multiple cassettes. The increased technical factors are necessary for obese patients to allow proper penetration. However, the increase in kVp, as well as the increased patient thickness, will create more scatter which will decrease the contrast of the image.[3] Scatter may be reduced with collimation of the beam to the area of interest as well as the use of a grid.[3] Even with these solutions, images will never be perfect. However, they may be easier for the Radiologist to read and diagnose

Conclusion

To avoid the need for additional exams and care while imaging the obese patient population, it is important to seek solutions to the complications and problems that may come with imaging this population. With obesity on the rise, it is important for hospitals to accommodate this patient population to ensure that the patients are safe, and the staff can successfully provide high-quality health care for the patients. Having essential equipment within the hospital, selecting appropriate technical factors, and having adequate patient positioning are key factors for the radiologic technologist to ensure adequate diagnostic imaging is achieved while ensuring the patient receives the lowest dose possible.

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