Overview of mammography and its importance

Mammography is the radiographic imaging of the breasts. It is a special diagnostic and screening tool of the human breasts. A mammography is done with specific x-ray equipment which is able to find tumors too small to be felt. Mammography examination’s ultimate goal is the early detection of breast cancer, typically through detection of characteristics masses and / or micro calcifications. A mammogram is the best radiographic method available for early breasts cancer detection. It is ideal and indispensable for women above the age of 40 years old, for whom the risk of breast cancer is increased. Like x-rays, mammogram uses doses of ionizing radiation to create images but at lower dose amplitude-x-rays (most often around 0. 7mSv). Radiologists then analyze the produced images for any abnormalities. A longer wavelength x-rays (typically Mo-K) is normally used for mammogram compared to those used in radiography of bones. Like many other medical tests, mammograms are not 100% accurate. Therefore, a regular mammogram scheduling is needed to detect any early breasts changes before any obvious signs or symptoms show up. It is also scientifically proven that mammogram can reduce breast cancer mortality rate by more than a third. Despite its function in early detection of breast cancer, mammography has a false-negative (missed cancer) rate of at least ten percent. This is due to the dense tissue obscuring the cancer and the large overlap of cancer appearance in mammograms with normal tissues appearance.

Mammography first started in 1960s. However, modern mammography has only existed since 1969 when the first x-ray unit dedicated to breasts imaging was made available to the public. Such examination as a screening

device became standard practice by the year of 1976. Mammography then continues to improve as lower dose of radiation able to detect smaller potential problem earlier. Throughout the years, mammography has made advances to further improve its diagnostic ability. Digital mammography and computer aided detection are two examples of recent advances in the field of mammography. Digital mammography, also known as full field digital mammography (FFDM), is a mammography system in which solid-state detectors that convert x-rays to electrical signals replace the conventional x-ray film. These detectors are similar to those found in digital cameras where electrical signals produced are used to create images of breasts which are then projected on a computer screen or printed on a special film similar to conventional mammograms. A digital mammogram is essentially the same as a conventional film screen mammogram. Computer aided detection (CAD) systems help to detect abnormalities by using computer software. A digitized mammographic image that can be obtained either from a digitally acquired mammogram or a conventional film mammogram is used by the computer aided systems. The computer software then searches for abnormal areas of mass, density or calcification that may indicate the presence of cancer. It highlights the abnormal areas on the images, alerting the radiologists to the need of further analysis.

A special mammography machine is used for the screening of breasts. The machine comprises of an x-ray tube connected to a breasts support which houses the film cassette or imaging device on a C shaped arm, with moveable compression paddle between the two. There are few standard functional requirements for the mammography machine in order to produce

a good quality image. The high voltage generator of mammography machine shall supply a near direct current high voltage with ripple less than 5 percent. Most modern mammography machines have a automatic selection for kilo voltage (kVp) output in order to optimize contrast. The generator produces a constant potential and the high voltage applied to the tube must be from 22 to 35kVp in increments of 1kVp. The focal spot size of mammography machine should be as small as possible to ensure adequate resolution. A focal spot size of 0. 3mm is recommendable for general mammography and 0. 1mm (small focus) for magnification views. The tube current of mammography machine should be set as high as possible in order to minimize exposure time and thus reducing the likelihood of motion artifact. A moving grid with grid factor of less than 2. 5 at 30 kVp is essential to ensure optimum image quality. An automatic exposure control (AEC) is important in mammography machine. This is due to the wide variation in breasts sizes and compositions. There is little scope for mAs selection errors as there is a need for high radiographic contrast and consequently the system has low latitude. As for image recording material, most of the mammography facilities are still utilizing traditional cassettes, intensifying screens and single emulsion film with processing being taking place. Mammography usually uses cassette containing a single intensifying screen and the film which is usually green sensitive has a single emulsion layer. Both these equipment are essential to give optimum resolution. A mammography film requires high spatial resolution. It should has enough speed to ensure that the dose is acceptable without being so fast that it causes visible quantum mottle and high contrast with enough latitude to show both dense glandular tissue and the skin edge. Quality control,

assurance programs and strict processing parameters are vital to ensure the standard in film quality is not compromised. Any reduction in film quality may lead to misinterpretation of image and incorrect diagnosis. In the modern days, digital mammography is slowing making its way to the imaging field. This modern modality has some advantages over the conventional film mammography. The examination time and time between examining patients decreases as chemical processing and changeover of cassette is no longer necessary. Markers can be applied on image digitally. Images produced can also be manipulated. One of the major advantages of image manipulation is the ability for image magnification with significantly less unsharpness compared to those associated with macro or magnification images that are sometimes required to demonstrate suspicious areas already seen on mammograms. Unlike the conventional magnification views, digital magnification does not involve an additional exposure to radiation.

Patients are required to do some preparations prior to a mammography examination. Fasting or observation in particular dietetic rules days before mammogram examination is not necessary. However, for women sensitive to caffeine, they shall refrain from taking caffeine containing products such as cola, chocolate and coffee two weeks before undergoing the test. This is because caffeine could make the breasts more tender which may affect the quality of radiograph. Menstrual cycle phase usually does not affect the outcome of the examination. However, it is also highly recommendable to schedule for mammogram one week following patients’ menstrual cycle. This is so as the breasts are less tender compared to that during pre-ovulatory and postovulatory period (half cycle) as well as during premenstrual period.

It is also advisable for patients to wear two piece clothing on examination day to ease the undressing process for mammogram. Cosmetics, oils, creams, lotion and talc or deodorant must not be applied hours prior to test at the underarms and breasts areas. Failure in doing so may result in those appearing in mammogram as calcium spots. Patients are also encouraged to bring along all previous mammograms for comparison purposes by the radiologist. Most often, mammograms are done on older patients compared to younger patients. this is due to the breast tissue changes during life. The breast tissue density in younger women often makes mammogram rather difficult to interpret. However, as women age increases, some changes in the structure of breasts occurs as glandular and fibrous tissues reduce in size and this results in breasts tissues become more fatty. On the examination day, a simple interview with the patients is conducted before the examination takes place. They will be asked on any prior surgeries history, family or personal history of breasts cancer as well as hormone use. It is also the responsibility of the radiographer or technologist to enquire the patients' last menstrual period as to determine whether the patient is pregnant. Pregnant patients are not recommendable for such examination. Upon completion of the short interview, patients are then ushered to change into hospital gown and remove all potential artifact before proceeding for the examination.

When the examination takes place, the breast is compressed using compression paddle on the mammography unit. A parallel plate compression evens out the breast tissue. Compression of breast reduces the thickness of tissue that x-rays penetrate, decreases the amount of scattered radiation,

and reduces the required radiation dose and holding the breast (remove movement unsharpness) still and thus improving the image quality. Both craniocaudal, CC view (head to foot) and mediolateral oblique, MLO (angled side view) of the breast are taken in screening mammography. Extra views such as geometrically magnified and spot-compressed views of particular area of concern may be taken in diagnostic mammography. While performing the craniocaudal (CC) view, the mammography unit is positioned with the breast support table (image receptor holder) horizontal and the height adjusted to slightly above the level of patient’s inframammary angle. The patient is then instructed to face the machine, standing with approximately 5-6cm back, feet facing the machine but body rotated 15-20° away from the side under examination. This is so that the breast under examination is brought closer to the image receptor holder and aligned with the center of it. The patient’s arms hang loosely by her side and head is turned away from the side to be examined. The breast is then lifted gently up and away from the chest wall of patient. While supporting the breast, the height of the machine is adjusted so that the image receptor holder makes contact with the breast at the inframammary fold and the breast is approximately 90° to the chest wall. The breast is then carefully placed in contact with the cassette. Hand is then slowly removed from the breast, whilst ensuring that no skin folds are created underneath the breast. Patient’s arm of the side under examination is then flexed at the elbow and the hand is placed on the patient’s lower abdomen or relaxed at the side of the trunk. This relaxes the pectoral muscle. Patient’s shoulder is gently pressed down to bring the outer quadrant of the breast into contact with the image receptor. Slight pressure is maintained at the patient’s back to ensure

she does not inadvertently pull back from the unit and cause some tissue to be lost from the resultant image. Radiographer’s thumb is then placed n the medial aspect and middle finger on the superior aspect of the breast, gently pulling forward towards the nipple while the compression is applied slowly. Radiographer’s other hand is placed on the patient’s shoulder of the side being examined to ensure that it stays relaxed. The light beam diaphragm can be used during the application of compression. This is to ensure the nipple is in profile, all breast is included in the main beam, both medial and lateral margins are included, no skin folds and an adequate breast compression. A CC marker with left or right identifier is positioned on the axillary edge of the cassette, within the primary beam. Patient is strongly advised not to move and the projection is done quickly after that. The same CC procedure is performed on both left and right breast. The CC view with the same procedure is performed on patient’s both breasts.

Besides the CC view, a mediolateral oblique (MLO) view of patient’s both breasts is also taken for screening mammogram. The positioning of patients for left breast MLO view is to have patient facing the mammography unit with feet pointing towards it. From the position used for CC projection, the unit is rotated through 45° with the x-ray tube on patient’s right and the beam angled caudally. The height is adjusted to bring the lower border of cassette 2. 5cm below the inferior portion of the left breast. It may be necessary to further adjust the height during patient positioning. The lateral edge of the left of the thorax is in line with the image receptor holder so that the left breast also lies next to it. The radiographer then stands behind and slightly to the right of patient. Patient is then asked to raise her left arm and

chin. The raising of chin may prevent the superimposition of the mandible over the breast. Patient’s left breast is then held with right hand and patient is kept in position by holding on to the right shoulder. Patient who is advised to lean forward into machine with feet still facing forward is asked to lean slightly laterally. The left axilla of patient should lie over the corner of image receptor that is nearest to chest wall. Radiographer then proceeds to life the posterior skin edge of the left axilla to prevent skin folds from occurring. Patient’s left arm is then pulled across and behind the image receptor holder. Patient’s elbow is also flexed so that the forearm can be placed on the unit for support and elbow is positioned so that it hangs down comfortably behind the holder. The humeral head is gently pushed forward and the corner of image receptor lies in the axilla, anterior to posterior fold. While the patient maintains the position, radiographer double check to ensure there is no skin fold in the axilla or under the lateral aspect of the breast and to check for and remove any creases at the inframammary angle. The breast is then lifted up and away from the chest wall while holding the patient’s left shoulder. The breast is then placed on the image receptor and compression is applied. Projection on the left breast is then taken. The same MLO view projection is then repeated vice versa on the right breast of patient.

Upon completion of the examination, patient is advised to change back to her clothes. Patient is then escorted out and at the same time patient is informed on her next appointment for the review of results with the radiologist. Any discussion on the results with patient prior to the review of radiologist is prohibited.

Mammography has been long known to be an effective modality for breast screening. Such examination improves physician’s ability to detect small tumors and early treatment can be performed to reduce mortality rate. Mammogram is also the only proven method to reliably detect tumors as well as all types of breast cancer, including invasive ductal and invasive lobular cancer. Radiation used in mammography examination is of low dosage and usually has no side effects towards patient. Moreover, radiation does not remain in patient’s body after the examination. Despite its benefits in the purpose of screening and diagnostic, mammography poses certain risks towards its patients. There is a slight chance of cancer from excessive exposure to radiation. The effective radiation dose for this procedure varies depending on the thickness of tissue. However, radiographers are trained to use the lowest radiation dose possible for radiation protection purposes while producing the best images for evaluation. False positive mammogram is also one of the risks in performing mammogram. Five percent to 15 percent of screening mammograms need more testing such as additional view for mammograms or ultrasound to further determine suspected abnormality. Most of the further tests turn out to be normal. However if there is an abnormal finding, biopsy may be performed on the patient to determine whether the tumor is benign or malignant. Women above the age of 40 are normally advised for a mammogram annually as they pose a higher risk of being diagnose with breast cancer. However, an ultrasound is more preferably performed on patients below the age of 40 as their breasts tissue is denser. Last but not least, women of all age should go for routine breast check up regularly for early detection on any breast abnormalities.

Above diagram shows a conventional cassette film mammogram machine.

Above diagram shows a Craniocaudal (CC) mammography view in progress.

Above diagram shows a Mediolateral Oblique (MLO) view in progress.

Above diagram shows a normal (left) mammography image compared to cancerous (right) mammography image.