評估台灣地區乳房攝影品質控制、輻射劑量及射束品質量測修正方法

EVALUATION OF MAMMOGRAPHY QUALITY CONTROL, RADIATION DOSE AND MODIFIED X-RAY BEAM QUALITY ASSESSMENT IN TAIWAN

中文摘要

美國於 1992 年訂定乳房攝影品管標準法案(MQSA: Mammography Quality Standard Act)，乳房攝影品質管制逐漸為台灣放射診斷領域所重視且不可忽略的項目之一。

本研究共分為三部份：第一部分為乳房攝影品質控制之評估與必要性；第二部分為乳房攝影照相模式參考指標評估乳房攝影輻射劑量之安全性；第三部份為修正式乳房攝影半值層量測法之評估。

第一部分主要探討台灣地區 2002 年(總計 54 家醫院)與 2003 年(總計 78 家醫院)乳房攝影品管現況，針對實地檢測儀器品管部分之 X 光半值層與平均乳線劑量、洗片機品質管制、假體影像品質評估等三部份，採用行政院衛生署訂定之乳房 X 光攝影醫療機構認證原則之評核方式評分。2002 年針對洗片機品管、假體影像評估、半值層與平均乳腺劑量及格醫院比例。洗片機品管部份及格醫院比例為百分之三十七；假體影像部分及格醫院比例為百分之七十八；平均乳腺劑量部分及格醫院比例為百分一百。2003 年洗片機品管部份及格醫院比例為百分之七十九；假體影像部分及格醫院比例為百分之八十七點五；半值層部分及格醫院比例為百分之九十六點七；平均乳腺劑量部分及格醫院比例仍然維持為百分之百。穩定之洗片機品管狀況對於假體影像中之條狀纖維及顯微鈣化群模擬物，具有較明顯之關聯意義，尤其是點狀顯微鈣化模擬物(Speck)其 r 值>0.5，故具有較明顯之關聯意義。將顯微鈣化群模擬物以群組分類成兩組 Group，Group one 為顯微鈣化群模擬物判讀值低於 3(含 3)以下；Group two 為顯微鈣化群模擬物判讀值高於 3(不含 3)以上，將該兩組 Group 以 Mann-Whitney Rank Sum Test 比較後發現之結果呈現出 Group 1 之整體洗片機品管評分結果比 Group 2 要來的低。

第二部份於台北某市立醫院臨床測試下， 320 位受試者每位執行 4 組乳房攝影照相，平均受測年齡為 51.3 歲。結果顯示正位向與斜位向之乳房壓迫厚度具有顯著差異(p<0.001)。放射師所選定之照相 kV 與受檢者之乳房厚度於標準四組 X 光照射角度具有高度之正相關性(p<0.001)。於乳房攝影照相模式參考指標下接受估計的 1280 組乳房攝影片中， 87%乳房攝影片使用 Mode 1 與 Mode 2 照相模式參考指標，其所接受之輻射劑量遠低於 300 毫雷德(Mode 1: Mean=118.4±60.2 毫雷德 with 571 D.F., p<0.001; Mode 2: Mean=200.8±85.4 毫雷德 with 537 D.F., p<0.001) 。受試者於 Mode 3 下約有 5%高於最大輻射吸收劑量 300 毫雷德

(Mean=314.4±140.6 毫雷德 with 147 D.F., p=0.292) 。照相模式參考指標下 Mode 1 之乳房壓迫厚度設定爲 0 至 30 毫米；Mode 2 之乳房壓迫厚度設定爲 31 至 45 毫米；Mode 3 之乳房壓迫厚度設定爲 46 至 60 毫米。結果顯示受檢者於照相模式參考指標下所接收之輻射吸收劑量符合法案 MQSA 中所訂定之標準。以本次估計結果顯示平均乳房壓迫厚度爲 32.3 毫米(p<0.001)，我們建議針對乳房壓迫厚度低於 45 毫米以下者，其所接受之平均乳腺劑量應有向下修正之必要性。

第三部份主要探討台灣針對乳房攝影品質管制目前採用以實地檢測方式進行，此方法雖耗費人力但是對於初期全面性資料的取得具有正面之意義。然而於檢測過程當中針對 X 光射束品質量測部份，即所謂半值層量測部分，若使用美國放射線學院之量測方法，針對部分乳房攝影機會有量測上之不一致性與量測數據之偏差發生。本研究方法以臨床實用性、量測穩定性之觀念針對美國放射線學院之量測方法做部分修正，總計估計台灣地區 69 家醫院 11 種不同廠牌之乳房攝影機，依院方之專業放射師提供之兩組照相 kV 同時使用美國放射線學院之量測方法(HVL_ACR)與修正式乳房攝影半值層量測法(HVL1)進行評估比較，最後取得 276 筆資料進行分析。以線性迴歸模型檢定 HVL_ACR 與 HVL1 兩種方法，HVL_ACR 平均半值層數值爲 0.35 毫米 (S.D. HVL_ACR =0.024)； HVL1 平均半值層數值爲 0.35 毫米(S.D. HVL1 =0.024)。r=0.9715, r-square = 0.9437(p<0.001), Coefficient=0.976993, p<.001.Standard Error=0.0204579(p<0.001)。

英文摘要

Taiwan governments started overall screening mammography on 2004. The policy of screening mammogram has announced by Department of Health, Executive Yuan, Taiwan, and start on July, 2004. Breast radiation dose is the most important issue when starting screening mammography. Through this study we would like to know that the situation and understand why they need to accessed these quality control tests, younger women’s radiation dose, radiation dose per mammogram, significance in different compressed breast thickness, And finally we modified Halve value layer measured procedure.

The study was devided three parts: Estimation and Imperative of Mammography Quality Control, Mammography Radiation Dose Safety By the Evaluation of Exposure Setting Parameters and Evaluation of X-Ray Beam Quality (HVL) Analogous Assessment in Mammography.

The first study, we estimated the mammography processor quality control data and facilities proformance such as HVL and Average Glandular Dose on 2002 and 2003. The results showed that the phantom image was improved through mammography

quality control project. And there is highly significant between processor quality and speck groups.

The second study, 320 subjects are participanted, every subject takes 4 exposure views(mammograms). Average estimated age is 51.3 years old. There is a significant difference of compressed breast thickness ($p<0.001$) between Cranio Caudal view and Medio Lateral Oblique view. The results also show 87% mammograms have significantly lower absorbed radiation dose compared with 300mrad when breast compressed thickness below 45mm(Mode 1: Mean=118.4±60.2mrad with 571 D.F., $p<0.001$; Mode 2: Mean=200.8±85.4mrad with 537 D.F., $p<0.001$). About 5% estimated mammograms result in higher absorbed radiation dose (>300mrad) when breast thickness between 46mm to 60mm (Mode 3: Mean=314.4±140.6mrad with 147 D.F., $p=0.292$).

The third study, we used more standard and easier procedure (named HVL1) to assess mammography x-ray beam quality. Prospectively compare HVL1 with standard ACR procedures (named HVL_ACR) for Halve Value Layer estimation in all mammographic units. Total 11 mammographic brands, 69 hospitals, and 276 estimated HVL data are evaluated in our study. Each hospital selected two most commonly used clinical kVp. Both HVL1 and HVL_ACR are evaluated at each kVp. 70.3% estimated data chose 25kVp and 26kVp settings. HVL1 procedure gets the same result in compared with HVL_ACR procedure. It shows a positive relationship between HVL1 and HVL_ACR ($r= 0.9715$, R-Square = 0.9437, $p<0.001$). For GE, Toshiba, and Instrumentarium mammographic units, there are no significant difference between HVL_AVR and HVL1 ($t = 1.63197$, 1.83557, and 2.90656 respectively ($p >0.001$)). Furthermore, HVL1 had better results on photon energy reproducibility (Regression between E0a and E0b, where $r=0.9935$(ACR mode), $r=0.9969$(HVL1 mode), $p<0.001$). With this new procedure of HVL measurement, we get the same and accurate data as the standard procedure provided by ACR mammography QC manual.