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THE CORRELATION BETWEEN PRE-TEST PROBABILITY AND V/Q SCAN RESULTS IN PATIENTS PRESENTING WITH SUSPECTED PULMONARY EMBOLISM

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science (MSc), in Emergency Medicine.

JOHANNESBURG, 2016

DECLARATION

I declare that this is my own unaided work. It is being submitted for the degree of Master of Science (MSc), in Emergency Medicine, to the University of the Witwatersrand. It has not been submitted before for any other degree or examination at this or any other University.

_____ _____

Abdul Basit Rahmani Date

ETHICS COMMITTEE APPROVAL

Approval for this study was granted by the Human Research Ethics Committee, University of the Witwatersrand (Clearance Certificate Protocol Number – M090903 / Reference Number R14/49).

DEDICATION

This work is dedicated to my family and all my educators.

ABSTRACT

Pulmonary embolism (PE) is a major diagnostic challenge facing emergency medicine physicians. It affects over 900,000 patients every year. Only two-thirds of the patients affected are alive one month after the diagnosis, while only half live to about a year.

The exact aetiology is not known, but several risk factors have been implicated in the aetio-pathogenesis of the disease. Furthermore, as this disease has no definitive symptoms or signs, the diagnosis in patients suspected of harbouring a PE is only confirmed or excluded after special investigations.

Although anticoagulation is an effective treatment, it has its inherent side-effects and associated morbidity. Thus, it is prudent to utilize clinical scoring systems to direct diagnostic pathways prior to instituting treatment. In this regard, several clinical decisions have been promoted to assist physicians in the workup of a patient with hypoxia. One well advocated rule is the Wells criteria, which consists of seven components, each of which is given a score. All the scores are then added up to give a total, i.e. the Wells score. Based on the Wells score, the clinician is then able to assign a clinical pre-test probability of the patient having PE – i.e. low, medium or high risk.

Although a pulmonary angiography offers the only definitive means of establishing a diagnosis of PE, it is not practical to employ such an invasive and expensive technique as a screening test. The V/Q scan has been widely used instead; and, has been shown to be an effective non-invasive procedure for the detection of PE.

Patients referred for a ventilation-perfusion scan (V/Q scan) are categorised as having no typical evidence of PE, or very low probability, low probability, intermediate probability or high probability of having a PE.

Objective: The study set out to determine the correlation between the probability given by the Wells score and the probability obtained from the V/Q scan results.

Methods: The study entails a retrospective analysis of 120 adult patients (>18 years of age), who were referred for a V/Q scan for suspected pulmonary embolism at Charlotte Maxeke Johannesburg Academic Hospital and Chris Hani Baragwanath Academic Hospital over a 16 month period.

Clinical notes were obtained to ascertain risk factors, presenting symptoms and other data to determine pre-test probability of having a pulmonary embolus. This pre-test probability was categorised according to the Wells score into low, moderate or high risk to provide a more objective measure. The V/Q scan results were obtained from the Nuclear Medicine Department at the health care facility, and these results were subsequently compared to the Wells score in order to establish a correlation between the two parameters, i.e. pre-test probability vs V/Q scan results.

Results: The sample population comprised of patients from various age groups, ranging from 18 years to 86 years of age. The median age was 55 years, with almost half of the patients being in the 6^{th} and 7^{th} decades of life.

Significant risk factors in our setting were found to be advanced age, history of immobilisation and acute medical illnesses. In the younger population, a history of immobilisation due to trauma or post surgery, and HIV/AIDS were found to be the most significant risk factors.

Based on the history, and presenting signs and symptoms, all the patients were initially categorised into low, moderate or high pre-test probability based on the Wells score. The majority of the patients were categorised as moderate risk (59%). Thirty percent (36 patients) were categorised as low risk, and the remainder (11%) as high risk for having a PE.

On the V/Q scan results, a total of 74% of patients scanned fell into the low probability, very low probability or no typical evidence category. For the purposes of statistical analysis, these three categories were combined into one category, labelled simply as low probability. Thirteen percent of the patients were classified as

intermediate probability and the remaining thirteen percent as high probability on the V/Q scan.

On analysis of the data, 80% of patients that were initially categorised as low risk based on the Wells score were also classified as low probability on the V/Q scan results (this category included the low probability, very low probability or no typical evidence categories as mentioned earlier). Of the patients classified initially as high risk on the Wells score, only 15% were also classified as high probability on the V/Q scan results.

Conclusion: Of the 120 patients studied, only 15 patients (13%) turned out to have a high probability of PE on the VQ scan. Our study demonstrated good agreement between patients with low risk of PE on the Wells score compared to the low probability of PE on the V/Q scan results. Practically this implies that if a physician finds himself in a health care centre lacking a nuclear medicine facility, he may safely base management decisions in patients with a low pre-test risk of PE on the Wells score. However, there was poor agreement between the moderate and high risk patients compared to the intermediate and high probability of PE on the V/Q scan results, respectively. These patients would require a V/Q scan to guide management decisions.

Many factors may have contributed to this poor agreement in our setting. The first factor is the diagnostic workup and inappropriate investigation of patients in the public sector hospitals. Since the patients were referred based solely on presenting signs and symptoms, it is possible that some patients were referred inappropriately for V/Q scans. We do acknowledge that this diagnosis is not always easy clinically in light of the non-specific signs and symptoms. It is for this very reason that clinical decision rules, such as the Wells prediction rule, have been developed in an attempt to improve implicit clinical judgement. The patients in our sample population may not have been referred for a V/Q scan primarily based on the Wells score. Instead, the Wells score was often calculated in retrospect by the investigating departments.

Furthermore, this being a retrospective analysis, no formal diagnostic pathways were followed prior to requesting a V/Q scan. It seems from the results however, that some patients had been subjected to a V/Q scan unnecessarily, despite having a low pre-test probability as well as negative D-dimer results. The V/Q scan could have been entirely avoided in these patients and thus prevented unnecessary radiation exposure. A further prospective study with a larger patient base may yield more conclusive results.

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LIST OF ABBREVIATIONS

ABC – Airway, Breathing, Circulation

ACCP – American College of Chest Physicians

AHA – American Heart Association

AIDS – Acquired Immuno-Deficiency Syndrome

aPTT – activated Partial Thromboplastin Time

BNP – Brain-type natriuretic peptide

CCF – Congestive Cardiac Failure

CHBAH – Chris Hani Baragwanath Academic Hospital

CMJAH – Charlotte Maxeke Johannesburg Academic Hospital

COPD – Chronic Obstructive Pulmonary Disease

CT – Computed Tomography

CTPA – Computed Tomography Pulmonary Angiogram

DVT – Deep Vein Thrombosis

ECG – Electrocardiogram

ECHO – Echocardiography

ED – Emergency Department

ELISA – Enzyme-Linked Immunosorbent Assay

FDA – Food and Drug Administration

HIV – Human Immunodeficiency Virus

IMA – Ischemia-Modified Albumin

INR – International Normalised Ratio

IVC – Inferior Vena Cava

LMWH – Low–Molecular Weight Heparin

MDCTA – Multidetector-row Computed Tomography Angiography

M:F – Male to Female ratio

MI – Myocardial Infarction

MR – Magnetic Resonance

NFD – Nephrogenic fibrosing dermopathy

NSF – Nephrogenic systemic fibrosis

NT-pro-BNP - *N* -terminal pro-Brain Natriuretic Peptide

PA – Pulmonary Angiogram

PE – Pulmonary embolism

PIOPED – Prospective Investigation of Pulmonary Embolism Diagnosis

UFH – Unfractionated heparin

US – United States

V/Q scan – Ventilation perfusion scan

VTE – Venous Thrombo-Embolism