Changing Trends in CT Pulmonary Angiography (CTPA) - the experience of the Maltese National Hospital

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Aims and objectives

Pulmonary Embolism (PE) is associated with substantial morbidity and mortality - in England and Wales 65,000 cases of PE are documented annually amongst hospitalised patients [1]. Prevalence of unsuspected PE at post-mortem autopsy is 3-8%, suggesting that the number of cases may be higher than that diagnosed at present [2].

Clinical diagnosis of PE remains difficult in view of variation in presentation, symptoms and signs between patients [3]. Thus the use of Computed Tomography Pulmonary Angiography (CTPA) as the first investigation is increasingly noted. Reasons for this include: increasing accuracy of the scan having very good positive and negative predictive values when compared to other tests, increasing accessibility after hours, and the ability to offer alternative diagnoses [4-6]. Current studies report CTPA positivity rates between 9 and 29% [8-11]. For these reasons CTPA is the investigation of choice in most guidelines, including the British Thoracic Society guidelines. CTPA however also has disadvantages, namely exposure to radiation and small risk of contrast-induced nephropathy. It is also an expensive test itself, further increasing costs when incidental findings needing further investigations are encountered [7]. Therefore the assessment of clinical pre-test probability using validated clinical scores and D-Dimer testing remains very important in the management of suspected PE.

We have carried out an audit cycle to observe the changing patterns of referrals for CTPA in suspected PE and positivity rates. Secondary aims included assessment of diagnostic quality of CTPA in our department, source of referral, number of out of hours scans and percentage of alternative diagnosis made on CTPA.
Methods and materials

This audit cycle was carried out in Mater Dei Hospital, the acute general teaching hospital of the Maltese islands. The first cycle included data from 1st June 2010 till 31st May 2011 and the second cycle between 1st January 2013 and 30th June 2013. All CT pulmonary angiograms performed in these time intervals were identified and retrospectively reviewed on Radiology Information System (RIS) and Picture Archiving and Communication System (PACS). Data collected for both cycles includes the following:

- total number of CT pulmonary angiograms performed
- source of referral
- total number of positive CT pulmonary angiograms
- diagnostic quality of each examination, by measuring the Hounsfield units (HU) at the main pulmonary trunk (>250: technically adequate scan, <249: suboptimal investigation)
- whether an alternative diagnosis is present in the negative scans for PE
- time of scan: within or out of hours

Data was recorded using Excel Worksheet. Statistical analysis was performed using SPSS version 20. No ethical approval was required.
Results

A total of 220 CT pulmonary angiograms were performed in the 12-month period of the first cycle. Over the 6-month period of the second cycle the total number was noted to increase to 370, an increase of more than 300%. The positive rate of CTPA in the first cycle was 19.4% (n=220), decreasing to 11% (n=370) in the second cycle (Fig.1). Analysis using the Fisher exact statistical test demonstrates this to be a statistically significant change ($p=.010$ with 1 degrees of freedom). Referrals from Accident and Emergency and General Medicine departments increased over the time interval, whereas those from surgical department decreased (Fig.2). The number of scans performed out of hours increased from 12% to 19%. Technical adequacy of the scans was noted to decreased from 89% to 74% (Fig.3). In the second cycle it was noted that 20 out of 98 scans (20.4%) performed out of hours were technically inadequate compared to 50 out of 263 scans (19.0%) performed during normal working hours (Fig.4). This is not shown to be statistically significant when analysed by Fisher’s exact statistical test ($p = .77$), as expected since these scans are performed by trained radiographers even when performed out of hours. Incidence of alternative diagnosis decreased from 52% to 44%. The commonest alternative diagnoses made on CTPA were congestive heart failure and consolidation. It was also noted during the second phase of the cycle that 11.6% of patients who had CTPA for exclusion of PE did not have a chest X-Ray taken prior to the scan, with only 62.7% of patients having had a chest X-Ray 24 hours prior to the CTPA (Fig.5). 50% of those having had a chest X-ray prior to the CTPA, already had a documented abnormality reported on the chest X-Ray (Fig.6). Furthermore, it was demonstrated that 58% of patients undergoing CTPA did not have a D-Dimer taken (Fig.7).
Fig. 1: Graph demonstrating the percentage of positive and negative CTPA. This difference is statistically significant as demonstrated by the Fisher’s exact statistical test (p=.010)

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Fig. 3: Graph demonstrating assessment of technical adequacy of the scan (%)  
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Fig. 4: Graph demonstrating difference in technical adequacy between scans performed within and out of hours - this difference is not found to be statistically significant when analysed by a Fisher’s exact statistical test, (p=.77)

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Fig. 5: Graph representing the number of patients who had a chest X-Ray performed prior to CTPA scan

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Fig. 2: Sources of referral (%) 

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Fig. 7: Pie-chart depicting the use of D-Dimer prior to CTPA. In 58%, this test was not taken.

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Fig. 6: Pie-chart demonstrating the result of chest X-Ray performed prior to CTPA

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Conclusion

Between the year 2011 and 2013 we have noted a steep increase in the total number of CTPA performed. This was accompanied by a statistically significant decline in the number of positive scans and a drop in alternative diagnosis.

It is also noted that 50.3% of the scans performed had an abnormal chest X-Ray prior to the scan. The most common abnormalities included congestive heart failure and consolidation suggestive of pneumonia. We did not however assess whether the clinical history and examination suggested the alternative diagnosis.

Recently reviewed management guidelines for suspected PE continue to emphasise the importance of pretest probability to guide the choice of test to perform. This is especially important since the positive predictive value of CTPA is dependant on pre-test probability [12-13].

Our audit demonstrates that CTPA is increasingly being used as a first diagnostic test when a diagnosis of PE is suspected, with the number of positive scans decreasing significantly over a 2 year time interval. Less strict adherence to existing pre-test probability scores and guidelines is the suspected cause for this change. Similar reflections are also made upon review of recent published studies performed in other medical centres worldwide.

We recommend stricter compliance to pre-test clinical scoring guidelines. Referring physicians should be made aware of audit results and sensitised to the risk-benefit issues with respect to CTPA in the diagnostic pathway of suspected PE.
References


