Evaluation of negative predictive value (NPV) of 16-Row CT angiography in comparison with conventional angiography

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Abstract: Negative predictive value (NPV) is one of the important indicatives for evaluating a medical procedure. Herein, we have evaluated the NPV of 16-multidetector-row CT angiography (CTA) in comparison with conventional invasive angiography (CIA) in the diagnosis of significant stenosis. In this regard, 8 patients suspected to stenosis were investigated. They patients were undertaken CIA procedure after CTA. The obtained results show, the NPV of 50% for patient-base analysis. The findings of this study reveal that CT angiography with 16-slice scanner might be considered as an acceptable technique for rapid triage of patients. Low values of NPV reveal a moderate performance of CTA. However, due to low number of patients, the obtained results cannot be used for final decision. Hence, more is required to improve and achieve reliable results.
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1. Introduction

Coronary artery disease is one of the main causes of disability and death all over the world. It is well-established that the conventional invasive angiography (CIA) is employed as crucial main protocol for diagnose of artery disease [1-3]. CIA is highly reliable compared to other indirect evaluation methods such as stress testing. However, CIA is not a good choice in some cases due to its invasive nature and the risks of complications i.e. arrhythmia, myocardial infarction, stroke, access site problems, etc. Furthermore, nearly 1/3 of CIAs were reported to be normal, and therefore this invasive procedure is not necessary for all patients [1]. Finally, there are constraints on the amount of CIA that can be undertaken, in terms of the cardiologist time. Therefore, an accurate non-invasive alternative evaluation method for diagnosing coronary artery disease is highly desirable. In order to overcome the complications of CIA, multi-slice computed tomography angiography (CTA) has been proposed in recent years as an alternative procedure for determining the presence of coronary obstructions. With the recent development in hardware with multiple detectors, the spatial resolution of the images has been significantly improved and consequently CTA has become the center of interest for clinicians. The imaging machines facilitated the rapid identification and assessment of atherosclerosis within the moving coronary arteries and potentially reduced the necessity of CIA method.

In order to overcome the complications of CIA, multi-slice computed tomography angiography (CTA) has been proposed in recent years as an alternative procedure for determining the presence of coronary obstructions. With the recent development in hardware with multiple detectors, the spatial resolution of the images has been significantly improved and consequently CTA has become the center of interest for clinicians. The 4-slice, 16-slice and 64-slice imaging machines have been utilized in 1998, 2001 and 2004, respectively [2]. These machines facilitated the rapid identification and assessment of atherosclerosis within the moving coronary arteries and potentially reduced the necessity of CIA. In Ref. [4] one can find another comprehensive systematic review and meta-analysis of the clinical effectiveness and cost-effectiveness of 64-slice or higher CTA as an alternative to CIA for detecting coronary artery disease. Other systematic reviews on evaluation 64-Slice CTA in the diagnosis and assessment of coronary artery disease has been conducted in refs. [2, 5,6]. Stein et al. [7] preformed a systematic review on 64-slice CTA for diagnosis of coronary artery disease. They concluded that negative CTA reliably excluded significant coronary artery disease. However, the data suggest that stenosis shown on CTA need confirmation. Combining the results of 64-slice CTA with a pretest clinical probability assessment would strengthen the diagnosis [7,8]. Further useful findings can be found in other works [9-14].

In this regard, the present study is conducted using a 16-row-detector CT scanner to evaluate the negative predictive value of CTA in identifying significant stenosis. The accuracy of 16-row CTA is compared with that of CIA method.

2. Methods

2.1. Patients

The study population was chosen from patients referred to hospitals with suspected coronary artery disease. In this study 8 patients asked to participate. According to cardiologist diagnoses, all these patients underwent CIA after CTA performed. Exclusion criteria for CTA were based on technical factors that made the patient unsuitable for the procedure. These included known allergic reaction to iodinated contrast agents, high baseline heart rate (>70 beats/min) with contraindication to beta-blockade, atrial fibrillation, inability to perform a 15-s breath hold, inability to lie flat, abnormal renal function (serum creatinine level >1.5 mg/dL).

2.2. Scanning Protocol

All patients were scanned with a 16-slice CT scanner. A dose of 15 ml contrast material was used during the bolus timing scan calculated (by the apparatus software) at the level of the descending aorta. All data sets acquired were reconstructed from the axial images using retrospective electrocardiogram gating.

The reconstructed images were visually evaluated for estimation of coronary artery narrowing. The judgment about the absence/presence of desises was made after viewing the various images and checking stenosis of main coronary vessels.

2.3. CIA procedure and analysis

Routine CIA was performed via the femoral or radial artery. All evaluated vessels were classified as normal as having non-significant disease, or as having significant stenosis. Accordingly, patients were classified as positive for the presence of significant coronary artery disease if there was a significant stenosis in any artery.

2.4. Statistical Analysis

The CTA accuracy for detecting vessel stenosis was evaluated via an indicative statistical parameter i.e. negative predictive value (NPV). These parameters were calculated for patient and presented as percentage.

3. Results

The characteristics of the 8 patients were analyzed and the result is presented in Table 1. The obtained result reveals that patients were diagnose as normal by both CIA and CTA.

Table 1: Diagnostic performance of CTA for the detection of >50% stenosis for patient-based analysis.

Analysis	NPV %
Patient based	50

Many progresses have been accomplished to provide the time-saving accurate diagnostic protocols for suspected patients. The advent of 16-slice CT scanners accelerated this evolution. CTA is recommended useful especially for patients due to the higher complications of CIA. However, a crucial issue is to understand how much the CTA findings are close to those of CIA. According to the patient-based data presented in Table 1, CTA have a NPV of 50 % when compared to CIA procedure.

Comparison between the obtained result and those presented in other review papers [5, 6], show that the patient-based NPV of presented study are less than the values reported by previous researchers for 64-slice CTA. Comparing the present study with other investigations reveals that the computed NPV is much less than those reported in literature [5,6]. This reveals a moderate performance of CTA.

3.1 Limitations

It should be remarked that the present study is conducted on a very limited works, hence, obtained results might not be generalized. The following limitations to the present study should be considered. First, note that patients exposed to higher dose of radiation in CTA procedure in comparison with CIA [25]. Therefore, concerns should be raised about applying conservative radiation dose, and careful patient selection especially in the cases of young people and women of childbearing age [26]. Therefore, the present diagnostic performance may not be directly applicable to patients with a lower prevalence of diseases. Finally, it should be noted that heavy coronary calcification and consequent beam hardening is the major limitations to reliable evaluation of all coronary arteries [27-29]. In these cases CIA might be more useful than CTA to obtain completely reliable diagnoses.

4. Conclusions

In this work negative predicted value (NPV) is considered to examine the replacement of two CTA and CIA methods for the detection of significant coronary artery stenosis. The obtained results demonstrated moderate diagnostic accuracy for the 16-row CTA. CTA had the negative predictive value of 50%. The value of NPV reveals a moderate performance of CTA. Due to the low number of

patients, further investigations is required to determine whether 16-row scanning technology has sufficient resolution to delineate coronary artery diseases. Hence the presented results are not accepted.

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