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Dual- axis rotational coronary angiography

Abstract

This paper presents and discusses one of the imaging modalities of the coronary arteries: dual- axis rotational coronary angiography, its benefits as well as limitations, including a review of research studies and publications. Information from conducted clinical trials as well as individual conclusions and experience of operators were taken into consideration.

Keywords: coronary angiography, cardiac swing

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Introduction

Coronary angiography is a basic imaging modality for coronary arteries and a gold standard in the diagnostic workup of the ischemic heart disease. The angiography involves infusion of an x-ray opaque contrast agent into coronary arteries that is subsequently imaged using fluoroscopy. Coronary angiography aims at localizing stenosis in coronary arteries (vessel type, segment), evaluating patency of arteries, degree of their stenosis as well as detect possible hemodynamic abnormalities during the procedure. During the conventional coronary angiography, the operator must visualize the coronary arteries in several planes (most commonly three views for the right coronary artery and on average four to six views for the left coronary artery) to accurately estimate a stenosis and adequately qualify it to possible further revascularization.

Historical perspective

Due to numerous limitations associated with this diagnostic modality – often tortuous arteries, overlapping lumenograms of coronary arteries and eccentric atherosclerotic plaques, often additional recordings are required to minimize the risk of missing a lesion or underestimate a lesion. A natural consequence of attempts to improve conventional coronary angiography was a concept to create an imaging modality using a dynamic motion of C arm of the angiograph. First such attempts were undertaken as early as in 1998 [1], initially involving motion of the C arm only in one plane and finally fully functional multi-plane rotational angiography and XperSwing were launched by Philips at the beginning of 2006.

Description of the method

Dual- axis rotational coronary angiography (also known as cardiac swing) is an imaging modality of coronary arteries that involves administration of a x-ray contrast agent into a coronary vessel with simultaneous continuous rotation of the angiograph arm according to preprogrammed trajectories, unique for the left and right coronary artery.

Benefits

One administration of a contrast agent provides full image of a coronary artery, corresponding to views of conventional coronary angiography and ability to assess intermediate views, providing more information on the coronary artery with regard to borderline significant changes, without the need for additional views. This is the most important and basic benefit of the rotational angiography – often avoiding missing or underestimation of a coronary lesion. This directly translates to patient safety and adequacy of the provided revascularization therapy.

Volume of the contrast agent used during a conventional coronary angiography is approximately 60 ml, while cardiac swing requires 25 – 30 ml. Reduction of dose of the contrast agent by 40 – 60% [2] optimizes our attempts to obtain maximum nephroprotection in all patients, including those with chronic kidney disease [2], patients with risk factors of contrast induced acute kidney injury (CI-AKI) as well as in healthy subjects. Objective reduction of volume of the contrast agent is an obvious thing, while its effect on patient's health is not. Currently there is an ongoing clinical trial at our center, enrolling 200 patients, to demonstrate if reduction of volume of

the contrast agent through the use of the dual- axis rotational coronary angiography has statistically significant effect on reduction of incidence of contrast induced kidney injury, including contrast-induced nephropathy, versus conventional coronary angiography (CORSAIR study).

Lower amount of a contrast agent injected into coronary arteries not only limits the use of the contrast agent but also shortens the procedure by 28 – 71% and reduced the absorbed dose of radiation by 32 – 61% [4] both by the patient and the operator. Usually the contrast agent is introduced to a coronary vessel during the dual- axis rotational coronary angiography using an automatic infusion pump synchronized with the angiograph. This is an additional benefit – during acquisition, the medical staff involved in the cardiac swing procedure is outside the x-ray radiation, which results in marked improvement of radioprotection.

Last but not least, economic and financial aspects of the cardiac swing procedure must be mentioned. It must be emphasized that in an era of reduction of funding of cardiac invasive procedures, reduction of use of the contrast agent utilized during the coronary angiography procedure by half results in clear benefits and resulting savings may be used for the further development of the Catheterization Laboratory.

Limitations

Despite undeniable benefits of the dual- axis rotational coronary angiography, limitations of the procedure must also be mentioned. The principal one involves requirement for selective intubation of a coronary vessel before the recording is made. A single administration of 10 – 14 ml of the contrast agent to a coronary artery requires precise infusion, which in cases of atypical anatomies with regard to origin of the coronary artery, makes cardiac swing impossible, e.g. using ante portes technique. Under certain circumstances a diagnostic catheter may fall out from the vessel ostium during the injection of the contrast agent, requiring repeated selective intubation of the coronary artery, repeated recording and administration of another dose of the contrast agent. However, such situation may also occur during a conventional coronary angiography. The cardiac swing may be potentially risky if there is a suspicion of significant stenosis of the ostium of the left main coronary artery and ostium of the right coronary artery due to a risk of wedging of the diagnostic catheter, which eventually may result in life threatening arrhythmias.

The dual- axis rotational coronary angiography is currently not available in all Catheterization Laboratories and, as any new medical procedure, has a learning curve and its efficient management takes time [5]. In rare cases, morbid obesity of patients may limit full range of motions of the angiograph C arm and then the cardiac swing could not be used. However, this does not mean that conventional coronary angiography can be performed in such patients without any major problems.

Summary

In conclusion, the dual- axis rotational coronary angiography has many undeniable benefits supported by clinical trials. This is an imaging modality of coronary arteries that results in reduction of both contrast volume and dose of radiation as well as shortening of the procedure itself [4, 6]. The presented procedure may become a standard method of invasive diagnostics of the coronary arteries with the exception of few situations related to limitations of the method itself and its propagation seems the next step in the development of the invasive cardiology procedures. Despite numerous, above mentioned benefits of the cardiac swing, currently there are ongoing research studies at many centers to confirm another, clinically significant benefits of this procedure.

Literature

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