BMH MEDICAL JOURNAL

BMH Medical Journal 2016;3(3):59-60 **Editorial**

Robotic PCI - Has It Come of Age?

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Keywords: robotic enhanced percutaneous coronary intervention, conventional percutaneous coronary intervention

Last issue of the Journal contained an article on the benefits of robotic telesurgery [1]. Now we would like to examine another aspect of robotics in medicine - Robotic enhanced percutaneous coronary intervention (PCI). The first-in-humans pilot clinical trial involving 18 patients was published in 2006 [2]. In this study angioplasty guidewire, balloon and stents were navigated by a computerized system. The guidewire could cross the lesion successfully in 17 cases and 15 of these cases could be successfully completed by remote navigation. The remaining 3 cases were completed manually. The proposed advantages of the system was a significantly lower radiation exposure to the operator and possibly more precise positioning of the coronary stent. There was no increase in fluoroscopy time.

After this initial pilot study several technological advances have occurred in the remote navigation system. There is a patient side cassette which drives the devices within the vascular tree and a remote computerized console from which the operator does the remote navigation. In the initial systems, the operator console had only facility for device movements. Angiographic monitors were at the bedside, at a distance from the operator. Now the larger console has multiple monitors in addition, to view the angiographic images with facility for computerized lesion measurement and analysis. This would allow better sizing of lesions and estimation of correct stent size needed. Let us see how these advances have translated into actual advantages to the patient and operator.

PRECISE (Percutaneous Robotically-Enhanced Coronary Intervention) Study was the first large scale study of robotic enhanced PCI involving 164 patients enrolled at 9 sites [3]. Technical success defined as successful manipulation of intracoronary devices using the remote navigation system alone, was achieved in 162 patients (98.8%). Clinical success defined as residual coronary stenosis of less than 30% and absence of major adverse cardiovascular events within 30 days was achieved in 160 patients (97.6%). Four patients (2.4%) had periprocedural non Q wave myocardial infarction. There were no deaths, Q wave myocardial infarctions, stroke or repeat myocardial revascularizations during the 30 days. The remarkable feature was that radiation exposure was 95.2% lesser than conventional procedure for the primary operator. The fluoroscopy time and radiation exposure to the patient was comparable to previous published values for conventional PCI. There is an added advantage to the operator in avoiding the heavy lead apron and potential orthopedic issues. Moreover a sitting position at the console reduces the fatigue factor and could enhance the ability to

make better decisions. A sub study of the same trial reported more complete and faster robotic enhanced PCI, with reduced radiation while not compromising safety after the initial 3 learning cases of each operator [4].

After the initial demonstration of the feasibility of robotic PCI, others have ventured into complex PCI with the robotic system. Kapur V and colleagues used it for multi lesion and multi vessel coronary artery disease, saphenous vein graft intervention and in ST elevation myocardial infarction [5]. They documented enhanced visibility, precise lesion measurement, accurate positioning of the stent and better operator radiation protection with robotic PCI.

A comparison of 40 robotic enhanced PCI with 80 conventional PCI has been published by Smilowitz NR et al [6]. Only two robotic cases needed conversion to manual PCI. Robotic enhanced PCI was associated with a trend towards lower fluoroscopy time, radiation exposure and contrast volume. The impact of precise lesion measurement in potential stent saving has been studied by other investigators [7]. They found that visual stent assessment was accurate only in 21 of the 60 cases studied. In 5 cases, one stent could be saved by robotic measurement compared to visual lesion length assessment. On similar lines, another group of workers showed that robotic enhanced PCI had a significantly lower longitudinal geographic miss compared to conventional PCI [8].

But for the equipment cost, robotic enhanced PCI seems to be a good option both for the operator and subject. We need more studies on hard end points and long term benefits of robotic enhanced PCI to justify the added cost before it can be made a universal recommendation.

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