Research Article

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Comparing 4 and 5 French Catheters in Coronary Angiography: Assessing Radiation Exposure, Screening Time and Contrast Used

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Introduction

In an era where advancement in the technology of medicine is like none before, cardiac catheterization has become a routine procedure which is regularly performed in many healthcare centres. For this reason much research and study have been done on this aspect of cardiology to improve the efficacy of the cardiac catheterization and to minimize complication rate. Catheters and introducer with a smaller diameter have the potential to lower puncture site bleeding and subsequent complication hence allowing earlier ambulation yet still is as effective as catheters of larger diameter [1].

ACIST Contrast Delivery System

In coronary angiography, contrast injection can be done manually or via the use of an automated device. In this study, all contrast injections were done using the automated system – ACIST contrast delivery system. This section is dedicated to further explaining the ACIST medical system. Advanced Contrast Imaging System Technology or ACIST is the name of a medical device company specializing in developing contrast injection medical systems specifically in the field of cardiology and radiology [2]. The 'Contrast Delivery System' is one of the many devices developed and is currently being used in patients in this study.

This system is composed of 5 main components – the AngioTouch hand controller, a touch screen monitor, a built-in air column detection sensor, isolated contrast reservoir and real-time pressure reading [2,3]. The AngioTouch hand controller allows real-time and variable control of the rate of contrast injection [3]. The touch screen monitor provides intuitive prompts for setup, flow rate limit and injection volume adjustments, contrast tracking and procedure monitoring [3]. A built-in air column detection sensor provides alerts if air is detected in the tubing connected to the catheter and automatically terminates injection [3]. The contrast reservoir helps reduce contrast wastage and saves time between cases [3].

Objective

The objective of this study is to evaluate the safety and efficacy of using 4F catheters for coronary angiography done via the radial artery, with the main aim being to show the use of 4F catheters is as effective as 5F, if not better.

Methods

Planning and Data Collection

The hospital for which this study was done uses both computerised system as well as files to store patient information. The data collection involved in this study is done purely via the computerised system. For safety reasons, it is mandatory for procedural details of every patients undergoing angiography to be recorded on a spreadsheet in the cath lab database, even when a project or study is not in process. The spreadsheet was used to collect patient data in this study. The cardiac catheterization facilities in this hospital is a laboratory without on-site cardiothoracic surgical programs and hence is mainly used for cases of diagnostic angiographies. This is a retrospective study of 543 patients of both genders and adults aged over 18 years of age. The 543 patients were identified after exclusion of outliers such as incorrect data entry into the computerised systems. This study involves looking at procedural details of patients who underwent cardiac catheterization for coronary angiography at the hospital in a single cardiac catheter lab in the past 18 months. All catheterizations in this study were done via the radial arterial route. The size of the catheter used in each patient was predetermined by the consultant cardiologist who will be performing the procedure. A total of 5 cardiologists

were involved in this study. Out of the study group of 543 patients, 243 patients underwent cardiac catheterisation with 4F coronary catheters with the remaining 300 undergoing catheterisation with 5F catheters.

Before the procedure, all patients either had their oral anticoagulants discontinued (if they were on any) or had their INR checked to ensure it is below 1.8. All procedure were performed by qualified medical staffs who are experienced in the procedure. A team usually consists of a cardiologist, a radiographer and 2 nurses, though this may vary depending on patients' requirements. For the procedure itself local anaesthetic was administered around the puncture site and Seldinger technique was used to access the radial artery. Radial arterial access was done using 20G Terimo open needle and the insertion of introducer sheath was guided with 020 flexible steel wire. After the coronary catheter is in position contrast is injected via the ACIST contrast delivery system. All contrast used in this study were iodine-based contrast.

After sufficient amount of images were taken the catheter and introducer sheath were removed and haemostasis was achieved by means of external manual compression followed by the use of radial compression device (TR band). Depending on the results of the coronary angiography patients were then discharged or referred on for further interventions. A successful cardiac catheterization is defined as completion of all planned procedure via the radial artery without the need to use another approach. The procedural details or parameters that are involved in this study will be further explained in the section that follows.

Parameters

This study utilizes 4 parameters to assess the efficacy and safety of using 4F coronary catheters: patients' body mass index (BMI), radiation exposure, screening time and amount of contrast used. Patients' BMI is taken into account to standardise the study as a high BMI may be associated with increased screening time and radiation exposure. Radiation exposure is recorded as absorbed dose in the unit of milligray (mGy). Screening time is recorded in seconds (secs) and is defined as the time right after the pedal on the imaging machine is activated by the operator till pedal deactivation. This is done automatically by the recording device. The amount of contrast used is recorded as dose in the unit of millilitres (ml), with a lower contrast dose being considered desirable due to its possible nephrotoxic effects.

After the collection of data and organization of results are completed, all statistical analysis are done using the software 'StatsDirect'. Comparison and analysis of results are done between the group of patients who underwent coronary angiography with 4F catheters (n = 243) versus patients who underwent coronary angiography with 5F catheters (n = 300), instead of between each individual operator.

Results

The table below demonstrates the summary of the data collected from the 543 patients in this study. All parameters: catheter size, radiation exposure, screening time and amount of contrast used for all cases are shown separately in a single table that follows.

Size of catheters (French)	Average exposed radiation dose (mGy/cm^2)	Average amount of contrast used (ml)	Average screening time (seconds)
4	34535	71.0	230
5	38135	78.1	237

Table 1: Summarising the difference between 4 French and 5 French coronary catheters.

Analysis of the results from this study of 543 patients demonstrated an average exposed radiation dose which is significantly lower in the 4F coronary catheter group (34535 vs 38135 mGy/cm^2, P = 0.0365). The mean volume of contrast used was also significantly lesser in the 4F cardiac catheter group (71.0 vs 78.1ml, P = 0.002). The final parameter - screening time also showed a shorter average in the 4F coronary catheter group as compared to the 5F group (230 vs 237 seconds). The difference however has been shown to be not significant (P = 0.65). The mean BMI in the 4F cardiac catheter patient group is 31 ± 8 kg/m^2 whereas the mean for 5F catheter patient group is 29 ± 6 kg/m^2, showing not much difference between the 2 groups and hence should not exert a significant effect on the angiography itself.

Discussion

Advancement in cardiac catheterization techniques have allowed developments in the following areas: introduction of progressively smaller catheters, increase use of radial artery for access hence allowing early ambulation as well as improvements of vascular closure or compression device. The use of smaller gauge cardiac catheter (4F in this case) will further lower complications, and though closure devices are routinely being used they may not be necessary if hemostasis can be achieved through external compression alone [1,4]. An overall reduction in cases of access site complications in recent years has been attributed to the use of smaller gauge cardiac catheters together with other improvements in techniques [1,5].

This current study compares radiation exposure and screening time together with amount of contrast used between coronary angiography performed using 4F and 5F cardiac catheters. Some operators report problems in handling and difficulty with injection of contrast resulting in prolonged screening times using 4F catheters. This study has however shown otherwise, with the average screening time being significantly shorter in the 4F coronary catheter group as compared to 5F group. Studies which are done to assess the image quality produced through the use of 4F cardiac catheters have shown that images are adequate ranging from acceptable to excellent [1].

Conclusion

This study has shown that the use of 4F coronary catheters in diagnostic coronary angiography performed via radial artery may reduce patients' radiation exposure, may be more efficient as less contrast is needed and has the potential to shorten screening

time. 4F cardiac catheters can serve as a good option in patients whose situation is not urgent and where further intervention is not expected immediately.

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