

# Cardiac catheterisation performed by a clinical nurse specialist

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## Abstract

**Objective**—To establish the feasibility and safety of an appropriately trained clinical nurse specialist performing diagnostic cardiac catheterisation.

**Design**—Non-randomised retrospective comparison between the first 100 and second 100 consecutive investigations by a clinical nurse specialist and 200 consecutive patients investigated by two cardiology registrars over a similar period.

**Setting**—Regional cardiac centre performing 3200 catheterisation procedures per annum.

**Patients**—200 patients undergoing routine (non-emergency) cardiac catheterisation for investigation of ischaemic heart disease.

**Main outcome measures**—Procedural complications, image quality, fluoroscopy times.

**Results**—Satisfactory diagnostic images in all nurse specialist cases with no deaths and two complications (coronary artery dissection and femoral pseudoaneurysm). Procedure duration and fluoroscopy times slightly shorter for clinical nurse specialist by 3 and 1.6 minutes, respectively ( $P < 0.05$ ).

**Conclusions**—Non-medical practitioners can be trained to perform straightforward cardiac angiography in low risk patients with consultant supervision, as for cardiology registrars. With important restrictions such posts may have a limited role in supporting future consultant based services.

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Keywords: cardiac catheterisation; clinical nurse specialist; feasibility study

It is widely anticipated that the implementation of the Calman report on higher medical training will restrict the service commitments of the new Specialist Registrar grade.<sup>1</sup> These restrictions may affect the provision of diagnostic cardiac catheterisation, as cardiology trainees have traditionally made a major contribution to the workload in regional centres. Theoretically, the resultant staffing shortfall should be offset by expansion of the consultant grade and a shift towards consultant based clinical services; however, because of financial constraints it is unlikely that health commissions will approve the requisite num-

ber of new appointments to achieve this goal. In North America, one possible solution to similar problems that has been formally evaluated is the use of specifically trained, non-medical staff (physician assistants) to carry out diagnostic cardiac catheterisation procedures according to a strict protocol with limited supervision by a cardiologist.<sup>2</sup> This pilot study assessed the feasibility of training a clinical nurse specialist with relevant background experience to perform low risk cardiac angiography safely and competently with a similar level of consultant supervision as a cardiology registrar.

## Patients and methods

### PATIENT SELECTION

The study population comprised 400 patients undergoing left ventricular and native coronary angiography via the transfemoral approach for standard clinical indications. Patients requiring a transbrachial approach and those with valvar heart disease, congenital heart disease, or a history of coronary artery bypass surgery were excluded. High risk cases such as those with ongoing myocardial ischaemia, hypotension/shock, pulmonary oedema, and uncontrolled arrhythmias were also excluded. However, patients admitted with unstable angina that had settled with medical therapy before investigation were eligible for the study, including those receiving intravenous heparin up to the day of the study.

### PROTOCOL

The clinical nurse specialist's background included three years of ward based cardiac nursing (mainly on a coronary care unit) and a further nine years' full time experience working in the cardiac catheterisation laboratories of a regional centre. The 12 month training programme was similar to that followed by registrars joining the department with no prior experience in invasive cardiology. The first 20 cases were directly supervised by a consultant who scrubbed for the procedure, until a basic level of proficiency was attained. Thereafter, the nurse performed cardiac catheterisation procedures independently, assisted by a scrub nurse, but the consultant remained within the laboratory area and was immediately available for advice and assistance. The registrars were in the second or third year of specialist cardiology training having performed or assisted with 30-50 angiograms before this analysis.

Cardiac catheterisation was performed using a standard, percutaneous, transfemoral

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Comparison of the patient characteristics and procedure details of a clinical nurse specialist and two cardiology registrars

	Registrars (200 patients)	Nurse (1st 100 patients)	Nurse (2nd 100 patients)	Nurse (Overall)
Patient's age (mean (SD) years)	61.4 (10.3)	63.4 (9.2)	60.3 (15.3)	61.9 (12.7)
Male:female	133:67	75:25	74:26	149:51
Unstable angina (%)	44.0%	51.0%	47.0%	48.5%
Procedure duration (mean (SD) min)	33.1 (12.4)	30.1 (12.7)*	30.3 (12.5)*	30.2 (10.3)
Fluoroscopy time (mean (SD) min)	6.0 (3.8)	5.0 (3.4)*	3.8 (2.3)*	4.4 (2.9)
Complications	4/200‡	1/100§	1/100¶	2/200

\*P = 0.03, nurse 1st 100 patients *v* registrars; P = 0.9, nurse 2nd 100 patients *v* registrars; †P = 0.05, nurse 1st 100 patients *v* registrars; P = 0.004, nurse 2nd 100 patients *v* registrars.

‡three ventricular fibrillation, one haematoma (femoral artery tear); §coronary dissection; ¶pseudoaneurysm.

approach (Judkins technique).<sup>2</sup> Cineangiograms were obtained with a Siemens Angioscope monoplane x ray system (Siemens, Bracknell, UK), including left ventricular angiograms in two projections and selective coronary angiograms in multiple projections. The operator was directly responsible for positioning the image intensifier and x ray table, and for collimation/magnification, without a radiographer. At the end of each procedure, the videotape recording was checked by the consultant before catheters were removed. Haemostasis was achieved by manual compression. The nurse also attended the formal angiographic reporting sessions to improve familiarity with coronary anatomy, as well as awareness of technical/methodological factors that affect the quality of diagnostic images obtained.

#### END POINTS

Procedure duration (from infiltration of local anaesthetic to removal of catheters), fluoroscopy time, and complications were recorded for all cases. Data from the first 100 and second 100 cases performed by the nurse were compared retrospectively with the first 100 consecutive cases performed by each of two cardiology registrars in training during a similar period. Complex cases (valvar heart disease, graft angiography) and cases requiring a transbrachial approach, performed by the registrars, were excluded from the analysis. The registrars used the same catheterisation techniques and angiographic equipment as the nurse and had a similar level of supervision provided by a consultant or senior registrar.

#### STATISTICS

All data are expressed as means (SD). Statistical significance was assessed by analysis of variance for continuous variables, and  $\chi^2$  test for discrete variables; P < 0.05 was considered significant.

#### MEDICOLEGAL ISSUES

The nurse was directly responsible to each patient's consultant cardiologist. Indemnity was agreed with the employing NHS Trust after appropriate consultation with the legal services' department and the medical and nursing directors. Informed consent was obtained before all procedures.

#### Results

Satisfactory diagnostic images were obtained in all patients among the first 100 consecutive investigations performed by the nurse. There

were no deaths and only one complication—acute right coronary artery dissection successfully treated by angioplasty and intracoronary stenting without subsequent evidence of myocardial infarction. In the second 100 consecutive investigations one complication—pseudoaneurysm of the femoral artery—was treated successfully by ultrasound guided compression without sequelae.

In the retrospective comparison with the cardiology registrars, the demographic and clinical characteristics of the patients investigated were similar (table). The registrars also obtained satisfactory diagnostic images in all cases with no deaths and four complications—ventricular fibrillation requiring DC shock in three patients, and femoral artery tear requiring surgical repair in one patient. Compared with the registrars, the nurse achieved slightly shorter procedure durations (30.1 (12.7) *v* 33.1 (12.4) minutes; P = 0.03) and fluoroscopy times (5.0 (3.4) *v* 6.0 (3.8) minutes; P = 0.05) for the first 100 patients with a further small reduction in fluoroscopy time (3.8 (2.3) minutes) for the second 100 patients (table).

#### Discussion

The clinical activities of a cardiologist require both cognitive and technical skills. The cognitive elements are based on clinical acumen and the ability to evaluate patients and make decisions on diagnosis and management. These skills are exclusive to clinicians and require the conventional career structure of medical school, followed by general professional and specialist training. The technical elements involve procedures that vary considerably in complexity and the level of continuous cognitive input required. Thus, some of the simpler, low risk procedures can be delegated to junior doctors, with less mature cognitive skills, under the supervision of a consultant. This in turn has contributed to a dependence on cardiology trainees to maintain the high throughput and clinical productivity of current consultant led services.

#### MAIN FINDINGS

This study has shown that a specialist nurse with appropriate background experience can be trained to perform standard transfemoral cardiac catheterisation procedures safely and competently in low risk cases. There was no substantial difference in the performance of the nurse and two cardiology registrars using the same angiographic facility with a similar

level of consultant supervision, although this was a retrospective, non-randomised comparison. Mean procedure duration (30–33 minutes) and fluoroscopy time (4–6 minutes) were comparatively long for both groups, partly because of inexperience, but also because of the use of outdated, cumbersome x ray equipment with suboptimal fluoroscopic image quality, operated without the assistance of a radiographer.

The selection criteria were designed to ensure that the nurse investigated only uncomplicated, low risk patients. In this population, routine cardiac angiography is usually straightforward and requires comparatively little clinical judgment or decision making (cognitive elements). Nevertheless, such cases make up more than 50% of the workload in a busy regional service, often delegated to inexperienced cardiology registrars operating with back-up from a senior cardiologist for the minority of cases in which difficulties arise. Unlike registrars who may be replaced by new trainees every 12 months, non-medical practitioners once trained in cardiac angiography, are likely to remain within the same department for several years, progressively increasing their level of experience and service contribution. We do not believe that their role should be extended to more complex or high risk procedures that demand a much greater level of cognitive input, and require the continuous involvement of an experienced cardiologist. However, they could be trained to undertake preoperative evaluation and investigation of elective cases according to specific protocols. Indeed an experienced nurse specialist might be better placed to provide patients with accurate information and counselling about the procedure, and to identify potential problems in advance than an inexperienced house officer.

#### PREVIOUS STUDIES

Demots *et al*<sup>3</sup> in North America trained a physician assistant with background experience in cardiac medicine to perform routine coronary angiography using the transfemoral Judkins technique, including patients with prior coronary artery bypass surgery. She performed 150 cases with no deaths and a low incidence of complications (1.3%). Compared with cardiology fellows in training at the same institute, the assistant achieved shorter mean procedure duration (41 *v* 62 minutes) and fluoroscopy time (11 *v* 12 minutes) for simple cases.

#### CLINICAL IMPLICATIONS

Consultants face increasing demands on their time for training of junior staff,<sup>1</sup> management, audit, and continuing medical education. If the requisite expansion of consultant numbers is not achieved over the next few years because of financial constraints, staffing shortfalls will affect delivery of a wide range of cardiac services. Under these circumstances, a limited role for non-medical specialists performing technical activities such as routine cardiac angiography under the direction of consul-

tant, could substitute for some of the clinical duties of cardiologists and their trainees. The use of non-medical staff to perform cardiac catheterisation procedures is subject to significant restrictions—for example, such practitioners are dependent on supervision by an experienced cardiologist, although this could be from an adjacent suite; they cannot report angiograms or determine clinical management plans; and require prompt medical back-up to deal with any emergencies or complications. However, many of these limitations also apply to inexperienced cardiology registrars. Moreover, problems are relatively uncommon in low risk cases, occurring in less than 1.0% of diagnostic studies in a recent confidential enquiry into cardiac catheter complications,<sup>4</sup> and initial management is usually straightforward and can be guided by standard protocols (such as DC shock for ventricular fibrillation, atropine and volume expanders for vasovagal reactions).

The results of this study need to be interpreted cautiously because only a small number of patients were investigated by a single individual. Definitive statements about the safety and competence of non-medical operators performing cardiac angiography must await more widespread application of this model of clinical practice. It is important that any such expansion is centrally monitored, with an approved protocol to ensure appropriate selection, training, and certification of practitioners, and with provision for review of the registry data by an appropriate specialist subcommittee of the British Cardiac Society.

#### IMPLICATIONS FOR CARDIOLOGY TRAINING

Another potential concern is the need to protect the experience of cardiology trainees if non-medical practitioners are performing a substantial number of routine angiography studies. However, the workload of most regional centres is considerably in excess of current training requirements.<sup>5</sup> Our department undertakes over 3000 adult diagnostic studies per annum, of which two-thirds are currently performed by registrars or senior registrars. Under certain circumstances, non-medical operators might actually facilitate invasive cardiology training. For example, a practitioner might perform a routine list of diagnostic angiograms in one room, releasing the consultant to instruct a registrar performing angioplasty cases in the adjacent suite.

#### STRATEGIC ISSUES

We envisage the use of non-medical operators primarily as an approach to reduce dependence on cardiology trainees to deliver routine cardiac angiography services, while allowing consultants to concentrate on more complex invasive and interventional procedures. These practitioners can only perform a very limited range of activities under the direction of experienced cardiologists, and are in no way a substitute for consultant expansion. Nevertheless, we believe that such posts may have a role to play in the evolution towards consultant based cardiac services.

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