# TRAINING REQUIREMENTS FOR SPR'S IN ARRHYTHMIA MANAGEMENT, PACING AND ELECTROPHYSIOLOGY

### **KEY POINTS:**

- 1. Provision of care for cardiac arrhythmias in the UK often poor, patchy and not modern, with a low level of provision of curative ablation, simple and complex device therapy.
- 2. Such therapies are very successful, and compare very favourably in outcomes and cost-effectiveness with coronary revascularisation techniques.
- 3. Provision of services for managing cardiac arrhythmias is very dependent on the number of trained staff available, both medical and non-medical
- 4. Previous NHS directives have excluded arrhythmia management with a significant impact on recruitment and retention of young cardiologists to this branch of the specialty that the 2005 NSF Revision now has a chance to address.
- 5. All cardiologists in training currently have some exposure to cardiac pacing and arrhythmia management, and this basic training can be used to provide a cardiac pacing service in every DGH within the next 3-6 years.
- 6. Advanced training in cardiac electrophysiology, catheter ablation and complex device therapy requires much more dedicated time, teaching and resources, but the provision of catheter ablation, complex devices and skilled arrhythmia care in general, will not improve unless such training is provided.
- 7. In Western Europe in general there is likely to be a move towards recognition of the need for additional advanced arrhythmia training after basic cardiology training.
- 8. The Arrhythmia Community in the UK will need to establish clearer training courses, competency guidelines and exit criteria to rapidly and effectively grow the appropriately skilled medical workforce.
- 9. Government can demonstrate their commitment to the training process by establishing NHS funded advanced arrhythmia training posts in specialist centres according to perceived and expanding need, supplementing basic arrhythmia training.

### INTRODUCTION

It is estimated that up to 30% of acute cardiology admissions to hospital are related to a cardiac arrhythmia. Although many are not life-threatening, they are associated with significant morbidity and require careful assessment and management. Life threatening arrhythmias need emergency care and subsequent assessment of the risk of sudden cardiac death.

Rhythm management involves a number of different levels of knowledge, including:

- > Details of the mechanisms of cardiac arrhythmias.
- A detailed understanding of the effects and uses of drugs and their appropriate application.
- > The use of non-pharmacological approaches such as radiofrequency ablation.
- Risk-assessment for sudden cardiac death.
- > The use and application of implanted devices for controlling arrhythmias.

The past 10-15 years have seen a revolution in the management of arrhythmias, and because arrhythmias are common, can be very effectively treated and can lead to sudden loss-of-life, all cardiology trainees need to have a broad basic training in their management. Antiarrhythmic drug treatment was once the mainstay of treatment for arrhythmias until it was appreciated that there are real dangers in their inappropriate use, but this still needs to be widely appreciated in the UK. Consequently, during cardiology SpR training frequent exposure to patients with arrhythmias in acute and elective care is essential. If available, SpRs should spend one year out of six attached to a consultant with a major interest in arrhythmias to acquire skills in:

- Interpretation and reporting of the 12-lead surface ECG in brady- and tachyarrhythmias.
- > Appropriate use of antiarrhythmic drugs, and their dangers and complications
- > Basic pacing and other device implantation skills.
- > Acquisition of skills to enable him/her to supervise device follow-up clinics.
- The rudiments of intracardiac electrophysiology and how it is used to guide treatment.
- Which patients should be referred for assessment by a cardiac electrophysiologist and why.
- Managing patients with blackouts/T-LOC.

For those trainees who wish to pursue a deeper and more specialized approach to arrhythmias ultimately leading to a career in arrhythmia management, higher training will expose them to invasive electrophysiological techniques, catheter ablation and complex device therapy, but this requires a further dedicated period of training.

# MANAGEMENT SKILLS FOR CARDIAC ARRHYTHMIAS

Modern arrhythmia management requires training in the following skills:

- 1. Pharmacologic therapy
  - Non-pharmacologic therapy by:
  - External DC counter shock (DC cardioversion)
  - Internal DC Cardioversion
  - Electrophysiological studies and programmed stimulation in the assessment of the risk of sudden cardiac death
  - > Percutaneous radiofrequency catheter ablation
  - Use of mapping tools that facilitate treatment using electroanatomic techniques for catheter localization, high-technology tools for imaging catheters and intracardiac structures, and ways of recording and interpreting the pattern and timing of activation of electrical the heart during an arrhythmia
- 2. Implantation and follow-up of pacemakers for bradyarrhythmias (slow heart beats)
- 3. Implantation and follow-up of devices for tachyarrhythmias (fast heart rates) -
- 4. Implantable cardiac defibrillators (ICDs)
- 5. Implantation and follow-up of devices for resynchronising the contraction of the heart in heart failure (Bi-Ventricular pacemakers)
- 6. Techniques for removal of pacing/ICD systems and intracardiac electrodes when needed, e.g. for infections
- 7. The management of patients with blackouts/T-LOC

## Pharmacologic Therapy

Since the discovery of the effects of digoxin in atrial fibrillation in the late 1800's, drug control of arrhythmias has been the mainstay of treatment. Drugs are not curative but act to suppress the frequency of attacks and improve quality of life. This has to be weighed against known side-effects, both generic and specific to each drug. In many cases therapy is life long. The optimal use of drugs depends upon an understanding of arrhythmia mechanisms, the drug effects and experience in their use in different clinical settings in health and disease. Part of training need is to allow trainees to gain supervised experience with these powerful and potentially dangerous agents. This should provide confidence in applying drugs to different clinical situations and an understanding of when drugs may cause harm as well as good.

### **DC Cardioversion**

The application of a controlled electric shock to revert an arrhythmia to normal sinus rhythm has only been deployed in the past 30-40 years. All types of arrhythmia respond to direct current (DC) counter shock (DC cardioversion). In most cases a patient receives a general anaesthetic or conscious sedatation, and a shock delivered externally through the chest wall during the arrhythmia. The effects are usually immediate with conversion of the abnormal to sinus rhythm. Emergency situations involving potentially fatal arrhythmias, like ventricular fibrillation and tachycardia, respond well to immediate cardioversion and this is life saving therapy. The risks are small and training is straightforward. The basic principles need to be understood to ensure safe application of this therapy.

In stable arrhythmias, which are not life threatening, shock therapy can also be given inside the heart (intracardiac cardioversion) with a higher success rate than external. This is an invasive technique involving the passage of one or two catheters (wires) into the heart and is applicable in only a small number of patients.

### **Electrophysiology Studies**

The electrophysiological study, or "EPS" is an invasive procedure that records electrical signals from within the heart and delivers small electric currents (pacing) to determine the effect on electrical pathways.

An EPS may be performed:

- For diagnostic purpose only to determine the underlying nature of an arrhythmia.
- To assess life threatening risk.
- > As part of a therapeutic approach (ablation therapy).

An EPS is performed under local anaesthetic with or without sedation. A specialized catheter laboratory is required together with a computerized mapping and stimulating system. Under X-ray control, a variable number of recording electrodes are positioned within various cardiac chambers depending upon the nature of the arrhythmia being investigated. An important part of recording is to look at the sequence of intracardiac signals. This is commonly known as "mapping", but this term is loosely interpreted.

The aim of the study is to determine the presence and position of additional pathways with the heart. EPS are used almost exclusively in patients with fast heart rates in whom drug therapy has proven either ineffective or unacceptable to the patient. Rarely patients with slow heart rates require an EPS. Increasingly EPS is also used to assess the risk of sudden death in patients with damage to the main pump chamber (the left ventricle), mostly after a previous heart attack. Studies in this clinical setting are often referred to as ventricular stimulation studies.

#### **Radiofrequency Ablation**

This is a therapeutic technique often applied as a adjunct to an EPS once a nature and type of abnormal electrical patterns has been established. Radiofrequency energy has been shown to be safe and destroys tissue locally by thermal ablation often producing lesions only millimeters in depth. Practicing physicians should be cognizant of the indications, contraindications, limitations and complications of the technique and should be performing them on a regular basis. Some arrhythmias, like ischaemic ventricular tachycardia and types of complex atrial arrhythmia are best treated with the aid of highly specialized mapping computers currently limited to only a few centres in the UK. Other ablative energies, such a cooling of abnormal tissues, (cryoablation), and ultrasound or microwave energy can be used.

### **Devices That Control Arrhythmias**

Pacemakers for bradyarrhythmias:

Pacemakers are common treatment in the management of patients with symptomatic slow heart rates. Pacemakers are implanted by cardiologists using Dr Gerry Kaye, Hull, East Yorkshire & Dr Adam Fitzpatrick, Manchester local anaesthetic and light sedation, in a specialised catheter laboratory. One or two pacing electrodes (wires) are positioned in the right side of the heart under Xray control and connected to a battery powered stimulator (the pacemaker generator). The procedure takes between 30-60 minutes and has a low complication rate. The batteries last up to 10 years on average before requiring replacement.

Implantable defibrillators (ICD):

Implantable defibrillators (ICD) are similar to pacemakers in that there are wires, often 2, in the heart but in addition to delivering pacing signals to prevent slow heart rates they are able to deliver high energy electric shocks converting potentially fatal arrhythmias. These shocks are similar to the shocks delivered for cardioversion, but because they are delivered within the heart the amount of energy needed for success is generally much less than when energy is delivered through the chest tissues. They are larger than basic pacemakers but are still implanted under local anaesthesia with conscious sedation. They are life saving devices and their application is becoming more widespread.

Bi-Ventricular pacemakers (CRT devices):

Bi-Ventricular pacemakers (CRT devices) are a newer development used in patients with heart failure who remain symptomatic despite optimal medical treatment. This involves placing 3 wires within the heart and is a long and complex procedure often taking 2-3 hours. Patients are symptomatically improved and mortality has now been shown to be improved significantly, especially when the BiV pacemaker also have a defibrillator function built-in.

#### The Management of Blackouts/T-LOC

Like many areas of arrhythmia management, blackouts have been neglected, but account for 3% of visits to A&E, 1% of admission to hospital and a great burden on healthcare costs. Blackouts are in the top-10 causes of hospital admission, diagnoses are often elusive, and recurrences are common. Trainees should have a firm grasp of the different causes of T-LOC, including syncope, epilepsy, and psychogenic episodes. Falls are commonly preceeded by syncope due to reflex changes or due to a bradyarrhythmia, but this may not be recalled by elderly patients, and an arrhythmia diagnosis may be missed, with consequent morbidity, mortality and cost of recurrent episodes.

Trainees should have a good grasp of the differential diagnosis and the optimum tools for investigation. These include:-

- the recording of background data, e.g. by 24hour Holter monitoring, which is often misleading and needs great caution in interpretation recording of data
- during provocation, e.g. during head-up tilt-testing, which has value, but important limitations
- recording of data during spontaneous episodes, commonly only achieved with an implantable ECG loop recorder

Chapter 10 has further details.

# **CURRICULUM FOR ARRHYTHMIA TRAINING**

### Basic Training: Arrhythmia Management And Referral Pathways

- > Basic understanding of the mechanisms of arrhythmias
- > A thorough grasp of 12-lead surface electrocardiography
- Understanding of the action of drugs
- > Acute/emergency management of arrhythmias
- > Training in elective and emergency external DC cardioversion
- Non-emergency management of arrhythmias
- Attendance at specialist arrhythmia clinics
- > Management of post surgical patients
- Risk assessment
  - in patients with arrhythmias
  - > in patients with arrhythmias undergoing surgery
  - in younger patients with arrhythmias
  - in pregnancy
- Basic understanding of the use and application of invasive electrophysiology studies
- Investigation of patients with blackouts/T-LOC
- > Implantation of pacemakers, both single and dual chamber
- > An understanding of pacemaker programming
- > An introduction to implantation of ICDs and their programming.
- Training and understanding in the use of intracardiac cardioversion using both single and dual lead systems
- > Assessment of patients with heart failure for heart failure devices
- A clear understanding of which patients to refer for further evaluation by a cardiac electrophysiologist

## Advanced Training: Electrophysiology

- Previous thorough training in invasive cardiology particularly right and left heart catheterization (see below).
- > A detailed understanding of arrhythmia mechanisms
- Understanding of basic diagnostic electrophysiology studies, their applicability and use in the clinical setting.
- > Understanding of the equipment requirements for electrophysiology
- Understanding the electrophysiological characteristics of common arrhythmias, AVNRT, AVRT, atrial flutter and ventricular tachycardia.
- > Training in mapping and catheter ablation of common arrhythmias
- Exposure to complex mapping techniques and equipment
- > Understanding of the use of electrophysiological studies for risk assessment
- > Training in ventricular tachycardia programmed stimulation studies
- Training in transseptal techniques
- Exit certification with electrophysiology, which may be by competency or exit exam underwritten by the representative body for UK Electrophysiology in the future

## Advanced training: devices

- > Implantion of  $\geq$  200 single or dual chamber pacemakers
- > Detailed knowledge of pacemaker programming
- > Implanting in excess of 30 ICD's and detailed knowledge of programming
- Training in implantation of BiV devices and their programming and optimization in patients with heart failure using modern techniques such as tissue Doppler imaging
- Knowledge and training in pacing lead extraction, which may require some training attached to designated centres.
- Exit certification in advanced device therapy, which may be by competency or exit exam, underwritten by the representative body for UK Electrophysiology in the future

# **Continuing Medical Education& Professional Development**

- > Evidence of continued education within specialist field.
- Attendance of local and national training days at least 2 per year including industry sponsored training days.
- Attendance of BPEG EP training days should be mandatory, annually, and entered into a trainee's logbook.
- Attendance of one international EP meeting at least once a year during advanced EP training.

# **Training centres**

- Should have 2 electrophysiologists on their staff who spend the majority of their time practicing electrophysiology, one of whom should be a full time electrophysiologist without coronary intervention.
- > Implanting centre for  $\geq$ 250 pacemakers and/or devices per year.
- > Implanting centre for  $\geq$  30 ICD's per year.
- Ablations and EP studies, (including programme ventricular stimulation) <u>></u>150 per year.
- Availability of complex mapping and ablation technologies, e.g. electroanatomic systems for catheter and anatomical localization.
- ➢ BiV implantation:≥30/yr.
- Ideally cardiac surgery on site or available to add exposure to post surgical arrhythmias
- > Consultants involved in continued CME in new and developing techniques.

# Trainers

- > Should have dedicated weekly catheter laboratory sessions for EPS and ablation
- Should personally undertake at least 30 pacemaker/ICD/BiV implants/yr as primary or sole operator with 90 implants in the previous 3 years.
- In certain circumstances, active, (scrubbed-in), troubleshooting, and supervising other experienced operators undertaking such levels of activity may be accountable towards these targets.
- Should be working in a centre should be performing 150 EPS/ablations per year including 30 VT stims.
- Should have a thorough grasp of the management of patients with blackouts/T-LOC.
- Should be NHS consultants involved in CME/CPD as a trainer and life-long learner in new and developing techniques.