The Libyan Cardiac Society is experiencing exciting times. “Building up research work, launching a medical journal, and working with the government to improve the availability of services and the development of training are just some of the activities it is currently involved in,” says Dr Omar Msalam.

Established in 2001, the society became a member of the European Society of Cardiology (ESC) in 2004. It currently has 159 members, including cardiologists, cardiac surgeons, paediatric cardiologists, and peripheral vascular disease surgeons (Figure 1). The society has 10 different scientific working groups, with plans underway to start a Libyan heart journal.

“Decreasing the burden of cardiovascular disease in the Libyan population is the society’s overall aim,” says Dr Msalam. “Specific objectives include contributing to scientific research in cardiovascular disease, keeping in touch with the latest information and guidelines, holding conferences and symposia, and cooperating with international boards and societies like the ESC.” The society will hold its fourth annual meeting in Benghazi from March 21 to 23, 2008.

Although a big country (Figure 2), Libya has a relatively small population. In 2006, it had a population of 5.3 million people. Up until the 1970s, valvular disease attributable to rheumatic fever was the most common cardiovascular disease. “Now this disease has decreased through the availability of a better health service in the country,” says Dr Msalam. “Unfortunately, hypertension and ischaemic heart disease are now the main health problems. We have a lot of cases.” Diet, lack of physical activity, smoking, diabetes mellitus, and hypertension represent the main culprits.

Describing the health service, Dr Msalam says, “Up to now, Libyan patients have all health expenses covered completely by the government. That includes operations, investigations, and prescriptions for medicines.” Patients can also go to the private sector if they wish.

**Figure 1. A few of the 159 members of the Libyan Cardiac Society get together at the ESC meeting in Vienna, September 2007.**
Libya has 4 main cardiac centres. The oldest of these, the National Heart Centre in Tajura, opened its doors in 1976 (Figure 3). It stands 20 km from the country’s main city, Tripoli. Tripoli’s general hospital, Tripoli Medical Centre, also has units for cardiology, cardiac surgery, and other procedures. Benghazi Cardiac Centre and Elbutnan Hospital have cardiology services but no cardiac surgery.

In addition to these 4 centres, the general and rural hospitals see general and emergency cardiac patients for treatment and then refer them on to specialist centres. But Dr Msalam says that Libya does not have enough cardiologists. “Our cities are very spread out. There are enough facilities in the major cities but not enough at the periphery. We also need more interventional cardiologists, who are the future of cardiology.” Libya has around 50 cardiologists, including 15 to 20 interventional cardiologists, 10 to 15 paediatric cardiologists, 10 cardiac surgeons, and about 10 vascular surgeons.

Cardiologists can do their general medical training in Libya, but when it comes to specialising in cardiology, they go overseas. Most go to Europe, but some travel to the United States. Dr Msalam says, “There are plans to offer all of the cardiology training in Libya in the near future.” He explains, “Libya has most of the new drugs, machines, apparatus, and instruments”; these include catheter laboratories, pacemakers, stents, and echocardiography equipment. “Our doctors have no knowledge gap. What we do have are gaps between the guidelines and the implementation of guidelines, but we are starting to make them narrower,” he says.

Dr Msalam refers to the difficulties encountered as a result of the United Nations Security Council’s international economic sanctions, which were suspended in 1999 and finally ended in 2003, and the United States trade embargo that ended in 2004. “It was a problem for Libya because most of our drugs came from abroad. Now, everything is available.” Libya still has shortages in some fields of cardiology, including electrophysiology, which does not exist at the moment. The country also has a shortage of cardiac rehabilitation, but Dr Msalam feels confident about this problem’s resolution in the near future.” The Libyan Cardiac Society has support from the Ministry of Health to put more emphasis on this issue.

The Libyan Cardiac Society is starting to build up its research work and is preparing a project with the World Health Organisation, called the Step Surveillance. It will study 7000 people from 7000 different families, which, according to the World Health Organisation, will produce a random sample of Libya’s population. The study aims to evaluate the main risk factors for cardiovascular disease in the population, including family history, smoking habits, alcohol habits, hypertension, obesity, diabetes mellitus, hypercholesterolaemia, diet, and level of physical activity. The society is also planning other projects with the World Health Organisation on primary and secondary prevention of cardiovascular disease.

Dr Msalam says, “We will also be taking part in a survey about pregnancy and cardiovascular disease organised by the ESC, which will start at the end of 2007. We are also preparing for a national registry for cardiovascular disease in cooperation with the Ministry of Health and the main cardiac centres in Libya.”

Dr Msalam concludes: “I think that the Libyan Cardiac Society has made the first step along the right road. We dream of a strong, active cardiac society, and we have the will to convert the long-sought-after dream into reality.”

Jennifer Taylor is a freelance medical journalist.
Between 1992 and 1995, Bosnia and Herzegovina went through a difficult period of conflict, unprecedented in Europe since the end of World War II. Since the signing of the Dayton peace agreement in 1995, Bosnia and Herzegovina has been attempting to stabilize as a state, with the aim of completing the transition to becoming part of modern Europe. The nation needs to face many economic and political problems. Some parts of its society can provide individual examples of good progress; one of the most notable includes the founding of the School of Medicine of the University of Mostar, which was intended to accomplish several goals (Table 1).

The idea of founding the school first appeared in the late 1970s, when medical schools were starting up throughout the former Yugoslavia; however, unlike the cities of Tuzla and Banja Luka, Mostar did not receive the green light to do so at this time. Work began on Mostar Medical School in April 1993, coming to a successful conclusion on April 18, 1997, with its founding ceremony (Figure 1).

**Organisation of the Curriculum**
The study of medicine at Mostar Medical School, which lasts 6 years, is divided into 12 semesters of intensive instruction. During the first 3 years, students learn basic and preclinical medical science, and in the last 3 years they learn clinical and public health subjects. After the fourth year, which involves internal medicine, and the fifth year, when students study surgical subjects, it is compulsory for them to attend practices working in these fields during the summer months.

Practical and field work takes place in hospital and community settings, in Bosnia and Herzegovina or abroad, including institutions in Heidelberg, Munich, and Wuerzburg in Germany; Cork in Ireland; and Zagreb, Split, Osijek, and Rijeka in Croatia. This mobility of students during their training became incorporated into the teaching process before the Bologna recommendations encouraged it.

In the sixth year, students study family medicine under the supervision of the Queen’s University, Kingston, Ontario, Canada. This institution has implemented a family medicine development program in Bosnia and Herzegovina since March 1997. At the end of the last semester, students prepare their diploma thesis involving an original investigation, after which they sit their final examinations. The system of teaching adopted by the new medical school represents an innovation for the country; it consists of blocks of lectures from different subjects for small groups of 4 to 8 students. The system has proved popular with students and successful in terms of results, to the extent that other medical schools in Bosnia and Herzegovina and surrounding countries are now adopting it.

**A Student-Centred Institution**
The school’s organization as a student-centred institution from the very beginning has provided one of the keys to its success. The development of a permanent evaluation of the teaching process through student questionnaires has established a closer cooperation between the students and teaching staff. These evaluations carry such importance that they can influence the re-election of lecturers and the award of higher degrees. Such collaboration could stand as a model not only in this university but even more widely in Europe, as confirmed by an evaluation report from the European University Association.

**The Encouragement of Basic Medical Sciences**
The war inevitably meant some stagnation in the study of science and research in Bosnia and Herzegovina. The
Improving Cardiology

Along with the Mostar Medical School, cooperation with the cardiology department of the Internal Medicine Clinic has also developed. The clinic currently has 5 cardiologists and has begun the final stages of instituting a department of interventional cardiology. As part of that process, 4 specialists participated in an educational process in cardiology clinics in Zagreb and Tuzla. Various professional educational seminars for young physicians and cardiologists have taken place in recent years, contributing to the process of improving the quantity and quality of cardiology in Mostar and in Bosnia and Herzegovina.

At the beginning of February 2007, Mostar Clinical Hospital signed an agreement with the German Cardiology Center, Berlin, Germany, to train surgeons from the Mostar Clinical Hospital to perform the first cardiothoracic operations in the city. The first group of residents are already training in Berlin. The hosting in May 2007 of the 4th International Congress of Cardiologists and Angiologists of Bosnia and Herzegovina represents another highly successful cardiology initiative. Cardiologists from Mostar organised this event, which attracted visiting specialists from many European countries and the United States.

The journey so far suggests that a bright future awaits the hard-working and well-educated physicians who have benefited from the education given at the School of Medicine of the University of Mostar, and that cardiology in Bosnia and Herzegovina has a positive outlook.

Dr Barnard is the Managing Editor of Circulation: European Perspectives in Cardiology.

References

History of Cardiology: Denis Graham Melrose, BM, MS

A Key Member of the Team Who Developed a Heart–Lung Machine and Perfected Elective Cardiac Arrest

The idea of providing an artificial circulation to aid the distressed heart and to allow cardiac surgery first came in 1931, but it took until 1953 before a team, based in the United Kingdom, perfected a Swedish design that would make the heart–lung machine a reality. Diana Berry recounts the story.

Denis Graham Melrose, BM, MS, was born on June 21, 1921, in Cape Town, South Africa, where his father practised medicine. The family later returned to England, and the young Denis attended school at Sedbergh, Cumbria. On his arrival at University College, Oxford, expecting to study history, Denis was dismayed to find that his father had enrolled him as a medical student; at England’s declaration of war in September 1939, he ran away to Portsmouth to join the armed forces. The university proctors followed him, and they “persuaded” him to return to the university. As with so many other medical students at that time, he found his studies disrupted by the constant influx of the wounded, but despite these difficulties, Dr Melrose successfully qualified in 1945 and joined the Royal Navy as an ear, nose, and throat specialist.

He shipped out to Hong Kong, and then on his return to the United Kingdom in 1957, he joined the Hammersmith Hospital, London. There, he worked on the design and development of a heart–lung machine and, later, on a method of elective cardiac arrest and a technique to reduce blood leakage known as cold cardioplegia—a method that still finds routine use in cardiac surgery today.

In 1947, when Ian Aird, ChM, FRCS, became professor of surgery at the Hammersmith Hospital, he decided that the department should undertake 2 major areas of research that he considered vital for the future of surgery: the development of a pump oxygenator that would allow progress in open heart surgery, and, secondly, renal transplantation.

At that time, no facilities for experimental surgery existed at the Hammersmith, so Dr Aird worked on one floor of the old north block whilst Dr Melrose set up his research station at the Buxton Browne farm, which belonged to the Royal College of Surgeons. There, he developed a pump oxygenator that he initially used for experimental work in dogs.

The stimulus for designing an artificial circulation came originally in 1931 when John Heysham Gibbon, AB, MD, of Massachusetts General Hospital, Boston, Mass, was carrying out 15-minute assessments on a female patient who had developed a pulmonary embolus postoperatively. Dr Gibbon became obsessed with the idea of an apparatus that would allow the withdrawal of venous blood to a place where it could then take up oxygen and discharge carbon dioxide before reinfusion back into the patient’s arteries.

By 1953, Dr Melrose and his colleagues had developed and perfected a heart–lung machine based on a design by Viking Olov Bjork, MD, and Clarence Crafoord, MD, of the Sabbatsberg Hospital, Stockholm, Sweden. The oxygenator consisted of “a rotating cylinder set at an angle to the horizontal and containing annular perspex plates. The blood travels through it under the influence of gravity and is spread over the plates.” The arrangement of the plates allowed for the maximum surface area of exposure of blood to the oxygen, pumped into the cylinder with the use of 2 valveless rotary-type pumps driven by electric motors.

The blood volume in the oxygenator and the pressures in both the venous and arterial parts of the artificial circuit were measured. The system provided electrical control of pump speed in response to manometer signals, ensuring harmony in the maintenance of blood volume and arterial pressure. Delivery of oxygen came via a rotometer, which allowed adjustments to flow rate, and this enabled control of the acid–base balance by altering the flow rate of oxygen or adding small amounts of carbon dioxide.

In the experiments of the heart–lung machine in dogs, Dr Melrose and his colleagues took blood fed into the machine from the femoral vein and returned it via an artery. Twenty-six of the 30 dogs in the experiment survived, but the remaining 4 died from causes other than use of the oxygenator. After careful study of the results, Dr Melrose and colleagues felt the apparatus might be beneficially employed in the treatment of some forms of cardiorespiratory failure in humans. They also saw the potential for cardiac surgeons in the augmentation of heart function during lengthy and difficult operations designed to relieve cyanotic congenital heart disease.

However, the need for heparinisation of the patient—vital to the working of the oxygenator—presented another problem. At the time, many expressed caution about the odds of success in using the oxygenator in human cardiac operations, but by 1954, Drs Aird, and Melrose, and colleagues published an article in the British Medical Journal to express their opinion that they “now [had] evidence that with a machine of this kind the surgical approach to the
interior of the heart and even to the mitral valve under vision may well be possible.\textsuperscript{2}

The next development involved the use of the pump oxygenator as a means of assisting circulation during an operation, gradually increasing its responsibility for the total circulation. Some common procedures in cardiac surgery could cause a dangerous lowering of flow rate in the coronary arteries, which could lead to ventricular fibrillation or even an irreversible cardiac arrest. The accepted response at that time was to resort to “cardiac massage, occlusion of the thoracic aorta and gravity or pump transfusion of blood... to maintain coronary and carotid flow, at least in part.”\textsuperscript{2} However, Dr Melrose and his colleagues decided they could more effectively maintain an adequate carotid flow by employing the pump oxygenator to assist circulation throughout the operation. If at any stage cardiac function gave rise to anxiety, it could take over the entire function of heart and lungs. The team detailed their findings on the benefits of the oxygenator in an operation on a 32-year-old woman who had contracted rheumatic fever at the age of 13 with subsequent chorea.\textsuperscript{3} William Cleland, FRCS, lecturer in thoracic surgery at the Hammersmith Hospital, undertook the surgery. Electrocardiography was carried out throughout the procedure, which took several hours.

The procedure also showed the problems associated with an extracorporeal circulation; that is, haemorrhage and excessive bleeding occurred even after the administration of protamine to neutralise the heparin. In their conclusion, the authors identified bleeding during and after surgery as the most serious problem to be faced, although they considered the risk of bleeding as experienced to be preferable to the “still greater risk of clotting around the tubes of the machine at some critical stage of operation.”\textsuperscript{3} The team concluded that the pump oxygenator had proven beneficial in assisting the circulation in a patient undergoing a serious cardiac operation that they could not have attempted otherwise.

The next development was research by the Hammersmith team into the successful restarting of the heart after cardiac arrest. They hoped this would allow the “unhurried corrections of cardiac abnormalities under direct vision.”\textsuperscript{4} This required the development of techniques to allow surgery in a bloodless heart with the exclusion of a possible postoperative air embolism. Ultimately, the team hoped to successfully arrest and then restart the heart at will, and without damage. Their initial experiments determined the viability of inducing cardiac arrest on 33 anaesthetised dogs. Whilst protecting vital centres by perfusion with a heart–lung machine, or the reduction of body temperature, they injected potassium citrate into the coronary circulation to induce the arrest. They used the potassium citrate in concentrations varying from 25 to 100 mg/mL, injecting it into the root of the aorta. This caused cardiac arrest in diastole within seconds. The venous inflow tracts, pulmonary artery, and aorta were ligated to exclude blood from the heart.

They found the dose of potassium citrate to be critical, and experiments demonstrated the need for a minimum coronary artery blood level of 1 mg/mL, but with an unknown upper safety limit. They could restore normal beating of the heart when the potassium level was reduced by simple perfusion of coronary circulation. They found this effective at normal body temperature and as low as 26°C. The team concluded the addition of stimulants such as calcium chloride or adrenaline to be unnecessary or, indeed, dangerous. At normal body temperatures, they found low oxygen consumption, and cessation of coronary circulation in excess of 15 minutes presented no danger. The Hammersmith team concluded that despite the need for much further research, the method in general would provide the possibility of surgery on the motionless heart without danger of air embolism.

Dr Melrose was happy to share his expertise with colleagues around the world (see Figure). Today, the heart–lung machine and elective cardiac arrest feature routinely in thousands of open-heart operations every year. But one might find it worthwhile to remember that in 1953, in those early days of experimentation at the Hammersmith, “it became a custom to place a specimen rose plucked from the garden that morning on the machine to bring good luck.”\textsuperscript{4} (p107)

Diana Berry is a medical historian.

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