Training of Cardiac Surgeons for Bosnia and Herzegovina: Outcomes in Coronary Bypass Grafting Surgery

Jacob Bergsland, MD, Emir Kabil, MD, PhD, Emir Mujanovic, MD, PhD, Ibrahim Terzic, MD, Jo Røislien, PhD, Jan L. Svennevig, MD, PhD, and Erik Fosse, MD, PhD

The Interventional Center, Departments of Thoracic Surgery, and Biostatistics, Rikshospitalet-Radiumhospitalet Medical Center, Oslo, Norway; Cardiovascular Clinic, University Clinical Medical Center, Tuzla, Bosnia and Herzegovina; Buffalo General Hospital, Kaleida Health, Buffalo, New York; and Department of Biostatistics, Faculty of Medicine, University of Oslo, Norway

Background. **Bosnia and Herzegovina did not have invasive cardiac diagnosis or cardiac surgery before the recent war. With assistance from the United States and Norway, a cardiovascular clinic was developed. This study reports center-specific and surgeon-specific clinical outcomes. Since off-pump coronary bypass grafting surgery was prioritized in the treatment of coronary disease, a comparison was made between operations performed with and without cardiopulmonary bypass.**

Methods. **Surgeons and key staff members were trained in the United States. A Norwegian data management system for cardiac surgery was implemented and cases entered after quality review of the data. A total of 1276 patients were entered; operations were performed with cardiopulmonary bypass in 540 and without in 736. The primary surgeon was entered as a variable in an anonymous fashion.**

Results. **Overall mortality for coronary bypass grafting surgery was 1.6%, and the major complication rate was 4.5%. Patients operated on off-pump received fewer grafts and had a shorter length of stay. Unfavorable outcome was more common in patients when cardiopulmonary bypass was used in the operation. Regression analysis demonstrated that the European System for Cardiac Operative Risk Evaluation (EuroSCORE) and use of cardiopulmonary bypass were predictors of poor outcome. The individual surgeon factor did not impact on outcomes.**

Conclusions. **Our study confirms that coronary artery bypass grafting surgery may be performed safely in a poor country in a hospital without experience with cardiac surgery. Selection of talented staff and cooperation with international cardiac centers are crucial. Off-pump coronary artery bypass grafting surgery is suitable for a new center and does not require more training than standard procedures.**

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After the disintegration of Yugoslavia and the subsequent war, Bosnia and Herzegovina (BIH) emerged as an independent country. The war left the country with drastically reduced resources and increased demands for medical services because advanced medical care had previously been provided in other parts of Yugoslavia. A serious deficiency was the lack of cardiac invasive diagnosis and treatment and lack of cardiac surgery. It was not possible for BIH to continue the policy of sending cardiac patients out of the republic for treatment. Coronary artery disease and rheumatic valvular disease are common in BIH, which after the war has one of the lowest income levels in Europe.

A center for cardiology and cardiovascular surgery was developed between 1995 and 1998 in the medium-sized city of Tuzla. Resources and training were obtained mainly from the United States (US) and Norway, and the clinical program was initiated after 3 years of preparation. This report describes the training program and reviews the results of coronary bypass grafting surgery (CABG) in the new center.

Material and Methods

Training

Surgeons were trained at Buffalo General Hospital, an institution affiliated with the State University of New York. Technical expertise, certification in general and vascular surgery, and ability to communicate in English were mandatory requirements. Surgeons underwent 6 months of hands-on and didactic training, and participated in preoperative, perioperative, and postoperative care as well as in local conferences and in one major national conference. US textbooks about cardiac surgery and open access to the library gave opportunity for self-study.

The study period in the United States was followed by training in BIH under the supervision of a US surgeon.

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Address correspondence to Dr Bergsland, The Interventional Center, Rikshospitalet-Radiumhospitalet Medical Center, NO-0027 Oslo, Norway; e-mail: nielsb@aol.com.

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Table 1. Preoperative Risk Factors

	OPCAB	ONCAB	*p* Value
Patients (n)	736	540	
Age (years)	58.5 ± 9.2	57.4 ± 8.6	0.04[a]
LVEF	0.52 ± 0.126	0.515 ± 0.128	0.55[a]
Male gender (%)	82	81.1	0.36[b]
EuroSCORE	2 (1–3)	1 (1–3)	0.001[c]

[a] Two-sided *t* test. [b] Two-sided χ^2-square. [c] Mann-Whitney test.

Data for age and LVEF are presented as mean ± SD; EuroSCORE is median. (interquartile range).

EuroSCORE = European System for Cardiac Operative Risk Evaluation; LVEF = left ventricular ejection fraction; ONCAB = on-pump coronary bypass; OPCAB = off-pump coronary artery bypass.

The training focused on management of adult cardiac procedures and especially CABG, a main priority from the outset. Major effort was placed on off-pump bypass surgery (OPCAB), which was considered the most cost-effective therapy [1–3]. It was, of course, an important issue to educate both surgeons and perfusionist trainees in the use of cardiopulmonary bypass (CPB). The surgeons had extensive experience with operations for atherosclerotic peripheral vascular disease and vascular war injuries; therefore the techniques of vascular anastomosis had already been acquired. Knowledge about CPB, cardiac ischemia, and management of arrhythmias and low cardiac output syndrome was limited, however.

One of the 6 surgeons who underwent training in the United States was the previous chief of general surgery and became the chief of cardiac surgery, 3 others became staff cardiac surgeons, and 2 continued to focus on vascular surgery. Parallel with the surgical program, 2 cardiologists, 3 anesthesiologists, 2 perfusionists, 5 intensive care unit (ICU) nurses, 1 x-ray technician, and 1 clinical engineer were also trained in Buffalo.

Physical Resources

Rebuilding of facilities destroyed by war was accomplished with help from the United States and Norway. The US Agency for International Development (USAID) supported the educational program through a project run by the American International Health Alliance (AIHA) and contributed funds for reconstruction of operating rooms and the ICU. Resources allocated for the cardiac program included 4 beds in ICU, 2 cardiac catheterization laboratories, 2 cardiac operating rooms, and a ward with 25 beds. Equipment was donated or purchased, and operational expenses were initially covered by patients and subsequently by insurance funds.

Patients

A large number of patients were referred to the clinic. Intake was limited by capacity and financial resources, but gradually increased to almost 2000 catheterizations and more than 400 operations yearly. About 70% of the patients had coronary disease as their main problem. Patients with single-vessel disease were usually treated by percutaneous coronary intervention or minimally invasive direct coronary grafting, and patients with more than single-vessel disease received CABG using CPB (ONCAB) or OPCAB.

Surgical Techniques

All patients included in this analysis were operated on through a median sternotomy. In general, the left internal thoracic artery was used to bypass the left anterior descending coronary artery. The remaining bypasses were usually performed using saphenous veins. Some patients, usually the younger ones, received more arterial grafts. In ONCAB, aortic and right atrial cannulations and antegrade blood cardioplegia were used. Retrograde cardioplegia was occasionally added. CPB circuits were not coated, but membrane oxygenator and arterial filter were routinely used. OPCAB was performed using the "Lima" stitch for cardiac exposure [4] and a pressure type stabilizer. A cell-saving device was used when more than 2 grafts were planned or there was more bleeding than usual. An intravascular shunt [5] was used during anastomosis in most patients to prevent ischemia.

The decision to perform the operation on-pump or off-pump was somewhat arbitrary, with a tendency to assign to OPCAB those patients with more risk factors such as peripheral vascular disease and low ejection fraction. Patients requiring more than 4 grafts were often assigned to ONCAB. The 4 local surgeons and the US trained surgeon were assigned cases by consensus. The chief surgeon (one of the local surgeons) initially operated on most of the patients to obtain enough experience. All operations were performed by one surgeon assisted by a colleague.

Data Collection

The DatacorR software developed at Rikshospitalet University Hospital in Norway [6] was used to enter clinical data on the cardiac surgery patients. Data were entered by the operating surgeon and quality controlled by one of the authors (EM). In addition to demographic data, left

Table 2. Postoperative Outcomes in Off-Pump and On-Pump Coronary Artery Bypass Patients

	OPCAB	ONCAB	*p* Value
Patients (n)	736	540	
Mortality (n)	5	15	0.005[a]
Stroke (n)	15	17	0.277[a]
MI (n)	8	7	0.796[a]
Major adverse events (n)	24	33	0.019[a]
Arrhythmia (n)	97	55	0.115[a]
Bleeding (mL)	605 (477–786)	530 (414–710)	0.001[b]
Length of stay (days)	7 (7–8)	7 (7–9)	0.001[b]
Respirator time (hours)	3 (2–3)	3 (2–4)	0.003[b]

[a] Two-sided χ^2. [b] Mann-Whitney test.

Data for bleeding, length of stay, respirator time are presented as median values (interquartile range).

MI = myocardial infarction; ONCAB = on-pump coronary bypass; OPCAB = off-pump coronary artery bypass.