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Professor Sir Magdi Yacoub and the Aswan Heart Centre



Amelia Scholtz, PhD

Between myectomies, Professor Sir Magdi Yacoub spoke with Amelia Scholtz about the bustling present and promising future of the Aswan Heart Centre.

Professor Sir Magdi Yacoub, OM, FRS, is now a legend in cardiac surgery. He helped initiate a new era of heart transplantation in the United Kingdom in the 1980s and pioneered surgical techniques such as the Ross procedure, the modern arterial switch, and, more recently, a modified Mustard operation. His achievements have been recognized with a British knighthood and numerous honorary degrees.

Long before these successes, Yacoub—with his mother and siblings—spent his early years following his surgeon father around Egypt on a path determined by medical need and government imperatives. Among the many places in which the family lived, the Upper Egypt city of Aswan holds special significance. Yacoub affectionately recalls the natural beauty of the city and the cultural diversity that he witnessed on its streets as a child (Figure 1). He was reminded of Aswan a decade or so later when, as a young doctor, he saw patients from the city in his work at Cairo University Hospital. “Children coming from that area ... arrived to Cairo in a very sorry state. They were dehydrated. They were infected. They were dying. This was a very badly neglected area, particularly when it came to pediatric cardiology or cardiac surgery,” he recalled, adding, “of the entire Upper Egypt, particularly right at the end, Aswan was a neglected area.”

Over the subsequent years, Yacoub became increasingly concerned with care delivery, hoping to leave a more lasting legacy than what he terms “surgical tourism.” “The idea of going to do a few operations or offering medicine without consistency is just useless,” he opines. An underserved city with

1.5 million residents, Aswan was a natural choice for a cardiac research and treatment facility that would realize Yacoub’s dream of more lasting, widespread improvements for cardiovascular health in Egypt. He established the Aswan Heart Centre (AHC) in 2009 as a project of Chain of Hope, a charity also founded by Yacoub. With a continuing stream of donations from Egyptians rich and poor, as well as partnerships with universities and health care organizations around the world, the AHC is now a tertiary referral center serving patients not only from the Aswan region, but also from other parts of Egypt and Africa. In addition to its 96 patientbeds, 2 operating rooms, intensive care facilities, cardiac catheterization laboratories, patient examination rooms, advanced imaging facility, and 100-seat auditorium, the Centre houses life sciences and biomedical engineering laboratories (Figures 2 and 3).

Each year, AHC clinicians perform approximately 1,100 open-heart operations and 3,000 cardiac catheterizations, with approximately 25,000 consultations taking place in outpatient clinics. The AHC’s primary percutaneous coronary intervention service is the only program of its kind within a 250-mile radius and serves a population of 2,000,000. Additionally, the Centre runs one of the largest chronic total occlusion programs in the region and a transcatheter valve therapy service. Perhaps surprisingly, 60% of surgical patients are children. Two factors account for the preponderance of children in the surgical caseload. First, high levels of consanguinity in the Egyptian population make for high rates of congenital heart disease (CHD), including hypertrophic cardiomyopathy (HCM) and transposition of the great arteries (TGA). A second factor—the poverty of the region and related inadequacies in public health—both exacerbates congenital disease and increases rates of acquired disease (e.g., pulmonary hypertension and rheumatic heart disease [RHD]). Yacoub is

FIGURE 1 Scenery in Aswan



particularly troubled by “a lack of preventive measures” in Egypt, with insufficient action to curb high rates of tobacco use and pollution. The interplay between poverty and consanguinity is most apparent in cases of TGA, where a lack of medical care in the region means that many patients present with neglected disease. Yacoub explains, “We’ve been trying to revive the Mustard operation and modify it in order to treat

patients who are not suitable for neonatal switch and who have severe pulmonary hypertension and other comorbidities.”

As with all of the AHC’s clinical efforts, work on TGA and CHD more generally is matched with a robust research program (Figure 4). The AHC has established a comprehensive database of CHD in Egypt, with a focus on obtaining detailed phenotypic data. In addition, the Aswan Congenital Registry is being used to identify the genetic bases of CHD among Egyptians using data from patients and their families. Innovations in CHD also are occurring in the operating room, where surgeons are working to optimize operative techniques in both neonates and neglected cases. With regard to TGA specifically, Yacoub and colleagues have presented their modified Mustard operation in a 2017 editorial comment in the *Journal* and in a poster documenting midterm outcomes at the 2018 American College of Cardiology Scientific Sessions (1,2). In a series of 55 patients age 6 months to 10 years, “all patients derived considerable improvement in their exercise capacity and general condition” from the operation (2).

As with neglected cases of TGA, poverty accounts for the prevalence of RHD, which contributes directly to “25% to 30% of our workload,” Yacoub explains. “This is a disaster in the making that has to be confronted, not only at the clinical level but at the research level.” With regard to the former, AHC focuses on using and developing techniques for valve repair rather than replacement, because of the

FIGURE 2 Intensive Care Unit at the Aswan Heart Centre



difficulty of regulating anticoagulation and the frequency with which patients present with closed prosthetic valves requiring repeat replacement—“an absolute disaster,” in Yacoub’s words. On the research side, AHC scientists are attempting to characterize the bacteria behind RHD on a molecular level, with the long-term goal of developing a vaccine for the disease. Working with researchers at Imperial College London, AHC researchers also have been gathering samples from Egyptian patients with both acute and chronic RHD, aiming to identify genetic markers of susceptibility to developing the disease.

The symbiosis between research and clinical care is also apparent in the AHC’s work on HCM. AHC surgeons have now performed more than 220 myectomies, with results summarized in a 2017 paper in the *Annals of Cardiothoracic Surgery* (3). In the laboratory, AHC researchers are using genetic information from a database of >1,000 patients with HCM and their families to identify genes associated with HCM in the Egyptian population. They have already identified 2 genetic variants that, while rare in other populations, are found in most Egyptian patients with this condition.

Efforts to improve cardiovascular outcomes in Egyptian patients have previously been stymied by a lack of genomic data from Egyptian and other Middle Eastern populations. As Yacoub explains, “In the future, precision medicine requires an understanding of the genetic background of our population. When examining the genetic



background of HCM, researchers identify common genes from multiple countries, and also find unique sequences as well, which are not present in other [populations]. We try to compare with Western populations, [but] we do not have data about *our* non-diseased population about which we could compare. We have 1,000 genomes or 100,000 genomes from Britain.” Resistance to study of Egyptians’ DNA has

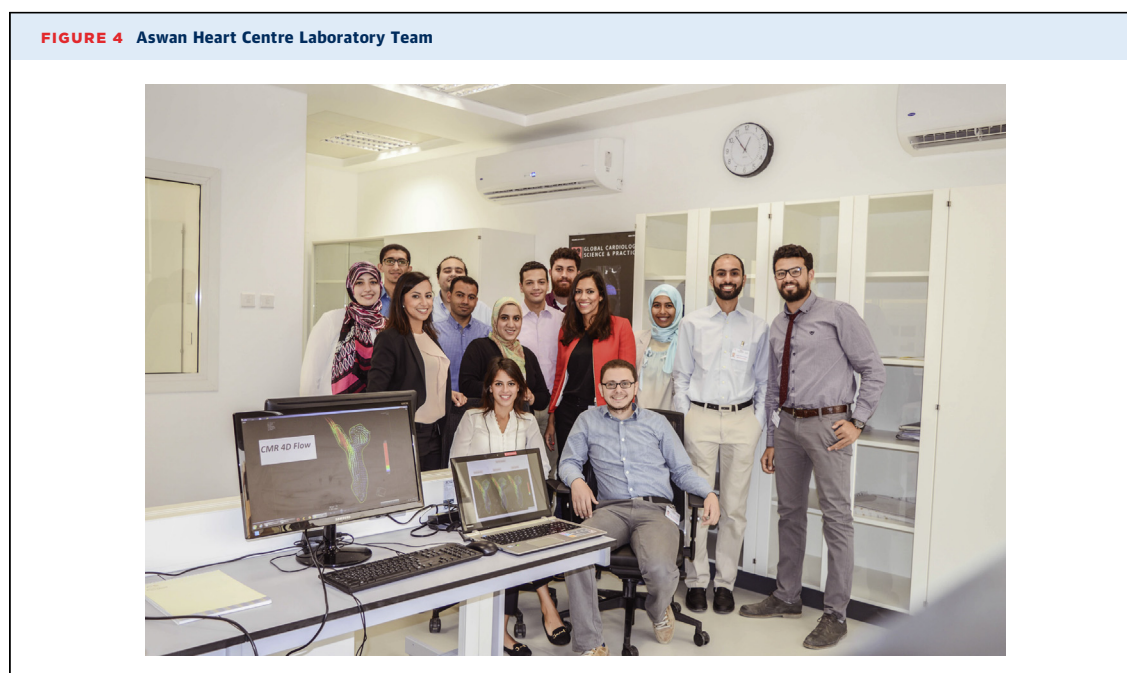


FIGURE 5 Yacoub With Young Researcher Assessing the Utility of Segmentation and 3-Dimensional Printed Models for Pre-Operative Planning



hampered efforts to obtain such data. “People in general are very cooperative, but then you have people who agitate and say, ‘This could be used against you. It’s a security issue.’ Certain officials are saying that this could contribute to biological war against Egypt, which is inaccurate and illogical.” AHC researchers, Yacoub explains, “try very hard to say, a) it’s not a security issue, and b) we are not going to discriminate against you.”

Their efforts have succeeded. Today, the AHC is pursuing population studies that emulate examples

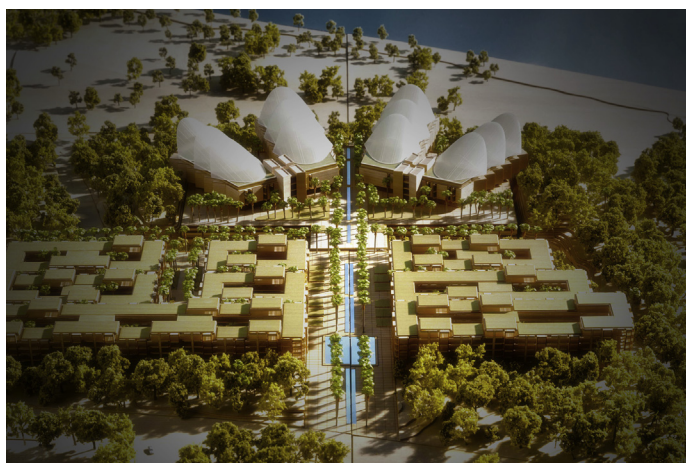
such as the U.S. Framingham Heart Study and the London Life Sciences Prospective Population Study. Centering on a small village approximately 20 miles from Aswan, the Ballana Heart Study seeks to define risk factors, biomarkers, genotypes, and phenotypes of cardiovascular disease in a stable, defined population. Community and government approval has been secured, as has a contract for a facility in the village. Researchers hope to follow patients for 30 years. The 1000 Egyptian Genomes (E-HVol [Egyptian Healthy Volunteers] Study) represents another front in the AHC’s genomic efforts. Researchers are seeking to sequence whole genomes of 1,000 healthy Egyptian volunteers to learn more about the genes involved in CHD. A total of 500 volunteers have been recruited and clinically phenotyped thus far, with preliminary results submitted for presentation at the 2018 ESC Congress in Munich.

The AHC’s contribution to cardiovascular health in Egypt also lies in its training of a new generation of homegrown clinicians and researchers (Figure 5). Yacoub has long been concerned about the country’s loss of biomedical talent. Yacoub laments that “although a lot of people have remained here or come back, they don’t find the appropriate facilities,” adding, “that includes me. For example, I couldn’t find what I wanted to do. I had to stay in the U.K., but now we’re creating appropriate facilities.” The AHC is helping to train clinicians both at Aswan and at a center in Ethiopia that seeks to duplicate the efforts at the AHC. “We’re supporting clinicians from other parts of Africa. They come regularly, and we go there,” Yacoub enthuses.

Yacoub is intimately involved in the training of new surgeons and the running of the AHC more generally. He spends 7 to 10 days/month in Aswan and is heartened to see the increasing autonomy of the younger clinicians he has helped train. “I work from morning until late at night, going into the OR, going into the research labs, seeing patients, so I’m very, very, very, very busy, but I enjoy that time tremendously.”

Looking ahead, Yacoub is most excited about the new, Norman Foster-designed AHC facility, for which it is hoped ground will be broken later in 2018, with completion in 2021 (Figure 6). The new construction will increase the AHC’s laboratory space and feature rooftop gardens. The plans also include a solar farm that will allow the facility to be carbon neutral. “It’s not just a hospital center—it’s a campus,” Yacoub explained. “It’s more like Cambridge or Princeton, something unique for the area.

FIGURE 6 New Aswan Heart Centre



People deserve it, because we have a lot of expertise, a lot of patients, a lot of science, a lot of everything. So, I'm very excited"—a sentiment that is, undoubtedly, shared.

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