Preface

It has been just 40 years since total artificial heart (TAH) and ventricular assist devices (VAS) projects both started at the same time at two different laboratories in the United States in 1957. The number of clinical uses of TAH and VAS has now exceeded 2000 — mainly for temporary use in severe heart failure related or unrelated to heart surgery, and the rest as a bridge to heart transplantation.

Our International Symposium on Artificial Heart and Assist Devices has now entered the second decade and has been well recognized worldwide. *Artificial Heart 6* (with heart replacement as the main theme), which we present here with great pleasure, is the proceedings of the 6th meeting, which took place July 30–31, 1996, in Tokyo.

The proceedings consists of nine sessions: TAH, Heart Transplantation, Biomaterials, VAS, Clinical Application, Pathophysiology, Engineering, New Approaches, and Special Session. Session V, Clinical Application, has three sections: 1, 2, and Muscle Pumps. Excluding the last two invited special lectures, Session IX (Special Session) has three selected papers under the category of “From Pulsatile to Nonpulsatile.” In the Fifth Symposium, three subjects — nonpulsatile pumps, muscle-powered pumps, and control physiology — were presented in three independent sessions as New Approaches 1, 2, and 3. I hope some topics in Session VII (Engineering) and Session VIII (New Approaches) of the present proceedings will also develop further and will comprise a major session someday.

The scientific exhibition which started in the 2nd symposium has become completely established as a regular event, and reports on approximately 20 displays have also been included in this volume. I am sure that all of you will find the proceedings interesting as well as instructive.

The 7th symposium has tentatively been scheduled to take place in the summer of 1999. I hope to meet with all of you again here in Tokyo.

Tetsuzo Akutsu
Vice President
Dr. Akutsu, Vice President of the Organizing Committee; Mr. Fujiki, Director of the Life Science Division, Science and Technology Agency; Dr. Morioka, Vice President of the Japan Medical Association; Dr. Koyanagi, Secretary General of the Organizing Committee; Distinguished Guests; Ladies and Gentlemen:

It is my great pleasure and privilege to be given an opportunity to say a few words at the opening ceremony of the 6th International Symposium on Artificial Heart and Assist Devices. On behalf of the Ministry of Health and Welfare, I should like to extend my warmest welcome to all the participants, especially those who are from abroad.

Development of artificial organs which will take over the function of a part of the human body will certainly improve the quality of health care. Some remarkable progress in this field, such as the pacemaker, has been saving many patients from serious diseases. We believe that further development of artificial organs will give us great benefits and play a greater role in solving various health problems.

The government of Japan also participates with the health-care industry in joint research and development efforts for artificial organs, including the artificial heart. In overseas countries, responding to various demands and based upon new technology, new products are being developed. I believe that international cooperation in this field should be furthered, utilizing such opportunities as this symposium. Development of medical products including the artificial heart is what medical professionals are looking forward to as one of the most important vehicles to improve the quality of health care. We are now trying to increase our efforts; however, at the same time, we also recognize that it is very important for us to guarantee safety and effectiveness.

Research and development in this field necessitates a huge amount of time and financial costs and, needless to say, continuous efforts by all of you. We depend greatly on your work, and we would appreciate it if you, in the process of developing such devices, will be aware of the needs of suffering patients and of medical staff working in the clinical fields.

Finally, we believe that this symposium will surely contribute to the provision of better and efficient health-care services.

May your discussions be fruitful and productive in better understanding the complex problems in the study of the artificial heart.

Thank you.

Shuichi Tani
Director-General
Health Policy Bureau
Ministry of Health and Welfare
Ladies and Gentlemen:

I would like, first of all, to congratulate the Japan Research Promotion Society for Cardiovascular Diseases and all those who have made efforts to convene this 6th International Symposium on Artificial Heart and Assist Devices. It is a great honor for me to have an opportunity to speak at this important symposium.

As the Director of the Life Sciences Division of the Science and Technology Agency, I am in charge of promotion of life sciences, which aims first at elucidating the complex sophisticated mechanisms of life, and then at utilizing the result of research, including research on artificial organs, to find solutions to various problems in human life.

The research on artificial organs, which we are about to discuss today, is, in my view, of great importance in Japan, where the number of elderly people is rapidly increasing. Also in other countries, where organ-replacement technology is rather widely applied, the development of artificial organs is eagerly awaited as well, due to an insufficient supply of natural organs. Recognizing this importance, the Council for Science and Technology, which is a supreme advisory body for science and technology policy in Japan, chaired by the prime minister, pointed out in its 1980 report, among others, the need for introducing engineering techniques into the medical field, in particular, the necessity and importance of the development of artificial organs in such areas as circulatory and metabolic systems, as an important measure for improving human health.

In response to this report and following reports of the Council for Science and Technology, my agency has been making efforts to promote research on artificial organs, in particular, circulatory and metabolic artificial organs. For example, we have been promoting research for the development of the artificial heart by using a mechanical technique simulating the human circulatory system since FY 1991.

It goes without saying that research on artificial organs requires extensive cooperation and coordination among research institutions and researchers in such fields as medicine, biology, and engineering. In this sense, I believe, this symposium could provide participants with an extremely useful opportunity to exchange the most up-to-date research information, which, I am sure, will greatly contribute to significant progress in this field.

Thank you very much for your attention.

Kanji Fujiki
Director for the Life Sciences Division
Research and Development Bureau
Science and Technology Agency

Mr. President, Ladies and Gentlemen:

On behalf of the Japan Medical Association, I would like to congratulate you on holding the 6th International Symposium on Artificial Heart and Assist Devices.

Recent progress in science and technology has been remarkable, and in the field of medicine, the introduction of medical engineering has enabled us to achieve further development of new medical treatments. Particularly, the development of artificial organs has made steady progress.

Unfortunately, heart transplants have not yet been performed in Japan. Some Japanese surgeons, however, have actually made great contributions to the development of the artificial heart. I think, therefore, it is very significant for us to have this symposium here in Japan this year.

Nature stands firmly in front of us like a thick wall against our further progress in science. We must make every effort to break down this wall in order to continue to make further advances.

I hope that this symposium will contribute to the substantial development and practical use of the artificial heart.

Thank you.

Yasuhiko Morioka
Japan Medical Association
Twelve years have passed since the first symposium was held in 1985. The International Symposium on Artificial Heart and Assist Devices has been held in Tokyo, usually biennially, in the midsummer of 1985, 1987, 1990, 1992, 1995, and 1996.

Dedicated and enthusiastic investigators from the world’s major artificial heart research laboratories were invited to participate at all six symposia.

A dream I had years ago, that basic scientists and clinical surgeons would get together, even if only in a small conference room, and discuss and rebuild a new concept of the artificial heart and heart replacement, came true in 1985. Since then, the symposium has been growing in size from 150 participants in 1985 to over 500 members in 1996.

The 4th, 5th, and 6th symposia differed in various important respects from the previous three. First, they featured presentations limited to the subject of heart replacement, with specific in-depth descriptions of selected techniques. Since so many more abstracts were received from abroad than had been expected, we could accept only those that were very strictly selected by the program committee.

Five hundred cardiovascular surgeons and engineers from all over the world, including 13 invited speakers, joined us in the 6th symposium. We were particularly delighted and honored that Dr. Michael E. DeBakey from Houston, who has been active for a long time as leader of the cardiovascular surgical field in the United States, addressed us with the impressive story of this exciting field.

The symposium program has been directly influenced by dramatic advances in artificial heart and heart transplantation. We are planning the 7th symposium to be held in the summer of 1999. I am looking forward to seeing all of you in 1999, here in Tokyo.

In closing, I would like to thank all the individuals and organizations who made this symposium possible. Their support was indispensable for holding the 6th symposium, and we hope for their continued support.

Hitoshi Koyanagi
Secretary General
The Yoshioka Memorial Prize, the Akutsu Prize, and the Koyanagi Scientific Exhibition Prize

The Yoshioka Memorial Prize

The International Symposium on Artificial Heart and Assist Devices is a biennial event that has been held six times since the 1st symposium in 1985. The president of the 6th symposium, Morimasa Yoshioka, was the third generation of the Yoshioka family to hold the position. Hiroto Yoshioka was president of the 1st, 2nd, and 3rd symposia; Hiromitsu Yoshioka, the 4th symposium; and Morimasa Yoshioka, the 5th and 6th. Just before 6th symposium we heard with profound sorrow the sudden news that Morimasa Yoshioka had died of prostatic carcinoma on July 8. All were descendents of Professor Yayoi Yoshioka, M.D., the founder of Tokyo Women’s Medical College, who was especially noted for her accomplishments and devotion to the education of women in the field of medicine. Tokyo Women’s Medical College opened the first heart institute in Japan in 1954 under the auspices of the late Professor Shigeru Sakakibara, an internationally recognized pioneer in cardiovascular surgery in Japan, to conduct comprehensive studies, both in research and in clinical cardiovascular diseases. During the 40 years since the institution was established, the Yoshiokas have been tireless in their efforts to financially support the development of clinical and research work for patients with heart disease. To promote research in this field, they have also sponsored the International Symposium on Artificial Heart and Assist Devices and assumed responsibility as its president. The Heart Institute of Japan has played a leading role in the field of cardiovascular surgery, cardiology, and pediatric cardiology not only in Japan but also worldwide. The Yoshioka Memorial Prize was established to honor the contributions of the late Hiroto Yoshioka, M.D., who served as president of the international symposium for the six years following its inception in 1985. The prize is presented to the author of the best clinical paper contributed to the symposium and includes an award of 500000 yen.

First Laureate, 1992: Kenji Yamazaki, M.D.
The Heart Institute of Japan, Tokyo Women’s Medical College

Second Laureate, 1995: Ryohei Yozu, M.D.
Department of Surgery, Keio University

Third Laureate, 1996: Setsuo Takatani, Ph.D.
Faculty of Engineering, Yamagata University
The Akutsu Prize

The Akutsu Artificial Heart Prize was created to honor contributions to the development of the artificial heart and to celebrate the 10th anniversary of the symposium. The prize carries an award of 300,000 yen. Dr. Tetsuzo Akutsu’s contribution to development of the artificial heart, with Dr. Kolff, is well known worldwide. From the early stages of the development of the artificial heart up to the present, his tireless efforts manifest his courage and dignity as a researcher. The prize is awarded for the best paper contributed in the area of basic research of the artificial heart. It is hoped that many young researchers, inspired by the discipline shown by Dr. Akutsu, will devote their efforts to development of the artificial heart and that the results they achieve will be for the benefit of mankind.

First Laureate, 1995: J. Vašků, M.D.
Vacord Bioengineering Research Company

Second Laureate, 1996: Hiroaki Harasaki, M.D.
Cleveland Clinic Foundation

Koyanagi Scientific Exhibition Prize

Professor Hitoshi Koyanagi is a cardiovascular surgeon in the Department of Cardiovascular Surgery, the Heart Institute of Japan, Tokyo Women’s Medical College, and studied under Professor Shigeru Sakakibara with Professor Soji Konno at the dawn of the era of cardiovascular surgery. Professor Konno, who succeeded to Professor Sakakibara’s position, died at the young age of 43 years. However, all cardiovascular surgeons must remember his name in the Konno-Rastan procedure for aortic stenosis with patch grafts and a prosthetic bileaflet valve, and in the Konno-Sakakibara biopombe. The Heart Institute of Japan has contributed greatly to the development of cardiovascular surgery in Japan, and Professor Koyanagi has borne important responsibilities since his appointment to his present position in 1980. He believes his mission is to promote heart replacement treatments such as transplantation and artificial hearts for many patients suffering from severe intractable heart failure since those treatments are performed daily in the Western world. As Secretary General, Professor Koyanagi has served the international symposium five times with Dr. Akutsu acting as vice-president since 1985, his aim being the realization of treatment by heart replacement. In commemoration of the 10th anniversary of the symposium and as an expression of their gratitude to Professor Koyanagi for his efforts in handling the symposium’s general affairs, the program committee members established the Koyanagi Scientific Exhibition Prize. The prize carries an award of 100,000 yen.

First Laureates 1995: Tokyo University Group, Tohoku University Group

Second Laureates 1996: Kenji Yamazaki, M.D.
The Heart Institute of Japan, Tokyo Women’s Medical College; University of Pittsburgh; Waseda University; Sun Medical Technology Research Corporation

Toyoko Komatsu, Symposium Secretary
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