

CASE STUDY

Mitsui Memorial Hospital, Tokyo, Japan

Hybrid surgery: A new option for the optimal treatment of cardiovascular diseases

Recently, a new approach to cardiovascular medicine has been drawing attention in Japan. Known as “team treatment”, this approach combines surgery and catheter-based vascular intervention. A series of treatment processes are performed across different specialties by surgeons and internal medicine physicians working together to provide comprehensive patient care. The Mitsui Memorial Hospital (Chiyoda-ku, Tokyo), a social welfare corporation, introduced a hybrid lab incorporating the Toshiba Infinix-i INFX-8000H X-ray vascular imaging system combined with a new operating table in 2009, creating a seamless environment for treatment. In a team environment, this enables both diagnosis and subsequent treatment by surgery and/or catheter approach or a combination of both for various cardiovascular diseases in one room.



Social Welfare Corporation Mitsui Memorial Hospital



The Mitsui Memorial Hospital makes positive investments in human and physical resources based on its three pillars of medical practices: advanced treatment of cardiovascular diseases, standard and minimally invasive cancer treatment, and improved quality of life (QOL) for the elderly. Fully equipped with centralized medical functions, the in-patient care unit has 482 beds, of which seven are for ICU, six for CICU, and 21 for HCU. The 13 operating rooms, of which three are for out-patient care, have been in operation since January 2009.



The hybrid operating room equipped with an operating table and an X-ray vascular imaging system for catheter-based intervention



Shinichi Takamoto, M.D.

Chief Executive Officer,
Mitsui Memorial Hospital

Dr. Takamoto graduated from the University of Tokyo in 1973. He is President of the Japanese Society of Cardiovascular Surgery; Secretary General of the Asian Society for Cardiovascular and Thoracic Surgery; Director of the European Association for Cardio-thoracic Surgery and the Japanese College of Cardiology; a member of the American Association for Thoracic Surgery and the International Society for Minimally Invasive Cardiothoracic Surgery; Fellow of American Heart Association and a member of the Society of Thoracic Surgeons.



Kazuhiro Hara, M.D.

Director of the Department of Cardiology,
Mitsui Memorial Hospital

Dr. Hara graduated from Tohoku University in 1980. He is a board member of the Japanese Circulation Society, the Japanese College of Cardiology and the Japanese Association of Cardiovascular Intervention and Therapeutics and Fellow of the American College of Cardiology, the American Heart Association and the Japanese Society of Internal Medicine.



Takeshi Miyairi, M.D.

Director and Surgeon in Chief of the
Department of Cardiovascular Surgery,
Mitsui Memorial Hospital

Dr. Miyairi graduated from the University of Tokyo in 1983. He is a member of the Society of Thoracic Surgeons, Japanese Association for Thoracic Surgery, Japan Surgical Society and the Japanese Society for Cardiovascular Surgery.



Kenji Ibukuro, M.D.

Director of the Department of Diagnostic
Radiology,
Mitsui Memorial Hospital

Dr. Ibukuro graduated from the Tokyo Medical and Dental University in 1983. He is a board member of the Japanese Society of Interventional Radiology and a member of the Japanese Research Society of Clinical Anatomy and the Japan Radiological Society.

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Background

The Mitsui Memorial Hospital is known as one of Japan's leading Cardiovascular Medical centers. Dr. Shinichi Takamoto, Chief Executive Officer of the hospital and Director of the Central Operation Center, states, "Cardiovascular disease is very common in the Japanese population, and is the second leading cause of death in Japan. Many of these deaths are related to lifestyle and can occur suddenly in the working generation and in apparently healthy people. Effective diagnosis and treatment is of utmost importance for these patients. In order to provide the best possible treatment for our patients, we keep ourselves up to date with the most advanced treatment, utilizing the latest medical devices and technology."

Integrating mutual benefits to enable optimal treatment options

Dr. Takeshi Miyairi, Director, Surgeon in Chief of the Department of Cardiovascular Surgery states, "We combine percutaneous transluminal angioplasty (PTA) with intimal resection or bypass surgery for patients with arteriosclerosis obliterans (ASO) or peripheral arteriosclerosis. Upon completion of clinical trials and authorization in Japan, other hybrid surgeries will also be made available, including catheterized cardiac valve replacement for aortic valve regurgitation and hybrid techniques for congenital cardiac diseases or arrhythmia."

Dr. Miyairi continues, "Hybrid surgery will benefit an increasing number of high-risk patients, including the elderly, children, and patients with complications, by combining advantages of vascular internal medicine and cardiovascular surgery. This type of treatment would not be possible by either technique alone. Specific advantages include less

bleeding during surgery, shorter operation time, reduced physical burden for the patient, lower surgical risk, and more successful surgeries. This will lead to shorter hospitalization periods and better outcomes. Hybrid surgery is designed ultimately to benefit the patient."

A strictly surgical procedure would require a large-scale thoracotomy, while treatment with catheterization alone can involve problems. The hybrid treatment allows selection of an optimal combination that best fits each individual case.

The hybrid operating room: An optimum environment that supports emergency cases

Managing emergency cases is the key to utilizing a hybrid operating room, as it should be able to address the demand for urgent surgeries. Since opening the hybrid operating room at the Mitsui Memorial Hospital, the room has been used for the treatment of aortic aneurysms, which were previously performed in the catheterization room. Dr. Miyairi reasons, "Compared to other catheter procedures, stent-graft repair of aortic aneurysm is more invasive and requires special attention. Particularly in an emergency case, the patient's condition may change suddenly during surgery and could require additional treatment or intervention urgently. In such a case, patient risk can be minimized if the surgery is done in a hybrid operating room equipped with all the required dedicated imaging and surgical facilities." Recently, a stent-graft procedure was performed in this environment on an elderly patient with a risk of possible aortic aneurysm rupture. Using the hybrid room for the procedure was successful; the patient has steadily recovered and is now awaiting discharge.

Team treatment: A coordinated system established for better patient care

Team treatment requires coordination among different specialties, such as cardiovascular surgery and vascular internal medicine. Dr. Kazuhiro Hara, Director of the Department of Cardiology, says, "For arteriosclerosis patients concurrently having angina and peripheral arteriosclerosis, our cardiovascular surgeon and endovascular physician work together to determine the treatment policy. After diagnostic assessment, appropriate procedures are comprehensively determined by the two departments." Further, he describes an additional advantage for vascular internal medicine, "Now, we can consider hybrid treatment as a choice for all our patients."

Dr. Takamoto states, "Patients don't care which department they go to. What is most important for them is to receive appropriate treatment and recover from disease. This means that we need to remove the departmental boundaries and combine respective knowledge. Although we have already used this method on a case-by-case basis, we can now work in a streamlined environment to allow hybrid treatment as a well-established system." Dr. Miyairi adds, "We discuss treatment policies more often than before." Dr. Hara agrees, "We review coronary artery images together and determine treatment plans as a team."

The angiography / CT / vascular dynamic image network: Supporting systematic collaboration that ensures everything works properly

The mainstay of this hybrid treatment is the combination of an operating table and an X-ray vascular imaging system for catheterization. Previously for intra-operative vascular imaging a mobile C-arm was used in the operating room. "With the new Toshiba Infinix system, we are now able to acquire higher-quality images during the procedure. The large panel offers a wider image with a larger field of view and the entire system is easy to use," says Dr. Miyairi. The vascular dynamic image network system (Toshiba Medical Systems' CardioAgent™) enables access to both Angiographic images and previously acquired CT images from the operating room. This allows the physician to precisely determine the relative positions of the heart and the vessels that are not fully visible from the operating table. The CT scanner used here is Toshiba Medical Systems' Aquilion ONE™, with 320 detector rows.

Stent-graft placement in abdominal aortic aneurysm (Images: Courtesy of Mitsui Memorial Hospital)



Pre-operation



Post-operation

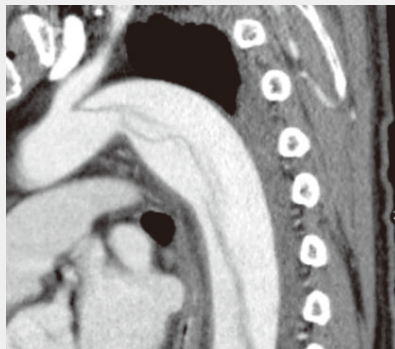
“With 16-cm coverage in a single scan, the Aquilion ONE is ideal for imaging aortic dissection,” says Dr. Kenji Ibukuro, Director of the Department of Diagnostic Radiology. “The intimal flap in a dissected aorta will move if no thrombus is present. With other CT scanners, the temporal resolution is not sufficient to capture this motion and results in blurring of the image. Aquilion ONE can avoid this by using cardiac gating.”

Aquilion ONE is also used for imaging and measurement assessment of aortic aneurysms prior to stent-graft treatment. Dr. Ibukuro describes further advantages of this coordinated approach, “In the actual operation, the surgeon sees the aorta overlapped by the thrombus. To simulate this situation, the radiologist creates an image with the thrombus superimposed onto it. Additionally, sizing and localization of the target can be optimized utilizing tools such as landmarking of bony structures onto the image.

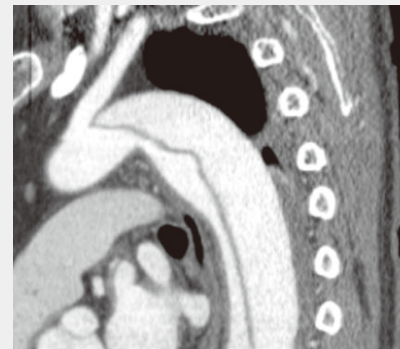
When selecting hybrid surgery facilities, the medical staff at the hospital also considered the products of other manufacturers. Reasons for having chosen the Toshiba Infinix-i System include its positional flexibility, and “the excellent performance as a whole,” explains Dr. Hara. “For seamless utilization, it is important to have all facilities connected to the hospital’s network to allow access to

Comparison of CT images of aortic dissection

(Images: Courtesy of Mitsui Memorial Hospital)



Conventional CT



Aquilion ONE™

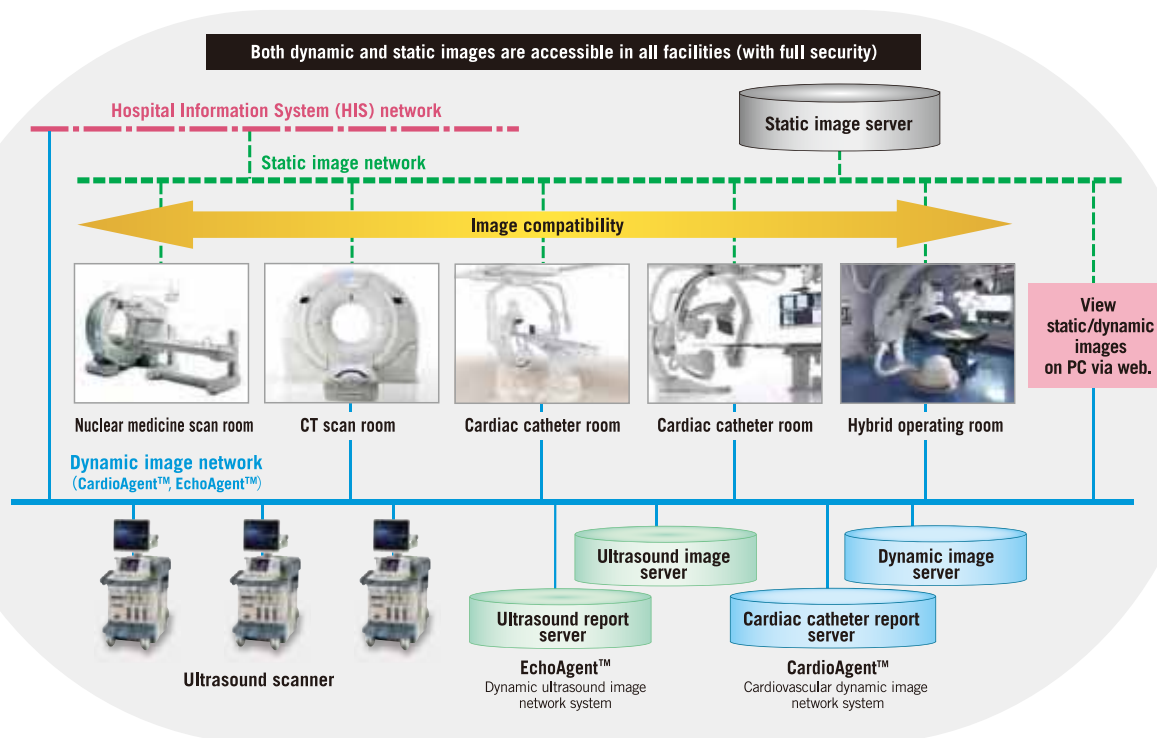
image data anytime, anywhere—whether you are in the conference room or operating room.”

Located in Chiyoda-ku, Tokyo, the Mitsui Memorial Hospital has relatively limited space available for its operating room. With a ceiling-mounted design, however, the X-ray vascular imaging system does not interfere with other floor-mounted medical equipment, such as anesthetic and artificial cardiopulmonary units. Dr. Miyairi notes the importance of this point, “This was our primary concern from the design phase.”

Hybrid surgery also contributes to local health care and hospital management

The hospital’s hybrid surgery is becoming increasingly recognized by the local community. “We have more referrals for stent-graft repair of aortic aneurysm,” says Dr. Miyairi. The hospital now accepts high-risk patients ineligible for conventional surgical procedures due to advanced age or complications such as renal insufficiency. This is a positive move that will assist hospital management.

Mitsui Memorial Hospital vascular diagnosis and treatment system



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Post-operation 3D image of stent-graft placement in abdominal aortic aneurysm

(Image: Courtesy of Mitsui Memorial Hospital)

Dr. Takamoto explains further, “We have 482 beds, and their occupancy ratio exceeds 90%. Patients spend 10-11 days on average in this hospital, much shorter than the 13-14 days required before. This is yet another advantage of our hybrid treatment.

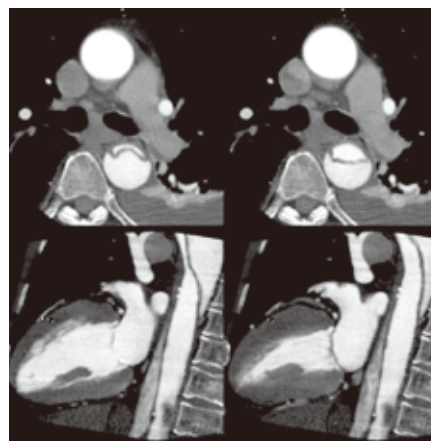
Of course, these challenges require the education and training of all staff, including the physicians/surgeons and anesthesiologists involved, as well as medical engineers and radiologists normally working outside the operating room. “As a future option, we are considering catheter-based aortic valve treatment as is already performed in Europe and the U.S. For this purpose, we need to

develop qualified resources,” Dr. Hara points out. “Aortic valve failure is common in the 80-to-90-year-old population; thus, a minimally invasive procedure needs to be established.” Dr. Miyairi notes, “Catheterization is certainly useful in terms of quick response but cannot meet the needs of specific patients. As the number of such cases increases, hybrid treatment will prove advantageous, allowing seamless transition to surgical intervention without having to move patients.” This means that there will be a need for closer collaboration among physicians and surgeons across different specialties. Additionally, they need to improve their skills. Dr. Takamoto says, “Physicians and technologists, especially younger people, are enthusiastic about using new devices and technology, dedicating time and effort to learning new techniques.”

Hybrid ORs open the door to the state-of-the-art treatment model

Under these circumstances, Dr. Hara says, “I often discuss this with Dr. Miyairi. We aim for half a step forward in treatment while maintaining the standard vascular procedures that will be modeled by other hospitals. ‘Half a step’ means that our supporting foot will remain on standard procedures. Having our own hybrid operating room, we would like to

provide support to other hospitals in every aspect by bringing in the latest treatment techniques from Europe and the U.S.” The hospital’s “half-a-step forward” approach attracts a large number of visitors from both Japan and abroad. “This is also very stimulating for us,” says Dr. Takamoto. In the not-so-distant future, we may be able to see hybrid treatment becoming standard practice.



Aortic dissection: The intimal flap (septal wall separated from the arterial lumen) is visualized. Both diastolic (left) and systolic (right) images can be acquired in a single scan.

(Image: Courtesy of Mitsui Memorial Hospital)



TOSHIBA MEDICAL SYSTEMS CORPORATION

1385, Shimoishigami, Otawara, Tochigi Prefecture 324-8550, Japan
X-Ray Vascular Business Unit: TEL +81-287-26-5042
CT Business Unit: TEL +81-287-26-5034
<http://www.toshiba-medical.co.jp/>

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MOIXR0028EA 2010-5 AK/NS

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The operating table at the hybrid operation room is ALPHAMAQUET 1150.