Progress in Cardioangioscopy

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In 1925, Dr. Kussmal in Germany constructed a device with a metallic tube containing a lens inside for observation of the interior of stomach. This was the first clinical use of an endoluminal scope (endoscope). However, since it was rigid, it was a great burden on the patient to have it introduced through the mouth into the stomach.

On August 31, 1945, a big storm attacked Tokyo and surrounding areas (Kanto region) of Japan. Trains were stopped for several hours due to the storm and Dr. Toru Uji, a surgeon at Tokyo University and Mr. Masao Sugiura of Olympus Optical happened to meet on the train and discuss the concept of a new endoscope. This was the start of development of the endoscope in Japan.

In December, 1949, in collaboration with Mitsuya Fukaoami and Mamoru Maruyama of Olympus Optical, they developed a flexible gastroscope 12 mm in diameter equipped with film and an illumination source in the distal most tip. Anesthetized dogs were successfully examined with this endoscope.

Tetsuya Sakamoto of Tokyo University used this endoscope for the first time as a gastroscope. The flexible gastroscope thus developed has served as the basic structure for the bronchoscope, cystoscope and other types of similar scopes.

Several years later, this gastroscope was replaced by a fiberscope which was more flexible and more easy to manipulate. Fiberscopes are now widely used as an essential tool to diagnose and treat not only the digestive tract but also the respiratory and urogenital tracts.

Although the endoscope was used clinically in peripheral arteries during surgery by Dr. SM Greenstone, many years elapsed until percutaneous transluminal coronary angioscopy was performed. This was due to difficulties related to the displacement of blood in the artery and the need for a more flexible and thinner endoscope.

In anticipation of clinical applications, we (the author and members of Olympus Optical) began to develop a new fiberscope for coronary use.
in 1976.

Thrombosis and thrombolysis in excised human coronary artery and the changes induced by balloon angioplasty were successfully observed in 1984 using this endoscope.

Meanwhile, Dr. JR Spears of Beth Israel Hospital, Boston reported the percutaneous transluminal application of the fiberscope to observe coronary arteries. He observed coronary ostia in 1983 using a broncoscope. Coronary arterial changes were also observed mainly intraoperatively by Litback (1985), Homebach (1986), Sanborn (1986), Sherman (1985), and Vent T(1987), among others.


The application of percutaneous coronary angioscopy was extended to the diagnosis of Kawasaki disease by Ishikawa (1991) and to examine CABG by the author (1994).

Meanwhile, angioscopes of the monorail type without a balloon were devised by the author (1989) and those with a balloon by Baxter Co and a 3-channel angioscopy balloon catheter by the author (1994). The outer diameters of fiberscopes for coronary use have now been reduced to 1F. Thus, percutaneous angioscopy is now routinely performed in several institutions to examine the underlying mechanisms of acute coronary syndromes, select therapeutic modalities, evaluate medical, interventional and surgical therapies, and to predict acute coronary syndromes.

In 1999, we developed dye image coronary angioscopy based on animal experiments for the identification of endothelial damage. Fluorescent image coronary angioscopy was also used clinically by the author (1999).

These new techniques may yield more detailed information on the composition and metabolism of coronary plaques. Angioscope-guided transcatheter interventions which were applied to peripheral vessel disease (1992) may also be applied to coronary arteries in the near future. Angioscopes for coronary use currently contain more than 8000 glass or silica fibers which provide improved images of coronary luminal changes.
Angiomicroscopy, which enables the evaluation of vascular changes at the cellular level has been used in peripheral vessels (1995), may also be applied to coronary arteries when it becomes flexible.

The examination of coronary microvessels is beyond conventional angioscopy.

One possible approach is to examine them from the inside of the cardiac chambers.

In 1912, Drs. von Rhea and Walker observed the interior of the heart during a thoracotomy, while Dr. Allen (1922), and Dr. Harken (1944) also observed the interior of the heart during thoracotomy in animals. In 1948, Hitoshi Sakakibara and colleagues examined the interior of the right heart during open heart surgery using a rigid endoscope. This may have been the first observation of the interior of the heart in humans. However, many years passed before percutaneous cardioscopy was performed to view the interior of the beating heart in patients, due to the lack of a thin fiberscope and effective equipment with which to displace the blood.

In 1988, the author successfully observed percutaneously in anesthetized dogs the right and left ventricles from inside using a thin fiberscope which was incorporated in a guiding balloon catheter. This device was used in patients with heart disease the same year. Application of this "Cardioscopy" was extended to dilated cardiomyopathy, myocarditis, hypertrophic cardiomyopathy and ischemic heart disease, and to evaluate the effects of drugs on subendocardial microcirculation developed in 1990 (1995).

In addition, cardioscope-guided endomyocardial biopsy was established (1990).

At the present time dye image and fluorescent image cardioscopy are being clinically tested to assess the subendocardial microcirculation.

Cardioscope-guided intramyocardial and intrapericardial drug administration have recently been started for angiogenic therapy of ischemic heart disease.

In 1996, intracardiac ultrasonography (ICUS) was developed and is now routinely used clinically to evaluate the cardiac chambers and valves in our laboratory since the combined use of cardioscopy and ICUS provides much more information on the cardiac wall architecture.

On April 1, 2000, the Japanese Association for Cardioangioscopy was founded based on 13 years of work on cardioangioscopy. Cardioangioscopy is now supported by the Japanese government's national health insurance program. In addition, a textbook titled "Coronary Angioscopy" was published by the author (Futura Publishing Co, NY) in Feb, 2001.
Many years have passed since I started working on coronary angioscopy and cardioscopy. I would like to express my sincere gratitude to Olympus Optical and my co-workers for their cooperation over many years. (Jpn Heart J 2001; 1-4)