The role of the university hospital in the development of biomedical engineering Education in Taiwan —the experience of an endoscopist in the last 35 years(1971-2006)

Cheng-Yi WANG[1], Chia-Hung CHIEN[2,3], Yi-You HUANG [3,4] and Feng-Huei LIN[4]
[1]Department of Internal Medicine, College of Medicine,
[2]Graduate Institute of Electronics Engineering, National Taiwan University,
[3]Biomedical Engineering Department, National Taiwan University Hospital,
[4]Graduate Institute of Medical Engineering, College of Medicine, and
College of Engineering, National Taiwan University

The uses of fiberscopes make the great advances in the diagnosis of gastrointestinal diseases in Taiwan in the last 35years. The first fiberscopes were used in Taiwan in 1971. It makes very good observation and also takes specimens for histological examination through the biopsy forceps. Early and superficial small cancers can be detected and treated.

The successful rate of total colonoscopy was limited to one third or less by the pioneer endoscopists in Japan. Our effort in the first two years tried to improve the rate of total colonoscopy by improvement of the technique, and also improvement of the scopes. The first report of the rate of total colonoscopy in 1972 reached 60 %. We noticed the visual angle of the scope has to be enlarged and the deflection of the tip of the scope should be increased. The hardness of the scope can be adjusted in different locations of the large bowel to improve advancing of the scope. We had no mature technology and no available manufacturer. No any local industry manufacturer showed interests to this refinement.

The Olympus Company in Japan, one of original makers of fiberscopes, gave me the privilege and first opportunity to use a new colonoscope, CF-1TL, for clinical trial in 1980. We reached 100 % successful rate to the cecum in the first trial of 80 cases. The average time of total colonoscopy was 7.8 min. The scope became the major model scope used in colonoscopy in the next decade..

Our first need in the first 10 years was to repair the scopes. We often sent our scope to Japan for repair services and we had to discontinue our practice for about 2 weeks. The local agent provided no repair services at the first years. It was why we set up the department of biomedical engineering in the university hospital in 1986 and took over the repair services of most health care devices. The local agent expanded their service department to a great deal and took the responsibilities of repairing all fiberscopes in Taiwan.

Therapeutic applications are another great advance in the development of digestive endoscopy. Resection of polyps or polypoid lesions and endoscopic hemostasis are two major directions. We have applied endoscopic polypectomy quite earlier since 1975 and concluded that small polypoid lesions can be resected by endoscopy safely, which provided tissue confirmation of adenocarcinoma. We noticed 6.5 % of polypoid lesions were cancer among the first 1,000 colonoscopic polypectomies.

We applied diluted epinephrine solution (Bosmin) for local spray use and got very high successful hemostatic effects in 1977-1980. We wish to use some assisted devices to control bleeding such as injector and mucosal ligators. No any local industrial company could help me and make reality of the ideas. But now, injectors and varices ligators are the common devices used in daily practice.

Twenty years ago, we still noticed a lot of cases of TB colitis and amebic colitis. The people in Taiwan were living in the high prevalence of HBV infection. To clean the scopes and to make disinfection of the scopes is of great concern during my practice. We have to ask our technical people to work hard to wash and clean their scopes with water and alcohol very carefully. These

measures make complete disinfection of the scopes and to avoid transmitted infection through the scopes.

We contacted a famous local maker of home-electric devices and also a very good manufacturer of home-washer. They had no interests to make endoscope washer because there was no market value. While, it became one of the essential procedures of cleaning and disinfection of the scopes after each use. Widespread use of endoscope washers is the rule and the facts. The company lost the opportunity to become a major endoscopic device supplier. I am sad about this.

We fight our needs of research personnel at the middle ten years. Finally, the Institute for Biomedical Engineering was established in our medical college in 1990 for the purpose of development of the basis of key technology and also man power for research. A program for biomedical engineering for all postgraduate students began in 1993 and collected 150 master students and 7 PHD students. Core courses were also set. A total of 11 credits are required for all students. Medical ethics, principle of biomedical engineering, and human structure and life phenomenon are three essential courses. There were four international symposia between 1990-1996 held by the Center to initiate the interests and to encourage learning and research proposal in biomedical engineering.

Our research team started to work and worked hard in the current 10 years. The Center was renamed The Graduate Institute of Medical Engineering in 1998. A total of 100 master students and 30 PHD students were enrolled in the Institute in two years, and now every year.

In about 5 % of all bleeding in the gastrointestinal tract was obscure. The source of bleeding remained unknown. Endoscopy could not observe and detect the sites of bleeding in the small bowel. We need total or complete observation of the small bowel. The so-called small bowel fiberscope only reached the initial one meter or less of the upper jejunum beyond the Treitz. Wireless endoscopy was our next dream. A small endoscopic jeep with saline and gas supply was designed. A small antenna transmits the images. The jeep can run on the rough intestinal surfaces from the anorectum to the proximal intestine. It injects gas and saline inside the bowel lumen. A recorder and also a remote TV monitor displays endoscopic pictures. The jeep can reach deeply into ileum and jejunum.

Our endoscopy jeep remains in the developing stage, while capsule endoscope by the Israel company was approved by FDA in August, 2001 and available in Taiwan in 2002. Double balloon endoscopes were applied for the same purposes from 2003.

Another approach of painless endoscopy is to develop virtual endoscopy Colon images can be obstained by rapid CT and MR scanning pictures It is not an invasive procedure. And often accepted by the patients. Just around 1994, during procurement of a new rapid CT device, our research team visited Central Science Academy to find key technology derived from missile technology, wireless transmission and high performance computing technology for the purpose of development of endoscopic jeep and virtual endoscopy. Dual technology is one of the trends of National Defense Technology .

We feel a strong R and D team with key technology should be the basis of health device industry. The Graduate Institute for Biomedical Engineering can provide the research manpower and the mature technology ready for industrial purposes. The hospital is a nice place for development of the new devices and also new technology for health care purposes. A certified laboratory can examine the devices at the preclinical phase. The hospital staffs and major faculty members play a big role in performing clinical trial and evaluating their uses. Risk analysis made by an experienced clinicians are good reference for the product. A course on the medical ethics and also the approval system of the medical devices should be included in the postgraduate course. They will give the students a solid concept of the maturation of a product.

The 21st Century is the Century of Biotechnology and Medical Engineering, Multidiscipline is a key point requirement not only in manpower resources but also in cooperative research.

Conclusions:

University Hospital plays a big role in the development of medical device industry both in clinical test and clinical trial. The medical staffs can quickly catch the needs and requirement and get the idea of development. A comprehensive core course should include anatomy and physiology in addition to ethics and the approval systems of health care devices. Department of Medical Engineering may be a good coordinating unit among engineering people and medical personnel.