

Report for the 2010 SSAT Traveling Fellowship for Surgeons in Academic Practice

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Associated Meetings:

5 Asian Living Related Liver Transplant Centers Meeting, Hong Kong

International Liver Transplant Society Meeting, Hong Kong

Red Cross Hospital, Tokyo, Japan

Dig where you stumble, for this is where the treasure lies

Asan Medical Center, Seoul, South Korea

There are no failures, only trials

Queen Mary Hospital, Hong Kong, China

If necessity is the mother of invention, ability is the father of opportunity

My application for the 2010 Karen and Josef E. Fischer Society for Surgery of the Alimentary Tract Travelling Fellowship was focused on the 2010 International Liver Transplant Society Meeting in Hong Kong, June 2010. After the good fortune of receiving the award I was graciously accepted as a visitor to three of the world's leading hepatobiliary units [The Japanese Red Cross Hospital (Tokyo), Asan Medical Center (Seoul), and Queen Mary Hospital (Hong Kong)]. Each of these centers has published on over 700 living related liver transplant procedures, as well as thousands of non living related transplant liver resections. Combined they represent the largest and most successful experience with these technically demanding procedures. The goal of these visits was to glean some sense for the organizational culture, technical expertise, and perioperative environments that facilitate this success. Although each program has developed its own individual system of care, there were multiple common themes. These included the following:

- Detailed, high resolution, preoperative imaging (hepatic veins, portal veins, hepatic arteries, bile ducts) with precise liver volumetry

- Intraoperative patience with meticulous donor transection technique focused on limiting peritranssectional blood loss
- Fluency with multiple hepatic venous reconstruction techniques aimed at preservation of mid liver hepatic venous drainage for both the recipient and the donor
- Careful intraoperative cholangiography to plan the biliary transection/reconstruction
- Microscopic hepatic artery reconstruction and occasional microscopic biliary reconstruction
- Fluency with multiple techniques to measure and modify portal venous inflow
- Expert multidisciplinary perioperative services (anesthesia, radiology, and nursing)
- A multidisciplinary institutional commitment to the program
- A team esprit d' corps

It is certainly true that the incredible success each of these programs has demonstrated does not rely on any one particular feature. In each of these situations, the whole definitely equals more than the sum of the parts. During this Fellowship I learned that excellence at each site has been achieved through a synergy of people, processes, and techniques.

It is impossible to describe all that I learned on these visits, but here are some vignettes from two of the sites that are representative.

Japanese Red Cross Medical Center, Tokyo, Japan

Director: Professor Masatoshi Makuuchi

With anticipation overcoming jetlag, I travelled the short distance from my hotel to the Japanese Red Cross Medical Center on the outskirts of Tokyo. It was a beautiful new building in a pleasant residential neighborhood called "Green Hills". At the JRCCM, I was fortunate that Dr. Ogata, who has been working with Dr. Makuuchi for over 20 years, was able to spend most of the day with me discussing nearly every aspect of liver surgery.

During the first day at JRCCM I observed two major surgeries. The first case was a young woman with a giant left liver hemangioma extending to segments 5 and 8. The case was started by one of the junior faculty who performed an elegant dissection of the falciform portion of the left portal pedicle. Each of the early branches to segment 1 were preserved with individual ligation of branches to segments 4, 2 and then 3; facilitating an extended left hepatectomy with preservation of the caudate lobe. Prof. Makuuchi then performed the liver transection with a refined crush clamp technique, skirting the hemangiomas in the anterior right liver but never losing focus on the path of the middle hepatic vein. Under an intermittent Pringle maneuver the transection was literally bloodless.

In the second room, another faculty member was plodding through the exposure to the remnant right liver in a patient with her third recurrence of metastatic rectal carcinoid (extended left hepatectomy with hepaticojejunostomy and segment 7 resections had previously been

performed). Through a wide right subcostal incision extended to a 9th rib space thoracotomy (the Makuuchi 'J'), he meticulously chipped the right liver out of its adhesive cocoon in the right upper quadrant of the abdomen. Anatomic drawings of the liver anatomy done preoperatively by the residents then guided a detailed intraoperative ultrasound of the liver, mapping 11 separate lesions. Immediately apparent was the assistance of the thoracotomy. Not only did it enable the safe and precise dissection of the diaphragm from the liver capsule, but it placed the liver in the middle of the operative field, allowing identification and a margin negative excision of a 5 mm metastasis nestled in the space between the middle and right hepatic vein trunks. Again using a fine crush clamp and tie technique a series of 5 wedge resections was accomplished encompassing all of the metastatic disease. 14 inflow occlusions of 15 minutes each for a total Pringle time of 210 minutes was used.

Late in the case, Prof. Makuuchi asked what I thought of the operation. Bringing to bear much of my previous training that had instilled an extreme fear of prolonged portal inflow occlusion, I was hesitant to answer. I was certain that a patient with a small liver remnant to start, exposed to a 10 hour redo thoracoabdominal dissection, with 30% of the remnant liver volume removed under 210 minutes of inflow occlusion was destined for a rocky postoperative course from liver failure. Politely, I asked how high he would expect the transaminases to peak postoperatively. He said, "Not at all", and proceeded to explain his philosophy that post operative liver failure after major liver resection has little to do with inflow occlusion time, and everything to do with gentle physical handling of the parenchyma, avoidance of all thermal injury, avoidance of peritranssectional bleeding and related transfusions, avoidance of perioperative systemic hypotension, and progressive lengthening of the off-Pringle time between inflow occlusion periods.

The patient received no blood products, was extubated in the operating room and ambulated the following day. Her postoperative day 1 INR was 1.3 and the AST was 250.

Asan Medical Center, Seoul, South Korea

Director: Professor SG Lee

Asan Medical Center is a sprawling new structure on the banks of the Han River, in the heart of Seoul. Asan was founded by the chairman of Hyundai Motors Corporation as an independent endowed hospital system that functions under the structure of the government health ministry. Professor Lee began living related liver transplantation there in 1998 and has built the program into the world's largest living related transplant unit, and likely the largest hepatobiliary surgical center in the world. Currently they perform over 350 living related transplants, 600 liver resections, and 400 pancreatic resections per year. The service is staffed by 8 attending surgeons and countless housestaff and fellows. During the two days I spent at the Hospital, they performed 3 living related liver transplants, 8 major liver resections, 6 pancreaticoduodenectomies, and four cholecystectomies. The main operating theater (Florette D) is composed of six OR suites around a central core, where a continually rotating set of foreign visitors gather to follow the progress in each of the adjoining OR rooms. All of the cases are projected from overhead cameras in the operative

lights onto large flat panel monitors in the OR rooms. This assists observation and allows the scrub and circulating nurses to follow the progress of the operations in detail.

Most of the scrub nurses have been in the unit for over 8 years and they work in near silent harmony with the surgeons. Each step of the operations is well rehearsed and the team flows seamlessly between transitions. At Asan most of the cases, and the living related transplants in particular, are truly team events. Typically, one set of surgeons will perform the donor operation. The donor liver transection is comprised of a right hepatectomy, identifying all segment 5, segment 8, and inferior hepatic veins over 5 mm for reconstruction, retaining the middle hepatic vein with the donor. The transection proceeds using a cautery-tip CUSA device and ligation of each fine crossing vascular and biliary radical with 5-0 silk ties. In the course of a transection over 200 ties will be placed.

A second set of surgeons remains on standby to perform the backtable reconstruction of the graft. Cadaveric iliac conduits are used to span the distance between the Segment 5/8 vein orifices and the recipient vena cava. Simultaneously, another set of surgeons will prepare the recipient liver for explant, leaving it attached by only the hepatic veins and inflow structures until the donor allograft is ready for implantation. Careful dissection is made to identify inferior hepatic vein anastomotic sites. When the donor allograft is ready, the recipient team returns for implantation. Recipient harvested saphenous vein is split longitudinally and sewn to the recipient right hepatic vein orifice creating a wider venous outflow (called the 'fence'). Separate venous anastomoses are then made between the donor right hepatic vein and the fence, conduit anastomosis of the reconstructed donor segment 5 and 8 veins to the recipient middle/left hepatic vein orifice, implantation of any donor inferior hepatic veins over 5 mm, and reestablishment of portal venous continuity. The graft is then reperfused. Yet another team draws the microscope to the field and completes the hepatic arterial anastomosis with interrupted 9-0 nylon. Finally, the last team arrives to complete the biliary anastomosis and closure.

An equally intricate system of care manages the postoperative patients through the ICU to stepdown unit to ward to discharge process. The outcomes and research from this high volume experience are exceptional. Many factors contribute to this success, but two that stand out are the environment of mentoring that has developed so many expert surgeons, anesthesiologists, and nurses, and the stressed importance of intraoperative precision enabling successful postoperative patient recovery.

At the three institutions I visited I was graciously hosted by members of each surgery unit. I am indebted to them for the friendship and camaraderie that was shared. At the junior and senior levels everyone involved was available to answer questions and explain techniques. In this regard, one of the educational highlights of the trip was a detailed one hour lecture that Dr. Shin Hwang gave to the group of visiting observers at Asan Medical Center regarding the sequential experiences and observations that form the foundation for their living donor/recipient middle hepatic vein anastomotic technique.

I was also fortunate to spend social time with members of the faculty at each institution. In Tokyo, Dr. Ogata invited me to a traditional tempura restaurant where I learned about his 20+ year experience at Prof. Makuuchi's side. In Seoul, Professor Lee hosted a group of 3 young surgeons at dinner where he told us about the trials and tribulations of the first few living related liver transplants he and his team performed at Asan, and the lessons learned that now form the foundation of the current world's number one volume living related transplant center. In Hong Kong, Professor Lo and Dr. Andy Chan welcomed me to a dinner with several visitors from around the globe. We shared stories about family, surgery, and our struggles to balance both. Together, these outings rounded out an exceptional cultural experience. I only wish I had had time at each location to exchange ideas and experiences with more of the team members.

After visiting these three centers, the trip culminated in attendance at the 5 Asian Center Living Related Liver Transplant Conference and the International Liver Transplant Society Meeting in Hong Kong. Both meetings were educationally rich, pulling together the world's experts in the field and highlighting the techniques and accomplishments of the Asian transplant centers. It was also a chance to see friends and acquaintances from Europe, Australia, and the US. The meeting and social programs were both outstanding opportunities to share and learn.

Relationship to the US experience

The combined experiences and learning gained during this Fellowship immediately beg the question of how much of the techniques and systems of care responsible for the success of Eastern liver surgery is transferrable to the Western experience. On the surface, the operative environment appears to be prohibitively different than in the West. For example, in none of the three centers I visited was there a time pressure in the OR. As a corollary, housestaff were not as constrained by work hour restrictions, allowing them to participate in lengthy operations and complex postoperative care.

Another important aspect of this discussion is the motivational differences to develop living related liver transplant programs in the West compared to the East. In the East, cultural and religious objections to deceased donor organ procurement have forced these centers to focus their energy and training programs almost exclusively on the living donor operation. Under this pressure they have developed sophisticated techniques and care systems that are the underpinnings of their success.

In the West, nearly opposite pressures are at work. Few will dispute that there is a utility for living related liver transplantation in the West, however, the availability of cadaveric organs in the West has focused most of the training and care environments onto whole organ liver transplantation. This averted focus, coupled with a societal need for near perfect donor outcomes, has disincentivized the development of Western living related liver transplant procedures and programs.

And then there remains the question of whether the liver substrate is fundamentally different in Eastern patients? Historically, I have learned that Eastern and Western hepatic surgery cannot be compared because Eastern surgeons (and patients) benefit from the absence of steatosis that so

frequently complicates Western liver resections. Although I observed less steatosis in Asian center patients and donors, it was not absent. Type II diabetes, obesity, and steatosis are all on the rise in Asia and the percent of hepatocytes involved with fat is currently a consideration for Asian living donor candidates on a daily basis. While it is certainly true that the median body mass index of the typical Asian patient is likely lower than in Houston, Texas, the difference appears to be narrowing.

Regardless of differences in operative environment, developmental motivations, and liver substrate, I think there are many principles and practices that are translatable to our operating rooms and hospitals. Certainly, I have become a better hepatobiliary surgeon in general for having observed these technically expert surgeons and their colleagues. In addition, the role of team consistency and unity in achieving excellent patient outcomes cannot be understated.

I am grateful to Dr. Barbara L. Bass, to the Society for Surgery of the Alimentary Tract, and to Karen and Josef E. Fischer for their generous support of these experiences. I look forward to the next Annual Meeting of the Society for the opportunity to share this experience with the Membership in an audiovisual format. I would encourage all members, particularly those in their first few years of practice to pursue this wonderful personal and professional opportunity.