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Discussion

DR. RONALD W. BUSUTTIL (Los Angeles, California): I wish to congratulate Dr. Fan for his presentation and thank him for providing me with a manuscript that beautifully details this very complex procedure of living-related liver transplantation using an extended right hepatic lobectomy in adult liver grafting. Clearly one could only justify this procedure in the most desperate of conditions.

In fact, this paper is perhaps most aptly put into perspective by Shakespeare's *Hamlet.* "Diseases desperate grown by desperate appliance are relived or not at all."

The scarcity of donors with which Dr. Fan and his colleagues are faced in Hong Kong, along with their other Asian colleagues, is virtually insurmountable. Because of the cultural and religious reasons in that part of the world, cadaveric organ donation is highly restricted. This situation imposes a need to explore rather extreme solutions to the problem of patients dying with liver failure.

However, what is extreme today may become standard practice tomorrow as new advances are perfected and applied. The precedent for this has already been set in this specific field of endeavor with the successful application of living-related liver transplantation in children.

When this technique was first introduced in 1988, skepticism was rampant. I was one of the most vocal skeptics. However, in 1997, living-related transplantation in children is an established procedure with close to 1000 cases being performed with excellent results in the recipient and rare morbidity in the donor.

It is the donor morbidity and mortality that is the crux of this issue that Dr. Fan has presented. In living-related liver donation as it is applied to children, segments 2 and 3 of the liver or the left lateral segment are removed for transplantation in the child. This represents at most 25% of the liver volume and does not require extensive dissection in the hilum. Liver failure of the donor has not been seen in close to 1000 cases, and major complications are rare. On the other hand, in the procedure described by the authors, 60% to 80% of the liver volume is removed, which presents a much more significant risk to the donor.

Extended right hepatic lobectomy performed as a therapeutic procedure for both benign and malignant diseases can indeed be associated with severe complications, namely portal vein thrombosis, bile duct stricture, and persistent cholestatic syndrome. The authors did in fact encounter these sinister complications in their series of seven cases. One donor patient suffered from liver dysfunction and hyperbilirubinemia lasting 3 weeks, and another required reoperation for a biliary stricture. In a larger series, I would suspect that a significant complication rate may be even higher than the 28% reported by the authors, which in my view would not justify usage in our own center.

Regarding the results in the recipients, the authors are to be congratulated in rescuing six of seven patients who would have surely died otherwise. However, again I am troubled by the high morbidity rate. Five of seven patients required reoperation for bleeding or sepsis, two of seven developed biliary strictures. Could the authors speculate on these problems? This rate of reoperation seems excessive when viewed in the light of other series of split-liver transplantation and liver-relating grafting.

Finally, I believe the authors' approach to obtaining consent for this procedure must be lauded. There clearly was no hint of coercion because the donor was never approached until he or she requested information regarding living-related donation. This position I believe is absolutely essential for an ethically based program of living-related donations.

I would like to conclude by asking you, Dr. Fan, several questions.

First, the mean operative time is quite long, 12 hours for the donor and 17 hours for the recipient. Do you think this has contributed to your complication rate? What is your strategy to improve it?

Second, usually bleeding from the cut surface of the liver after living-related transplantation or *in situ* split liver transplantation is uncommon. To what do you contribute your high incidence of bleeding postoperatively? Is this in part due to the fact that you resect liver tissue around the hepatic veins?

Third, you strive for 40% of the required liver mass. Does this vary according to the cause of liver failure? In other words, would a patient with end-stage liver disease from acute liver failure require more than that which would be seen in a patient who has chronic liver failure?

DR. AINSLIE G. R. SHEIL (Sydney, Australia): I too would like to compliment you on this important work and ask my questions from a somewhat different aspect. I think I belong to one of a number of surgeons who, for maybe 30 years or so,

has been hoping that the practice of living-donor transplantation would disappear from this world and be looked on only as an aberration and with some suspicion by surgeons in the future. But that has turned out not to be the case, and, increasingly, normal organs or part organs are being taken from healthy individuals to treat others.

I would like to ask you what is happening in Hong Kong in terms of stimulating organ donation from cadaveric donors and what proportions of the patients with fulminant hepatic failure referred to your group have achieved successful treatment by living-donor or cadaveric-donor transplantation?

I would like to finish by reporting a little of our experience in Australia. We do not have a high cadaveric-donor transplantation rate by world standards, but yet are able to treat 75% of our patients with fulminant hepatic failure within 4 days, which is about the time that you took to obtain consent and work up your patients. Overall, 88% can be treated by cadaveric organ transplantation. I would like you to comment on these figures in relation to the Hong Kong experience.

DR. CLYDE F. BARKER (Philadelphia, Pennsylvania): Thank you, Dr. Sheil. Your remarks are particularly pertinent because you are the chairman of the International Transplantation Society's Ethics Committee. Clearly, these are ethical issues that we are discussing.

DR. SHEUNG-TAT FAN (Closing Discussion): First of all, I would like to answer Professor Busuttil's question. The time of the operation is excessively long, I admit to that. Therefore, we are looking for ways to improve ourselves. There are at least three reasons for being slow in the operation.

First, we have been very cautious in the hilar dissection and in the transection of the liver.

Second, the transection of the liver is limited by the presence of intact outflow and inflow vasculature and therefore, the space in which we can work is really limited. The deeper the transection plane we reach, the more difficult it is, because you can imagine it is a very deep plane in this area, and that is also the area where the hepatic vein can be damaged. We therefore have been very, very cautious in doing the liver transection.

Third, it is about the coordination of the harvesting and the recipient operation. We try to coordinate the operations accurately so that the cold ischemic time of the graft is kept as short as possible. Thus, we have to wait for one side or the other side until everything is perfect and ready.

The second comment is about the high incidence of postoperative complications of the recipients. Yes, we are quite troubled by that. We believe some of the complications were related to the immunosuppressed state of the patients, particularly when we have one patient who was already immunocompromised by previous renal transplantation. But technical factors were probably contributing to some of the complications, particularly those related to the biliary anastomosis. We think in retrospect that the high incidence of biliary complications was related to our error in the line of the division of the right bile duct. We have been too cautious to divide the bile duct close to the liver graft, and so after the hepaticojejunostomy, fibrosis of the segmental ducts resulted in the stricture. In the future, we probably will be more ready to divide the right biliary duct closer to the confluence.

About the computed tomography (CT) volumetry: yes, we would like to adjust the graft size according to the status of the patient before the liver transplant. For acute liver failure, when the liver is normal to start with, I would say 30% of the estimated liver mass is the acceptable limit. For patients with preexisting portal hypertension, 40% will be the acceptable limit, provided that the cold ischemic time is really short.

Finally, to answer the question raised by Professor Sheil about organ donation in Hong Kong, we have been trying very hard to promote organ donation by setting a Hong Kong Liver Foundation. Unfortunately, up to now we have not been very successful in securing organ donation. For example, in the period starting from May 1996 until now, we have 20 patients referred to us for acute liver failure. Out of these, two received cadaveric grafts, and eight were treated by this operation, right lobe liver transplantation. Ten patients died before transplantation could be performed. So if we do not have the right lobe liver transplant, we can only have a 10% salvage rate. With the operation, we have 50%. I think that is the message.