PARTIAL LIVER TRANSPLANTATION WITH PRIMARY REVASCULARIZATION IN DOGS

Preliminary Report On New Method And Its Theoretical Background

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The recent developments in the study of organ transplantation is remarkable. Especially in kidney transplantation many successful clinical cases have been reported. Since the study of Welch, many canine experiments on whole liver homotransplantation, including orthotopic and heterotopic transplant, have been reported, however, only few reports mostly done by Starzl have been noticed in clinical cases.

We performed canine partial liver transplantation with anastomosing the vessels. In this preliminary paper, the method and the importance of partial liver transplantation will be discussed.

METHOD

Twenty-eight healthy adult mongrel dogs, weighing 10.0 to 24.2 kg, were used in twenty autotransplantations and four homotransplantations. Preoperatively they were not given any antibiotics nor immuno-suppressive therapy, and anesthetized with pentobarbital sodium. General hypothermia was not employed.

The peritoneal cavity was entered by a mid line incision. At the hilum of left lateral lobe of the liver, branches of hepatic artery, portal vein, hepatic vein and bile duct were dissected and divided respectively to remove the left lateral
Fig. 1 Classification of Our Partial liver Transplantation According to Its Location and Its Mode Anastomosis.

Group I: Right renal region...after right nephrectomy, arterialization of portal system

- Branch of hepatic artery ......No anastomosis
- Branch of portal vein ..........Right renal artery
- Branch of hepatic vein ........Right renal vein
- Bile duct .......................External fistula

Group II: Right infrarenal region

- Branch of hepatic artery ......No anastomosis ...................... A
- Abdominal aorta or branch of mesenteric artery ................. C
- Branch of portal vein ..........Branch of mesenteric vein
- Branch of hepatic vein ........Inferior vena cava
- Bile duct ........................External fistula

Group III: Subcutaneous region of right thigh

- Branch of hepatic artery ......No anastomosis ...................... A
- Ligation for 1 to 3 weeks prior to the operation ............... B
- Branch of portal vein ..........Distal end of right femoral vein
- Branch of hepatic vein ........Proximal end of right femoral vein
- Bile duct .......................External fistula

Group IV: Right iliac fossa or pelvis

- Branch of hepatic artery ......No anastomosis ...................... A
- Ligation for 1 to 3 weeks prior to the operation ............... B
- Right iliac artery .................. C
- Branch of portal vein ..........Distal end of right iliac vein
- Branch of hepatic vein ........Inferior vena cava
- Bile duct .......................External fistula
PARTIAL LIVER TRANSPLANTATION

Group I

G: Graft
HA: Branch of hepatic artery
PV: Branch of portal vein
HV: Branch of hepatic vein
A: Abdominal aorta
VC: Inferior vena cava
BD: Bile duct

Group II

Group III

Group IV

V. iliaca.com.
A. iliaca.com.
lobe. At the time of the removal of the lobe, it is necessary to keep in mind that
the isolation of each vessel should be preserved long enough for later anastomosis.
In dogs the diameter of the arterial branch at the hilum of the lobe was approxi-
mately as small as 1 mm. This makes it impossible to anastomose technically.
Therefore, the reconstruction of hepatic artery was not performed in most cases
of autotransplantation because of technical difficulties. In the cases of homo-
transplantation, however, it is possible to dissect and save the common hepatic
artery, which is large enough to anastomose. In homotransplantation and some
cases of autotransplantation the left lateral lobe was removed including the
common hepatic artery which was to be used for later anastomosis.

After the removal of the left hepatic lobe, the branch of the portal vein was
immediately cannulated and through it the liver was perfused with 500 ml of
cold isotonic saline solution (4°C) containing 100,000 units of penicillin, 0.1 g
of procaine hydrochloride and 5,000 units of heparin, with a pressure ranging 20
to 30 centimeters of water.

The following major four groups were classified by the locality of the grafts
and the types of reconstruction of the portal and the hepatic veins. This means
that three different types of inflow of the portal vein were accomplished; the
graft received arterial blood in group I, portal blood in group II, and peripheral
venous blood in group III and IV, respectively. The groups were subdivided by
the type of the arterial anastomosis which will be discussed later.

Group I: After extirpation of the right kidney, end-to-end anastomosis of
the right renal artery to the portal vein of the graft was accomplished. Con-
sequently arterial blood flowed into the transplanted liver through the portal
vein. And the diameter of the renal artery was intentionally narrowed from a
half to a quarter in size. The divided branch of the hepatic vein was then
anastomosed end-to-end to the right renal vein.

Group II: A branch of superior mesenteric vein was dissected and divided.
The proximal or distal end of the divided branch of the superior mesenteric vein
of the recipient was anastomosed end-to-end to the branch of the portal vein of
the graft. The branch of the hepatic vein was anastomosed end-to-side to the
infrarenal portion of the vena cava of the recipient. Consequently the grafted
liver was interposed similar to the physiological condition.

Group III: The right femoral vein of the recipient was isolated and divided.
The graft was inserted between the divided femoral vein with end-to-end
anastomoses.

Group IV: The same experiment was performed dividing the right common
iliac vein and the inferior vena cava. The grafted liver located in the right iliac
fossa or in the pelvis.

The major groups were subdivided by the mode of the reconstruction of the hepatic artery except in group I. In the case of group I the portal vein of the graft was arterialized as a sole source of blood supply. And in the other groups (II, III and IV) the reconstruction of the hepatic artery of the graft was classified into three types as follows:

In type A; the branch of the hepatic artery was ligated at the time of operation.

In type B; the arterial branch of the left lateral lobe had been ligated one to three weeks prior to the transplantation to acclimate the graft in the condition without the supply of arterial blood.

In type C; the common hepatic artery in continuity with the graft was anastomosed to the adjacent artery; abdominal aorta or superior mesenteric artery in group II, femoral artery in group III and common iliac artery in group IV, depending upon the group respectively. Technics in anastomosis were shown in Fig. 1.

Anastomosis of vessels was carried out mainly by hand-suture procedure with Tetoron (polyester fibre) thread, and partly by non-suture method with Teflon tube. External biliary drainage was established with polyethylene tubing. During operation and the first postoperative day each 500 ml of 5% glucose was infused and 100,000 units of penicillin per day was given for 3 days postoperatively.

RESULTS

Among twenty cases of autotransplantation, nine recipients died during the surgery or within 12 hours after the operation. Nine died within 48 hours. Two dogs survived more than 2 days, one (No. 8) 2-1/2 days, the other (No. 21) 12 days. Early deaths after operation were considered to be due to massive hemorrhage and great surgical trauma. To shorten the operative time and diminish surgical trauma, homotransplantation was performed to four dogs. Among this group, one recipient died during operation, another died within 12 hours. One (No. 33) of the remaining two dogs survived ten days, and the other (No. 29) survived more than three months even without any immunosuppressive therapy, which was sacrificed three and half months after the operation. And it revealed that the transplanted liver was completely replaced by the scar tissue (Table 1).

Table 2 shows the relationship between the patency of the anastomoses and
Table 1
Survival Period After Partial Liver Transplantation

<table>
<thead>
<tr>
<th>Type of transplantation</th>
<th>Number of cases</th>
<th>Number of survivors</th>
<th>During operation</th>
<th>&lt;12 hrs</th>
<th>&lt;24 hrs</th>
<th>&lt;36 hrs</th>
<th>&lt;48 hrs</th>
<th>2 days&lt;</th>
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<td>Right renal region</td>
<td>I</td>
<td>4</td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1 (2-1/2 days)</td>
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<tr>
<td>Right infrarenal region</td>
<td>II A</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subcutaneous region of right thigh</td>
<td>III A</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III B</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1 (12 days)</td>
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<td>Iliac fossa or pelvis</td>
<td>IV A</td>
<td>2</td>
<td></td>
<td></td>
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<td>2</td>
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<tr>
<td></td>
<td>IV B</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>1</td>
</tr>
<tr>
<td></td>
<td>IV C</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>2</td>
<td>7</td>
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<td>5</td>
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<table>
<thead>
<tr>
<th>Type of transplantation</th>
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<th>Number of survivors</th>
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<th>&lt;12 hrs</th>
<th>&lt;24 hrs</th>
<th>&lt;36 hrs</th>
<th>&lt;48 hrs</th>
<th>2 days&lt;</th>
</tr>
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<tbody>
<tr>
<td>Right infrarenal region</td>
<td>II C</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1 (10 days)</td>
</tr>
<tr>
<td>Iliac fossa or pelvis</td>
<td>IV C</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (3 months&lt;)</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>24</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>4</td>
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Table 2
The Survival Time, Patency of The Anastomoses and The Microscopic Findings of The Grafts

<table>
<thead>
<tr>
<th>Type of transplantation</th>
<th>Case No.</th>
<th>Survival period</th>
<th>Anastomoses</th>
<th>Microscopic findings</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Arterial</td>
<td>Portal vein</td>
</tr>
<tr>
<td>II A</td>
<td>12</td>
<td>&lt; 24 hrs</td>
<td>obstructed</td>
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</tr>
<tr>
<td>III A</td>
<td>17</td>
<td>&lt; 48 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II A</td>
<td>13</td>
<td>&lt; 36 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV A</td>
<td>18</td>
<td>&lt; 36 hrs</td>
<td>obstructed</td>
<td></td>
</tr>
<tr>
<td>IV B</td>
<td>23</td>
<td>&lt; 48 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV C</td>
<td>28</td>
<td>&lt; 36 hrs</td>
<td>obstructed</td>
<td></td>
</tr>
<tr>
<td>II A</td>
<td>11</td>
<td>&lt; 12 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III A</td>
<td>14</td>
<td>&lt; 12 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III B</td>
<td>22</td>
<td>&lt; 12 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV C</td>
<td>26</td>
<td>&lt; 12 hrs</td>
<td>obstructed</td>
<td>patent</td>
</tr>
<tr>
<td>II C*</td>
<td>31</td>
<td>&lt; 12 hrs</td>
<td>patent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>10 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>8</td>
<td>2-1/2 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III A</td>
<td>16</td>
<td>&lt; 24 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III B</td>
<td>21</td>
<td>12 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV C*</td>
<td>29</td>
<td>3 mos&lt;</td>
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</table>

* homo transplantation.

**PARTIAL LIVER TRANSPLANTATION**

**HOMO TRANSPLANTATION**
the microscopic findings of the graft in autopsy. Survival time was also studied. It revealed that when the anastomoses of inflowing vessels, especially of the branch of the portal vein, were obstructed, the graft showed coagulation necrosis resulting from ischemia and all of these dogs died within 48 hours (Fig. 2). In the cases of patent anastomoses of both portal vein and hepatic artery, liver cells showed atrophy due to marked congestion of the graft despite of the patent hepatic vein (Fig. 3).

Fig. 2  Grafted liver of Dog No. 13 (Group II A) which died within 36 hours after autotransplantation showing coagulation necrosis of the hepatic cells. The anastomosed inflowing vessel was obstructed by thrombosis at autopsy. H.E. 70x

Fig. 3  Grafted liver of Dog No. 26 (Group IV C) which died within 12 hours after autotransplantation showing atrophy of the hepatic cells due to marked congestion despite of the patent anastomosed vessels (hepatic artery, portal vein and hepatic vein). H.E. 70x
Fig. 4 Grafted liver of Dog No. 33 (Group II C) which died on the 10th day after homotransplantation showing complete damage of liver structure, massive necrosis of the hepatic cells, extravasation of red cells and infiltration of lymphocytes and leukocytes around the necrotic masses. The anastomosed vessels were all patent. H.E. 70X

Microscopic findings of the recipient of homotransplantation with the procedure II C as illustrated in Fig. 4 showed massive necrosis of the liver, resulting in the complete damage of liver structure. Extravasation of red cells and infiltration of lymphocytes and leukocytes around the necrotic masses were also observed.

Avascularized time of the graft before the cooling perfusion was 3 minutes at the shortest. Time interval between the interruption of the blood flow and the completion of anastomosis ranging from 62 to 136 minutes (92.7 minutes in average).

DISCUSSION

Comparing to other organ transplantation, the study of liver transplantation still have to be confronted many difficulties, such as technical problems and the difficulty in obtaining the liver specimen from human subject, as well as the difficulties in suppressing the "rejection."

There are many technical problems in liver transplantation. Firstly, the anatomical specificity of the liver, the dual blood supply and the complexity of draining vessels, produces the technical difficulty. Many technical improvements have been tried to solve these problems, such as utilization of vena cava as a draining vessel,2,11,17,30,22,23,25,35,41,50,52 aortal segment as a inflow vessel,11,14,17,20,26,35,41 Secondly, it is necessary to make some device to prevent the conges-
tion of the portal system during the interruption of the portal vein. In other words, temporary by-pass in orthotopic\textsuperscript{2,17,20,29,30,41,42} and permanent by-pass in heterotopic transplant are mandatory when total hepatectomy was performed. Another difficulties are the presence of “out-flow block”\textsuperscript{41,45,50} and the postoperative hemorrhagic diathesis\textsuperscript{21,44-46,49}

As the liver is a single organ, even if whole liver homotransplantation is successful in canine experiment, it cannot be applied to human subject clinically. Donation of a whole liver is restricted to the source from the cadaver, or else of the heterogeneous origin. The function of the cadaver liver has been reported not to recover to normal state after anoxic state of two to three hours duration in room temperature,\textsuperscript{41,54} because of unusual susceptibility of liver to anoxia. On the other hand, some reported that cooling of the liver was favoured during operation expecting prolongation of preservation time.\textsuperscript{2,21,22,29,41,50,52} It is an ethical and legal problem to remove and cool the liver as a suitable graft from human subject immediately after death.\textsuperscript{6,46} These difficulties of obtaining a liver of a human donor has become a great barrier to clinical application of liver transplantation.

It has been known that liver is tolerable against major resection, i.e., about only twenty percents of a liver tissue is sufficient enough to maintain a human life,\textsuperscript{25} and that it has very powerful ability to regenerate.\textsuperscript{12} Considering these facts, a partial liver as a graft will be obtainable from alive donor even though with the technical difficulty. In this way the ethical problem about donation will be solved.

Reviewing the literatures about partial liver transplantation no reports of primary reconstruction of blood supply of the liver have been found. Previous reports can be divided into following two groups. The methods of the first group, which has been reported by many investigators\textsuperscript{4,13,32,34,37} since 1895, are the free grafting of small fragments or slices of liver tissue of several millimeters in diameter—so-called “implanting” or “burying”—into subcutaneous tissue, lymph gland, camera anterior chamber, muscle and brain etc. Both auto- and homologous transplant have been tried. But the transplanted liver tissues with these methods are too small in amount to be discussed as a transplanted organ. The methods of the second group are two-stage autotransplantation of the liver. After the formation of collateral circulation between the liver and surrounding tissue or adjacent organs, the original hepatic vessels are ligated or divided. In this group, Seneviratne\textsuperscript{34} and his modificators Grisham \textit{et al.}\textsuperscript{12} reported that a hepatic lobe of a rat was transposed into its own abdominal subcutaneous space, and one or two weeks later when collateral circulation was established between
the lobe and surrounding tissues, the vessels of the lobal pedicle were ligated to obliterate the original blood supply. But this method can only be performed in some species which has a liver of clearly divided lobes. Also in this second group, a part of the liver was sutured to various sites, such as the mesotestis of the mouse by Myren, the upper surface of the spleen of the dog by Thorbjarnarson et al., the enteric seromuscular flap of the dog by Sigel et al., or the gastric seromuscular flap of the rabbit or dog by Benichoux et al. and Rauber et al. Three weeks or four months later when the collateral circulation had been established, the revascularized portion of the liver was amputated so as to complete autotransplantation. The size of revascularized portion are limited to a certain size except Sigel’s report. According to Sigel et al., it was possible to autotransplant by this method about the size of one-third to three-fourths of the left central lobe, i.e., 5 to 15 percents of whole liver in dogs. But these methods were used only autologously and required long time for the completion of the transplant.

Since these methods did not accompany the reconstruction of blood supply, it is rather difficult to call them organ transplantation in strict sense.

Human liver is divided into four lobes, i.e., left lateral, left central, right central (anterior) and right lateral (posterior) lobe. The classical anatomical left lobe means the left lateral lobe and the classical anatomical right lobe includes the left central, right central and right lateral lobe. The four lobes of the liver, unlike those of the lung, are not clearly divided, and the vessels of each hilum of the lobes are not long enough to dissect. At present, the systemic lobectomy such as proper lobe resection (1/4), hemihepatectomy (2/4) and maximum hepatectomy (3/4) can be performed. Especially, the left hepatic lobectomy can be carried out without operative risk. Therefore, we believe it is possible to utilize the resected lobe as the partial liver transplantation.

When technical problems of the partial liver transplantation are dissolved, with the accomplishment of immuno-suppressive therapy, transplant will be useful as an auxiliary or substitute liver for treatment of liver cirrhosis, biliary atresia or malignant tumor of the liver, with or without removal of his own liver. Even though the immuno-suppressive therapy has not been completely established at the present time, partial liver transplant may be useful in such a case as a small malignant tumor at the hilum located lethal portion, being partial hepatic resection impossible. Normal portion of the totally resected liver may be utilized for autotransplantation orthotopically or heterotopically.

From these standpoints of view, the experimental studies of partial liver
transplantation with primary revascularization have been performed in dogs since 1964 in our laboratory.

The time of interruption of circulation in a hepatic lobe as a graft was averaged 92.7 minutes ranged 62 to 136 minutes under cooling condition. In the study of cadaver liver perfusion, it was reported that the liver was tolerable without blood supply for two to three hours in room temperature. We considered that it is necessary to minimize the avascularized time to improve the results of the experiment. These have also been stated by others. We have been making an effort to improve the operative technique so as to minimize the avascularized time.

Twenty autotransplantations were performed, nine of which died within twelve hours, the other nine of which died between 12 hours to 48 hours, and only two of which survived more than two days. These were performed in our early experiments and the high mortality rate may be due to the large surgical trauma such as hepatic resection and transplantation in themselves. Then, to shorten the operative time and to minimize the surgical trauma, the four homo-transplantations were performed, two of which survived more than two days. One of these two survivors, the dog No. 33, died tenth postoperative day. The death was thought to be due to “Rejection.” And the other survivor No. 29, even without immuno-suppressive therapy, survived more than three months after transplantation. But in this case the graft had replaced by scar tissue when sacrificed. It was understood that, if the anastomosed vessels were obstructed in early postoperative period, the graft was simply to be a foreign body in recipient’s peritoneal cavity.

In autopsy the relationship between the patency of anastomosed vessels and microscopic findings was studied. In six dogs (No. 11, 14, 22, 25, 26, 31) which died within twelve hours in spite of patent vessels, similar histological findings of the graft were demonstrated despite of various types of transplantations. Atrophy of liver cells due to marked congestion was the usual findings. It is thought to be due to so-called “out-flow block.”

Here we would like to evaluate the four different types of transplantations of our experiments. In the experiments of Group I, the portal vein of the graft was anastomosed end-to-end with the recipient’s renal artery which was narrowed 1/2 to 1/4 of its normal diameter to regulate blood flow. But the transplanted liver in this group swelled remarkably and the method was thought to be unsatisfactory as Welch stated. In the experiments of Group III and IV, the graft received the peripheral venous blood through its branch of portal vein, and the angle and diameter of the both vessels did not match for anastomosis.
On the contrary in Group II, the graft received the portal blood of the recipient through the portal vein and that the diameter of the vessels and blood flow were most adequate for the graft. Reviewing the literature, it is better to revascularize both portal and arterial systems than to revascularize either of them. About the locality of transplanted liver, heterotopic transplantation seemed to be advantageous to the orthotopic one when clinically applied because of following two reasons. The recipient's own total hepatectomy may be unnecessary or undesirable under such conditions as cirrhosis or biliary atresia. The procedure is less traumatic and less cumbersome—vascular anastomoses are accomplished while the host's vessels are interrupted for short periods of time, and by-pass and anticoagulation therapy are not required. Therefore, it can be performed to seriously ill patients.

About the factors to determine hepatic cell mass it had been reported that the hepatic blood flow was the main one. But recently it has been said that some substance in portal venous blood has a specific hepatotrophic effect for maintaining hepatic cell mass, which finally disappears in the liver. Therefore, the atrophy of the graft may occur in the heterotopic transplantation when the graft does not receive splanchnic venous blood. Consequently in heterotopic transplantation such an anastomosis should be performed as the graft receives the portal venous blood before entering the recipient's own liver.

Immediately after the transplantation the phenomenon called "out-flow block" is apt to occur severely especially in dog, in spite of patency of anastomosed vessels. Some described that desirable type of transplantation is that the anastomosed portal vein is functioning as a decompressing outflow tract during the acute state at least. Some tried small side-to-side porto-caval shunt against outflow block in orthotopic whole liver transplantation.

From above mentioned reasons, we believe that the type of anastomosis applied in II C group in our series is most desirable. The most favorable result may be obtained when the anastomosis of the portal vein is performed end-to-end to the proximal dissected branch of superior mesenteric vein of the recipient. Of course, side-to-end anastomosis of the superior mesenteric vein with the portal vein of the graft may be possible theoretically but it is not feasible technically due to anatomical relationship.

In future in partial liver auto- or homo-transplantation in our II C Group, we are planning to study whether the life of recipient can be maintained only with the transplanted liver. These conditions can be established when total hepatectomy with Eck's fistula is done, in either one or two stage, and when the
graft is transplanted orthotopically after hepatectomy. In case of survival, we would also like to study the function of the graft.

**SUMMARY**

Hitherto the partial liver transplantation with primary revascularization has never been performed and all of the studies of liver transplantation with revascularization was that of the whole liver transplantation.

The authors invented the method of partial liver transplantation with primary revascularization, and discussed its theoretical background and its clinical applicability. Using this method for canine experiments, 20 heterotopic autotransplantations and 4 homotransplantations were so far accomplished. The transplantations were performed at various sites, such as in the right renal space after nephrectomy or in the right infrarenal region or in the subcutaneous space of the right thigh or in the right iliac fossa and in the pelvis. The most favorable location seemed to be in the right infrarenal portion as seen in II C type of anastomosis in our experiment.

**ADDENDUM**

The outline of this paper was once reported in the 1st Annual Congress of the Japan Society for Transplantation in Oct. 1-2, 1965 and more recently several reports concerning the partial liver transplantation with revascularization have been published while we prepared this article.

**REFERENCES**

7. Couinaud, C.: Lobes et segments hépatiques: notes sur l'architecture anatomi-
PARTIAL LIVER TRANSPLANTATION

28. Mikami, J. and Kasai, Y.: Right hepatic lobectomy: technique and indication,


