older (to 65 years old), the donor's blood type fit or agreed with the recipient's blood type, the donor's mind and body were healthy, the donor was free from liver disease, and the donor's intention to donate liver tissue was clear.

The surgical procedure was selected as follows. If the recipient was an adult, the liver graft was larger than 35% of the standard liver volume (SLV) calculated from the recipient's body surface area (BSA) (SLV [mL]=706.2*BSA+2.4). If the recipient was a child, the liver graft was smaller than 150% of the SLV in addition to the condition mentioned above. There were 3 types of hepatectomy: left lobe hepatectomy (n=46), lateral lobe hepatectomy (n=11), and right lobe hepatectomy (n=17).

Liver volume measurements

Each CT examination was performed using 1 of the following 4 scanners: the Somatom Volume Zoom + 4 (Siemens, Erlangen, Germany), the Sensation 64 (Siemens), the Aquilion Multi 64 (Toshiba Medical Systems, Tokyo), the LightSpeed VCT (GE Healthcare, Milwaukee, WI, USA), or the Aquilion ONE/ViSION Edition (Toshiba Medical Systems). All of the images were obtained during inspiration and covered the entire liver parenchyma. For the liver volumetry, we used only contrast-enhanced CT images, which were obtained in either the dynamic or equilibrium-phase scanning manner. In the case of dynamic scanning, non-contrast-enhanced CT images were obtained first, and then repeated acquisition was conducted after a single intravenous (IV) bolus injection of 450 mgI/kg of nonionic iodocontrast media (iopamidol, iohexol, iomeprol, or ioversol) at a rate of 3.5 mL/s (adjusted according to the patient's body weight) using a power injector (Nemoto Kyorindo Co., Tokyo).

Contrast-enhanced scanning of the liver in the arterial phase was initiated when the density in the descending aorta reached 200 HU. The second scan (portal phase) covering the liver was initiated 15 s after the arterial phase, and the third scan (venous phase) covering the chest to the pelvis was initiated 80 s after the injection. In the case of equilibrium-phase scanning, the images from the chest to the pelvis were acquired 80 s after the injection.

Each slice of liver was traced with a cursor, and the corresponding area and the morphological volume were calculated with the OsiriX application (version 4.1.1, 32-bit; Pixmeo SARL, Geneva, Switzerland) (Figure 1) [10,11]. The resection volume was calculated as the difference in liver volumes before and immediately after the operation (postoperative week [POW] 1;). The regeneration volume was calculated as the difference in residual liver volume between POW 1 and postoperative year (POY) 1. The regenerated fraction was defined as the regenerated volume divided by the residual volume at POW 1, and the recovery fraction was defined as the residual volume at POY 1divided by the preoperative original liver volume.

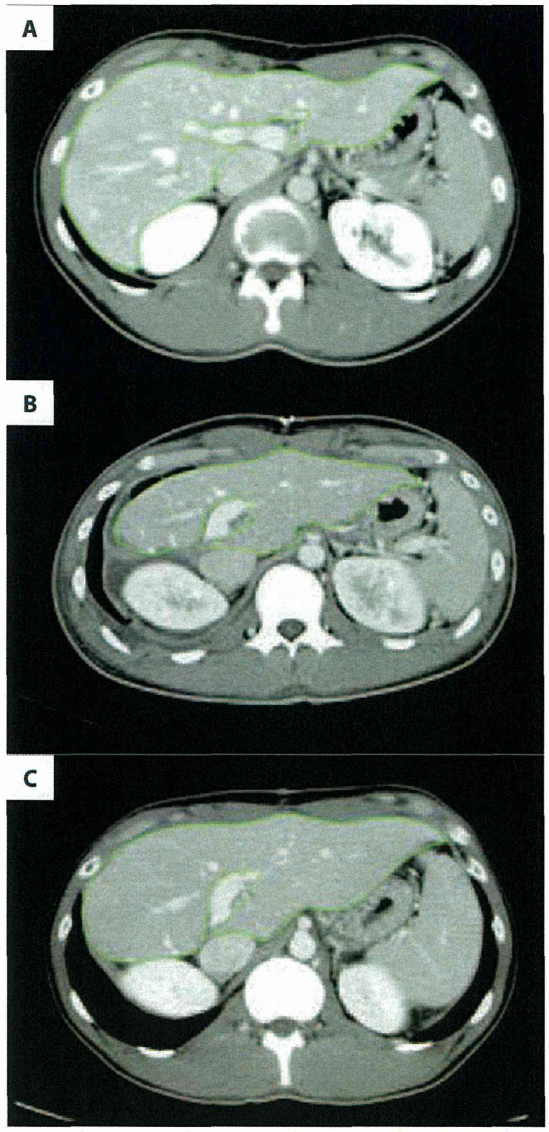

Figure 1. Contrast-enhanced x-ray CT. (**A**) Pre-hepatectomy. (**B**) Postoperative week 1. (**C**) Postoperative year 1. This donor underwent right lobectomy of 545 mL in size, corresponding to 47.2% of the preoperative volume. Follow-up CT (**C**) showed regeneration of the remnant liver to 99.5% of the preoperative volume.

Measurements of ASGPR function with Tc-99m GSA

After a bolus IV injection of 185 MBq of Tc-99m GSA, dynamic scanning was performed with the patient in a supine position, using a large-field view gamma camera (E.CAM; Siemens Japan, Tokyo) in an anterior view equipped with a low-energy high-resolution collimator. The dynamic planar images were obtained

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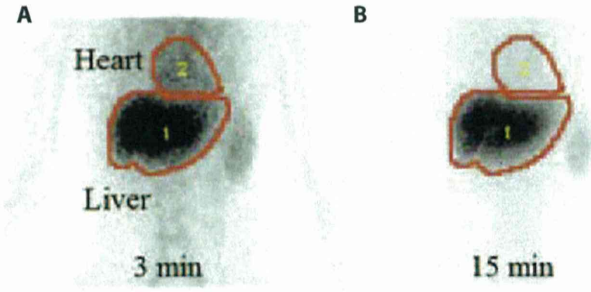

Figure 2. Representative anterior planar images of Tc-99m GSA. (**A**) 3 min after injection. (**B**) 15 min after injection. This donor showed HH15 of 0.59 and LHL15 of 0.92, indicating mild impairment of ASGPR function.

Table 2. Morphological liver volumes of the donors.

	Pre-operation LV (mL)	LV (1POW) (mL)	LV (1POY) (mL)	Resected size (mL)	Regenerated volume (mL)	Regenerated fraction (%)	Recovery fraction (%)
Left lobectomy	1266±242	956±185	1076±217	309±127	121±106	12.9±10.6	85.2±8.6
Lateral lobectomy	1015±167	861±164	910±196	154±63	49±81	5.7±9.2	89.6±10.8
Right lobectomy	1162±237	633±130	966±169	529±139	333±100	54.2±18.2	83.9±7.6

LV – liver volume; POW – postoperative week; POY – postoperative year.

Table 3. Perioperative blood test results.

	Pre-operation	1 POW	2 POW	1 POY
Hemoglobin (g/dL)	14.0±1.4	12.1±1.3	12.1±1.3	14.3±1.6
Total-bilirubin (mg/dL)	0.7±0.3	0.8±0.4	0.6±0.2	0.9±0.4
AST (U/L)	19.0±5.0	62.9±36.1	36.5±14.7	20.6±5.3
ALT (U/L)	17.0±7.0	103.7±44.5	64.0±33.5	16.5±6.5
LDH (U/L)	167.6±25.1	232.8±44.3	186.3±32.2	168.2±32.3
γ-GTP (U/L)	19.0±11.1	72.1±41.9	69.7±48.3	25.3±30.5
CRP (mg/dL)	0.0±0.1	2.0±2.7	0.4±0.5	0.2±0.6
Albumin (g/dL)	4.6±0.3	3.6±0.3	3.8±0.3	4.4±0.3
Prothrombin time (sec)	11.4±0.6	12.4±0.8	12.0±0.8	11.7±0.6
Platelet (×1000 μl)	238.1±45.7	235.0±82.6	319.5±80.7	200.6±44.4

POW – postoperative week; POY – postoperative year; AST – aspartate aminotransferase; ALT – alanine aminotransferase; LDH – lactate dehydrogenase; GTP – glutamyltransferase; CRP – C-reactive protein.

for 30 min by 147 serial frames (60×1 s, 87×20 s) with a matrix size of 128×128. We estimated the hepatic ASGPR function with 2 established approaches. First, we calculated the blood clearance ratio of Tc-99m GSA using the radioactivity of the blood pool at the heart from 3 min to 15 min after the injection (HH15). Second, we calculated the hepatic uptake ratio using the radioactivity of the liver divided by the heart and liver counts at 15 min after the injection (LHL15) (Figure 2). The quantitative results were used to investigate ASGPR function based on a previous study [12]. For the blood clearance ratio, we considered HH15 <0.55 to indicate normal ASGPR function, and 0.55≤ HH15 <0.65 to indicate mild impairment. For the hepatic uptake ratio, we considered LHL15 >0.93 as indicating normal ASGPR function, and 0.87< LHL15 ≤0.93 as indicating mild impairment.

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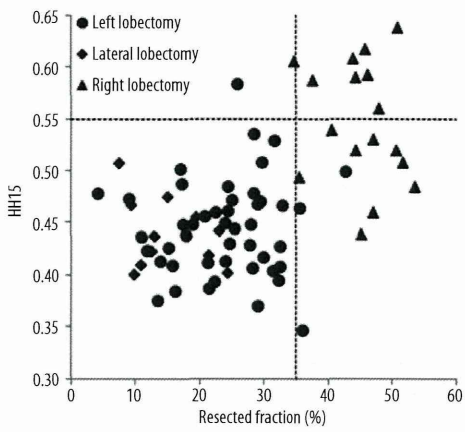

Figure 3. Scatter plot of GSA clearance (HH15) at POW 1 *vs.* resected size. The vertical dotted line indicates 35% of resected fraction and the horizontal dotted line indicates 0.55 of HH15.

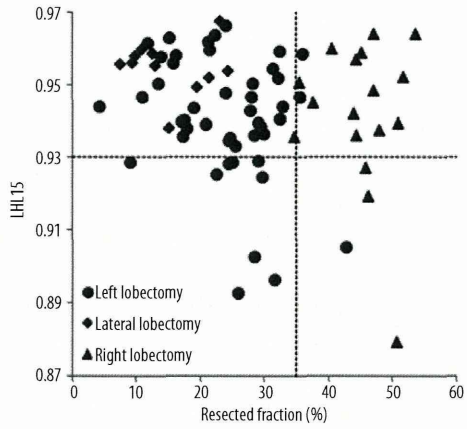

Figure 4. Scatter plot of GSA uptake (LHL15) at POW 1 *vs.* resected size. The horizontal dotted line indicates 0.93 of LHL15.

Statistical analysis

Data are expressed as mean ±SD. The changes in the donor liver volume and function were analyzed by paired *t* test. P-values <0.05 were considered significant. The correlations between the 2 parameters were analyzed using the Pearson product-moment correlation coefficient.

Results

Operative procedures and resection sizes

The preoperative liver volume was 1204±245 mL, ranging from 817 to 1971 mL. The largest volumes were observed in the group of donors who underwent a left lobe lobectomy, followed, in descending order, by the right lobe lobectomy group and lateral lobe lobectomy group (p=0.0058, ANOVA). The average resected size was 337±170 mL, corresponding to 28±12% (range 5–54%) of the original liver volume. The resected size was largest in the right lobe lobectomy group (529±139 mL, range 284–769 mL), corresponding to 45±5% of the donors' preoperative liver volume, whereas left lobe lobectomy and lateral lobe lobectomy resulted in relatively smaller resections. As a result, a donor who underwent a right lobe lobectomy showed the smallest residual volume at POW 1 (Table 2).

The perioperative course was stable except for 6 donors who presented with minor complications, including pylethrombosis (n=2), pneumonia (n=1), wound infection (n=1), subcutaneous abscess (n=1), and drug-induced liver injury (n=1). All donors left the hospital in good condition. Blood examinations showed temporal increases of hepatic enzyme at POW 1, which were normalized by POW 2 (Table 3).

Tc-99m GSA

Overall, HH15 at POW 1 was 0.47±0.06, ranging from 0.35 to 0.64. None of the donors showed 0.65< HH15 to suggest moderate or severe impairment of ASGPR function, or clinical postoperative hepatic insufficiency. However, larger resection size was positively associated with higher HH15, suggesting a size-dependent impairment of ASGPR function (R=0.53, p<0.001). In the present study population, mildly reduced GSA clearance (0.55≤ HH15 <0.65) was observed in 7 of the 19 donors who underwent larger resection (resected fraction ≥35%). In contrast, only 2 of the 55 donors who underwent a smaller resection (<35%) showed mild reduced clearance (Figure 3).

The LHL15 at POW 1 was 0.94±0.02, ranging from 0.88 from 0.97. None of the donors showed LHL15 <0.87 to suggest moderate or severe impairment of ASGPR function. Thirteen donors showed mild impairment of ASGPR function, but LHL15 at POW 1 did not show a trend with resected fraction (Figure 4).

Regeneration of the donors' remnant liver

Follow-up measurements demonstrated regeneration of the remnant liver (Figure 5). The trend was particularly clear in the donors who underwent larger partial resections, which showed a trend of positive correlation between the resected fraction and regenerated fraction (R=0.65, p=0.002). At POY 1, their remnant livers recovered the volume to reach 82.7×8.6% of

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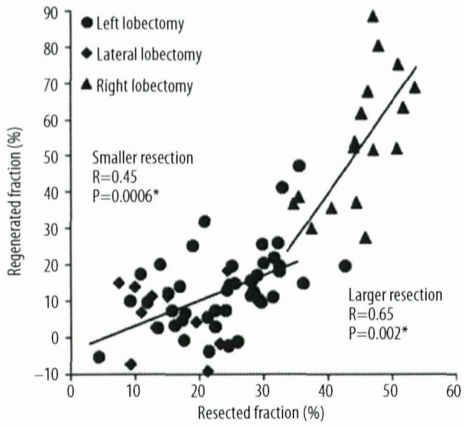

Figure 5. Scatter plot of remnant regeneration *vs.* resected fraction.

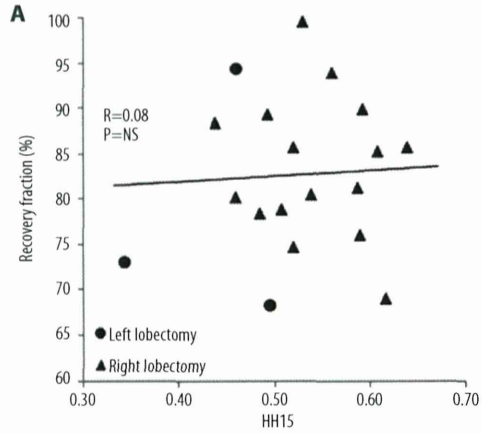

Figure 6. (**A**) Scatter plot of remnant regeneration *vs.* GSA clearance (HH15). (**B**) Scatter plot of remnant regeneration *vs.* GSA uptake (LHL15).

the preoperative volume (ranging from 68.1% to 99.5%). The recovery fraction did not correlate with HH15 (Figure 6A) or LHL15 (Figure 6B) in the present study population.

Discussion

Although the present results confirmed the safety of the partial hepatectomy of less than 54% of donors' original liver volume, it demonstrated impaired ASGPR function, indicating an increased risk of postoperative liver failure in a subgroup of the living donors. The impaired ASGPR function was associated with larger resection size (≥35% of the original liver volume), and this may warrant careful postoperative attention to prevent complications for donors undergoing larger partial hepatectomy. Among the 74 donors included in the present study, the postoperative impairment of ASGPR function did not correlate with poor prognosis, indicating that all procedures were done within the safety margin of partial hepatectomy.

Adult living liver donation is often associated with significant donor complications [13]. Although most complications have been of low-grade severity, a significant proportion has been severe or life-threatening, including postoperative liver failure [14]. Previous investigations reported incidences of liver failure after hepatectomy of 0.70–33.83% [15,16], and that the failure was related to inadequate residual liver tissue and functional capacity [17,18]. In practice, factors related to the recipient determine the size of the liver to be transplanted [6]. Therefore, resectable size and its safety margin should be defined for the safety of the donors undergoing partial hepatectomy. Postoperative assessments of functional capacity may therefore serve as a practical approach to investigate the safety margin of resected size for living human transplantation where experimental resection is impossible. Precise assessments of postoperative risk may improve the informed consent process, perioperative planning, and donor care [14].

In the present study, higher postoperative risk was associated with larger resection size (≥35% of original liver volume). In general, right lobectomy is assumed to have a higher risk than left lobectomy due to larger resected size [4]. It was also shown that morbidity and complications are significantly higher after right lobectomy (25%) compared to left or lateral lobe lobectomy (10%) [19]. However, there is still debate regarding the risk of right versus left lobectomy. A recent large multicenter study in Japan examined 3565 right and left lobe liver donations and reported similar morbidity rates after right lobe donation (9.4%) and left lobe donation (8.7%) [20].

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Since the prevention of liver failure is more important than treatment, careful preventive measures, including preoperative assessments of the liver's functional reserve and the prevention of intraoperative bleeding and other perioperative complications, may compensate for the size-dependent risk at experienced institutions [3]. The present results showed mildly impaired ASGPR function in donors who underwent larger resection. This may indicate the need for careful postoperative attention to prevent significant life-threatening complications.

We investigated ASGPR function using Tc-99m GSA scintigraphy as a parameter of postoperative risk. Tc-99m GSA is a novel liver scintigraphy agent which was originally developed as a radiolabeled asialoglycoprotein that binds to the ASGPR on hepatocytes [9]. Tc-99m GSA uptake is not directly inhibited by hyperbilirubinemia and can therefore be used to evaluate liver function even in early postoperative periods. For the quantitative analyses, we utilized 2 established parameters – blood clearance (HH15) and liver uptake (LHL15) of Tc-99m GSA. The HH15 is a simple index that is readily calculated from radioactivity of the blood pool at the heart, and it is thus independent from the size and shape of the liver associated with partial hepatectomy.

In contrast, the LHL15 is affected by remnant liver shape, and it thus may not be appropriate for evaluating ASGPR function after partial hepatectomy. For example, the region of interest (ROI) on a left lobe's remnant is inevitably larger than that on a right lobe's remnant. We feel that the HH15 is superior to investigate postoperative ASGPR function because it is independent from operation-induced changes in the remnant liver shape. Although there was a minor difference in the methodology used to calculate the clearance, previous investigations agreed that Tc-99m GSA clearance has more clinical value than its uptake [21,22].

In the present study, impaired postoperative ASGPR function (=prolonged Tc-99m GSA clearance) did not correlate with the final outcome. All donors examined in the present study showed size-dependent regeneration of the liver. The regeneration after POY 1 achieved 85.5±8.8% of the original liver, which is comparable with previously reported regenerated volumes [22,23]. The resected size did not affect the final outcome, probably because the resected sizes in the present study were all under the safety margin of the partial hepatectomy. We also observed 8 donors who did not show regeneration of the residual liver, although they did not present with significant postoperative complications or prolonged Tc-99m GSA clearance. Their resected sizes were relatively smaller (18.7±7.7%, range from 4.6 to 26.2%), and thus the regeneration capacity might not be stimulated due to sufficient functional reserve in the remnant.

In the present study population, Tc-99m GSA scintigraphy was scheduled at POW 1 for all patients. We propose that the risk assessment of postoperative liver failure should be done immediately after the operation because of the relatively common perioperative complications associated with the postoperative risk of liver failure [3]. In fact, postoperative liver failure is known to occur as early as postoperative day 5 [24]. Although postoperative liver failure may induce temporal hyperbilirubinemia, this would not affect the present results because the clearance and uptake of Tc-99m GSA are known to be independent from hyperbilirubinemia [25]. To the best of our knowledge, the present study is the first investigation of ASGPR function immediately after partial hepatectomy.

The major limitation of the present study is the lack of measurements of Tc-99m GSA clearance before surgery. Our healthcare insurance policy limits the use of Tc-99m GSA scintigraphy to healthy subjects. Preoperative assessments would allow the determination of the functional liver reserve, which may be correlated with the postoperative outcome. Clinically, however, risk assessment immediately after the operation may have more value, considering the relatively higher rate of perioperative complications.

Another study limitation was the overlap of quantitative parameters. We used a cut-off vale of HH15 >0.55 as an index of mildly impaired ASGPR function. This cut-off value corresponds to the lower limit of patients with impaired ASGPR function [12] and thus may include false-positives in terms of diagnosing ASGPR dysfunction. However, our study was designed to investigate the safety margin, and it thus required better sensitivity rather than the most accurate diagnoses.

Conclusions

The results of our study demonstrated impaired postsurgical ASGPR function in a subgroup of living donors who underwent larger partial resection (≥35% of the original liver volume). In contrast, smaller resection (<35% of original liver volume) was considered to be under the safety margin of the hepatectomy. Although the mildly impaired postsurgical ASGPR function did not indicate poor prognosis, careful attention may be required for donors undergoing larger (≥35%) partial resection.

Conflict of interest

None.

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治 療

薬物性劇症肝不全に対する肝移植

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索引用語：薬物性劇症肝不全，脳死肝移植，生体肝移植，補助的同所性部分肝移植(APOLT)，術後管理

1 はじめに

薬物性肝障害は薬物の直接的な細胞障害のみならずアレルギー機転によっても惹起される．その程度は肝機能検査値の軽度異常から非昏睡型・昏睡型の急性肝不全までさまざまである．過去の症例の蓄積から劇症肝不全をきたしやすい薬物が知られており，これらの肝障害機序や遺伝子多型による生体の脆弱性の検討もなされている．しかし検討は十分とはいえず，いまだに一定の頻度で薬物性劇症肝不全が発生している．これらの患者は病初期に内科的に治療されることが多く，移植実施施設への紹介はプロトロンビン活性の進行性の低下や昏睡を発症し劇症化した後になされることが多い．紹介された時点でウイルスや自己免疫機序による肝障害の可能性が否定され，臨床経過が妥当であれば薬物性劇症肝不全を疑う．しかし原因薬剤のD-LSTを含む特異的な検査が実施されていることは少なく，確診を得られないままに移植を実施することも多い．すなわち，薬物に関連した劇症肝不全では診断から治療まで十分には解明されていない．

2 薬物性劇症肝不全に対する肝移植

わが国の平成24年度全国集計[1]では，劇症肝不全全体に占める薬物性の比率は急性型で9.8％・亜急性型で20.4％である．また，おのおのの病型での肝移植実施率は15.5％と22.6％と報告されている．一方，2010年までにわが国で生体肝移植6,024例・脳死肝移植98例が実施されているが，薬物性劇症肝不全例はおのおの32例と1例であり，生体肝移植の5年生存率は78.1％となっている[2]．わが国の原因薬物は多岐にわたるが，欧米ではacetaminophenのoverdoseが最多とされてきた[3]．アメリカでは劇症肝不全全体の11.1％が薬物性で，その移植実施率は42.1％と報告されているが，薬物性劇症肝不全に対する肝移植症例661例のうち40％はacetaminophen(移植後生存率76％)，8％は抗結核薬(82％)，

Tsuyoshi SHIMAMURA et al: Liver transplantation for drug-induced fulminant hepatic failure
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7％は抗痙攣薬(52％で特に小児例で不良)，6％は抗生物質(82％)が原因であったという[4,5]．一方，ドイツでは劇症肝不全全体の実に41％が薬物性とされ，そのうちacetaminophenは9％を占めるにすぎず，non-acetaminophen薬物が32％であったとしている(移植実施率は47％でその生存率は80％)[6]．さらに，スペインからは劇症肝不全全体の19.5％が薬物性と報告されているが，acetaminophenは2.2％と少なくドイツと同様アメリカとは異なった傾向となっている．その移植実施率は56.2％，移植後生存率は56.2％である[7]．このように劇症肝不全全体に占める薬物性の比率，原因薬物，移植実施率や移植後生存率には国により大きな差異がある．

3 術前管理と移植適応決定

移植実施施設に紹介されると，劇症化例では原因に関わらず全身管理とあわせ肝障害の進展阻止と肝再生を待機する治療が実施される．この治療は移植を前提とした場合，手術までのbridging therapyと位置づけられる．薬剤性肝障害の機序(肝細胞障害性，アレルギー性，胆汁うっ滞性)により病態が異なる可能性があるが，実際の臨床では基本的に同様の対応がとられる[8]．全身管理のうち脳浮腫の回避・軽減，感染の予防，出血傾向の是正が重要である．昏睡起因物質や炎症性サイトカインの除去を目的とした血液濾過，血液凝固因子の補充や高分子量毒性物質の除去を目的としたFFPの投与や血漿交換，感染予防を目的とした各種抗生物質や抗真菌剤の投与がなされる[9,10]．劇症肝不全に対しては緊急の肝移植がfirst choiceである欧米でも，これらの血液浄化療法のbridging therapyとしての有用性が報告されている[11]．この段階になるとウルソやSNMCによる肝障害の進展阻止効果は期待できないと考えるべきである．一方，紹介時にトランスアミナーゼが高値の症例では肝障害進展阻止の目的でステロイドの使用が考慮される．ステロイドによる細胞保護効果のほか，アレルギー機転が関与している場合に効果が期待されるが，不応例に対する長期投与は易感染性の助長から移植適応を失いうることに注意が必要である．肝障害進展阻止を目的として可能性のある原因薬物を中止することはもちろんであるが，血液濾過や血漿交換により当該薬物の血中濃度の低下が得られる．しかし，一度進展した肝障害が原因薬物濃度の低下によりどれだけ軽減されるかについての明確なevidenceはない．一方，肝障害進展阻止策としてacetaminophen overdose症例に対するN-acetylcysteine投与など，原因薬物の肝障害機序に応じた対応が可能な薬剤も存在する．しかし，この点について薬物ごとの一定のガイドラインは示されていないのが現状である．

上記の治療により自己肝の再生が早期に起きた場合は移植が回避され保存的に治癒することになる．一方，これらの治療によっても改善の傾向が認められない場合に肝移植が治療法として選択される．この際，原因薬物を用いるきっかけとなった原疾患が悪性腫瘍，全身感染症など移植手術の非適応疾患である場合，移植適応決定に難渋することがある．当該薬物を含まない治療による原疾患制御の可能性を総合的に判断しなければならないためである．この点が薬物性劇症肝不全に対する肝移植の適応の特徴といえる．

薬物性劇症肝不全に固有の肝移植適応基準はacetaminophen以外では提唱されておらず，劇症肝不全全般に対する基準がそのまま

表1　劇症肝不全における肝移植適応のガイドライン

Ⅰ）脳症発生時に次の5項目のうち2項目を満たす場合は死亡と予測して肝移植の登録を行う．

1. 年齢：45歳以上
2. 初発症状から脳症発現までの日数：11日以上(亜急性型)
3. プロトロンビン時間：10%以下
4. 血清総ビリルビン濃度：18 mg/dL以上
5. 直接／総ビリルビン比：0.67以下

Ⅱ）治療開始(脳症発現)から5日後における予後の再評価

1. 脳症がⅠ度以内に覚醒，あるいは昏睡度でⅡ度以上の改善
2. プロトロンビン時間が50%以上に改善

以上の項目のうちで，認められる項目数が

2項目の場合：生存と予測し肝移植登録を取り消す．

0または1項目の場合：死亡と予測して肝移植登録を継続する．

表2　肝移植ガイドライン2008

移植適応基準スコアリング

ポイント	0	1	2
O-C	0～5日	6～10日	11日～
PT（%）	20.1～	5.1～20.0	0～5.0
TB	～9.9	10～14.9	15～
D/T	0.7～	0.5～0.69	0～0.49
PLT	10.1万～	5.1～10.0万	5.0万以下
肝萎縮	なし	あり (SLV 80%以下)	

(昏睡Ⅱ度発症時のデータより評価)

総得点	死亡率
9点以上	**90.0%**
8	**96.3%**
7	**91.3%**
6	**85.5%**
5	**74.7%**
4	56.3%
3	24.0%
2	20.0%
1	8.0%
0	0.0%

5点以上を死亡予測として移植適応

用いられている．フランスPaul-Brousse hospital，イギリスKing's college hospital，アメリカPittsburg groupからのものがその代表である[12-15]．わが国では1990年の肝移植適応研究会の適応基準案をもとに，脳症発生時の年齢，病型(初発症状から脳症発現までの日数)，総ビリルビン値，直接/総ビリルビン比，プロトロンビン時間の5項目よりなる「劇症肝炎における肝移植適応のガイドライン(急性肝不全研究会1996年)」が作成され，現在も脳死肝移植登録時の適応基準として用いられている(表1)．さらに，表2に示すscoring systemの妥当性について現在検討が進行中である(2013年10月から脳死肝移植申請用紙が同検討に適した様式に変更となった)．一方，当科では従来の適応基準を参考

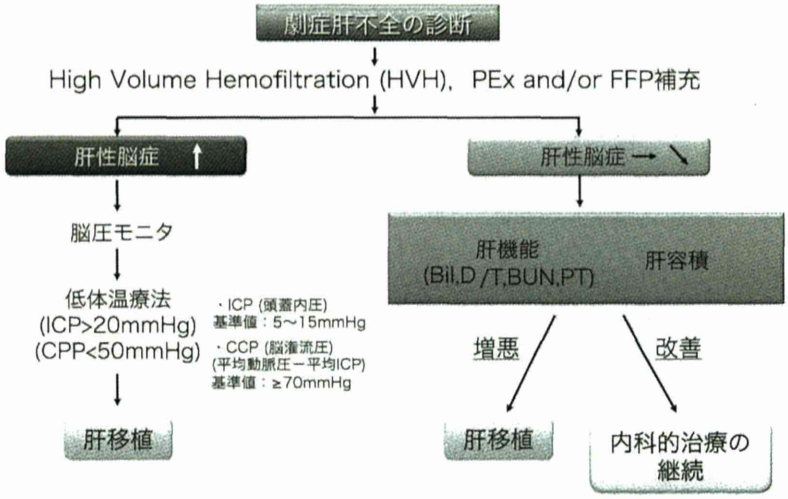

図1　当科での移植適応決定アルゴリズム

にしつつ，保存的治療に対する反応から最終的な移植適応を決定している．すなわち，脳症の程度・各種の肝機能検査値・CTによる肝容積を指標とし，血液浄化を含む内科的治療の効果を判定し最終的な肝移植適応を判断するものである(図1)．しかし，保存的治療の効果を期待しすぎるあまり，長期の待機から合併症(感染症やnitrogen death)を併発し移植時期を逸することは厳に慎まなければならない．

わが国では生体肝移植が中心であった経緯があり，肝移植の適応と判断された場合は短期日での意思決定とドナー候補者の評価が必要であった．その理由として1997年7月に臓器移植法が制定されたが，2010年7月の法改正以前は13年間で86例の提供にすぎず(6.6例/年)，脳死肝移植が劇症肝不全に対する現実的な治療法となりえなかったことがあげられる．しかし，法改正により脳死下臓器提供は年平均45例に増加し，脳死肝移植レシピエント選択基準で2005年3月から劇症肝不全に最高の待機点数が与えられていることとあわせて，現実性のある治療法となってきた(図2)．喜ばしいことであるが，このことはまた生体ドナーが存在する場合，生体・脳死肝移植のいずれを第一選択とすべきかという新しい問題を惹起している．脳死肝移植の可能性を過大評価し長期待機となれば，感染症などの移植非適応要件から生体肝移植のチャンスまで失うためである．この点については現段階でコンセンサスは得られていない．当科の現在の方針として，可及的早期に脳死肝移植登録を行い，生体肝移植ドナーの準備(評価)を進めながら，血液浄化療法開始から早くて1週後，遅くても2週後をめどに脳死肝移植から生体肝移植へのconvertを考慮している．自験例29例のうち移植後早期に感染症で死亡した4例の血液浄化療法開始から移植までの平均が23日(中央値19日)であり，逆に8日以内の症例に早期死亡がなかったことがその理由である．この点については，全国集計で移植非実施例の死亡までの日数のみならず，移植非適応要件(脳浮腫，感染症，出血など)の発生時期を明らかにすれば，convert決定時期についての大きな示唆が得られるであろう．