LETTER TO THE EDITOR

# Calculating the liver lobe weight for transplantation

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The major limitation for wider use of solid-organ transplantation continues to be shortage of donor organs. This has been a particular problem for children awaiting liver transplantation. Split-liver transplantation is a technique for dividing one liver into two portions for transplantation into two recipients. This technique was first reported by Pilchmayr *et al.* [1] and was subsequently performed by many surgeons [2,3].

Other modality of reduced-size liver transplantation is the living donor liver transplantation. It has been one of the most remarkable steps in the field of liver transplantation, capable of significantly expanding the scarce donor pool in countries in which the growing demands for organs are not met by the shortage of available cadaver grafts [4].

The aim of this study was to identify a relationship for predicting donor total liver weight as well as donor right and left hepatic lobe weight on the basis of only on donor body weight for transplantation.

Human cadaver livers ($n = 60$) were obtained from routine autopsies. The cadavers and the livers had to comply with the following requirements: (i) minimum age 18 years; (ii) no liver pathology to be expected from medical history; and (iii) no liver pathology noted at the autopsy. Resections were carried out *en bloc* with liver, celiac trunk, left gastric artery, lesser omentum, superior mesenteric artery and head of the pancreas. An eventual left or right hepatic artery was thus resected in continuity with the aorta. The liver was dissected free from its peritoneal attachments. The hepato-duodenal ligament was dissected as close to the duodenum as possible. The gallbladder, if present, was resected.

In the division of right and left lobes of the liver, it was necessary to excise the caudate lobe (segment I). The cutting plane of the liver consisted of a longitudinal section made immediately on the left of the suprahepatic inferior vena cava through the gallbladder bed preserving the arterial, portal and biliary branches to obtain two viable grafts (right lobe – segments V,VI,VII,VIII and left lobe – segments II,III,IV) as defined by the main portal scissure. The age, gender, the body height, the body weight, the liver weight and the right and left lobe weight of the cadavers were recorded, Table 1.

We correlated cadaver body weight (mean ± SD) (72.43 ± 9.54) kg with total liver weight (1.54 ± 0.36) kg. Also right (0.88 ± 0.23) kg and left (0.65 ± 0.17) kg lobe weight with total liver weight. Using regression analysis we obtained the following linear relationships:

$$\text{Total liver weight (g)} = [245.57 + 17.92(\text{body weight (kg)})], \quad r = 0.96;$$

$$\text{Right lobe weight (g)} = [67.58 + 0.52(\text{total liver weight (g)})], \quad r = 0.98;$$

$$\text{Left lobe weight (g)} = [-63.38 + 0.47(\text{total liver weight (g)})], \quad r = 0.98.$$

$r$ – Pearson's correlation coefficient (set up the grade of correlation among the figures). $r$ – the closer to 1 the better correlation.

The biggest challenge facing the fields of transplantation is the critical shortage of donor organs, which has led to a dramatic increase in the number of patients on the waiting list as well as in their waiting time. The gap between the number of transplantable organs from deceased donors and the number of patients awaiting transplantation continues to increase each year. The imbalance between supply of organs for transplantation and demand for them is widening all over the world.

In a previous work, we projected the size of the waiting-list and we made comparison with the number of transplantations carried out in the same period. We demonstrated that the list size grows at a rate much higher than the number of transplantations actually performed [5]. In addition to that, we projected the expected number of the deaths in our recipient waiting list considering that the number of cadaver donors would not change in the years to come [6].

Many liver transplantation techniques have been developed to decrease the shortage of donors such as reduced size-liver, split-liver and living donor liver transplantation. The volume and the weight of the reduced-size livers should be estimated before transplantation.

Total liver volume based on body surface area or body weight can be measured by using helical computed tomography scans [7]. Chan *et al.* [8] also working with computed tomography (CT) calculated the liver weight

**Table 1.** Distribution of the cadavers according to age, gender, height, body weight, liver weight and right and left lobe weight.

| | Age (years) | Gender | BH (m) | BW (kg) | LW (g) | RLW (g) | LLW (g) |
|---|---|---|---|---|---|---|---|
| Case 1 | 65 | M | 1.80 | 80 | 1715 | 959.38 | 742.67 |
| Case 2 | 61 | F | 1.70 | 70 | 1340 | 764.38 | 566.42 |
| Case 3 | 52 | M | 1.80 | 85 | 2160 | 1190.78 | 951.82 |
| Case 4 | 52 | M | 1.75 | 70 | 1940 | 1076.38 | 848.42 |
| Case 5 | 45 | M | 1.73 | 75 | 1480 | 837.18 | 632.22 |
| Case 6 | 74 | F | 1.70 | 70 | 1060 | 618.78 | 434.82 |
| Case 7 | 76 | M | 1.75 | 70 | 1335 | 761.78 | 564.07 |
| Case 8 | 52 | M | 1.70 | 70 | 1250 | 717.58 | 524.12 |
| Case 9 | 61 | M | 1.80 | 70 | 1770 | 987.98 | 768.52 |
| Case 10 | 45 | M | 1.70 | 60 | 1440 | 816.38 | 613.42 |
| Case 11 | 67 | M | 1.60 | 60 | 851 | 510.10 | 336.59 |
| Case 12 | 44 | F | 1.60 | 55 | 1430 | 811.18 | 608.72 |
| Case 13 | 70 | M | 1.70 | 70 | 1610 | 904.78 | 693.32 |
| Case 14 | 69 | M | 1.80 | 70 | 1480 | 837.18 | 632.22 |
| Case 15 | 40 | M | 1.70 | 70 | 1467 | 830.42 | 626.11 |
| Case 16 | 62 | M | 1.60 | 50 | 1030 | 603.18 | 420.72 |
| Case 17 | 30 | F | 1.80 | 75 | 1660 | 930.78 | 716.82 |
| Case 18 | 62 | M | 1.75 | 65 | 1696 | 949.50 | 733.74 |
| Case 19 | 37 | M | 1.90 | 75 | 2120 | 1169.98 | 933.02 |
| Case 20 | 75 | F | 1.70 | 75 | 1520 | 857.98 | 651.02 |
| Case 21 | 70 | M | 1.70 | 80 | 1750 | 977.58 | 759.12 |
| Case 22 | 46 | M | 1.80 | 75 | 2255 | 1240.18 | 996.47 |
| Case 23 | 33 | F | 1.70 | 70 | 1465 | 829.38 | 625.17 |
| Case 24 | 37 | M | 1.80 | 76 | 2240 | 1232.38 | 989.42 |
| Case 25 | 34 | M | 1.80 | 78 | 1520 | 857.98 | 651.02 |
| Case 26 | 24 | F | 1.70 | 75 | 983 | 578.74 | 398.63 |
| Case 27 | 62 | M | 1.80 | 90 | 1840 | 1024.38 | 801.42 |
| Case 28 | 76 | F | 1.70 | 70 | 1280 | 733.18 | 538.22 |
| Case 29 | 57 | M | 1.70 | 60 | 1818 | 1012.94 | 791.08 |
| Case 30 | 68 | F | 1.70 | 80 | 1300 | 743.58 | 547.62 |
| Case 31 | 42 | F | 1.65 | 65 | 1200 | 691.58 | 500.62 |
| Case 32 | 48 | M | 1.80 | 70 | 1600 | 899.58 | 688.62 |
| Case 33 | 52 | M | 1.80 | 80 | 2000 | 1107.58 | 876.62 |
| Case 34 | 69 | M | 1.70 | 75 | 1100 | 639.58 | 453.62 |
| Case 35 | 55 | M | 1.80 | 70 | 1164 | 672.86 | 483.70 |
| Case 36 | 23 | F | 1.80 | 95 | 1305 | 746.18 | 549.97 |
| Case 37 | 71 | F | 1.50 | 60 | 1602 | 900.62 | 689.56 |
| Case 38 | 51 | M | 1.70 | 80 | 1825 | 1016.58 | 794.37 |
| Case 39 | 32 | M | 1.80 | 70 | 1077 | 627.62 | 442.81 |
| Case 40 | 53 | M | 1.70 | 66 | 1603 | 901.14 | 690.03 |
| Case 41 | 75 | M | 1.70 | 70 | 1046 | 611.50 | 428.24 |
| Case 42 | 70 | M | 1.75 | 67 | 1227 | 705.62 | 513.31 |
| Case 43 | 65 | M | 1.75 | 74 | 1166 | 673.90 | 484.64 |
| Case 44 | 52 | M | 1.60 | 60 | 1190 | 686.38 | 495.92 |
| Case 45 | 39 | M | 1.80 | 80 | 1506 | 850.70 | 644.44 |
| Case 46 | 64 | M | 1.60 | 68 | 1220 | 701.98 | 510.02 |
| Case 47 | 53 | M | 1.75 | 76 | 1690 | 946.38 | 730.92 |
| Case 48 | 41 | M | 2.00 | 100 | 2695 | 1468.98 | 1203.27 |
| Case 49 | 86 | F | 1.60 | 55 | 1227 | 705.62 | 513.31 |
| Case 50 | 45 | M | 1.80 | 78 | 1689 | 945.86 | 730.45 |
| Case 51 | 34 | M | 1.70 | 75 | 1655 | 928.18 | 714.47 |
| Case 52 | 45 | M | 1.80 | 80 | 1745 | 974.98 | 756.77 |
| Case 53 | 60 | M | 1.80 | 80 | 1955 | 1084.18 | 855.47 |
| Case 54 | 48 | M | 1.80 | 78 | 1580 | 889.18 | 679.22 |
| Case 55 | 57 | M | 1.80 | 75 | 1990 | 1102.38 | 871.92 |
| Case 56 | 47 | M | 1.75 | 65 | 1470 | 831.98 | 627.52 |
| Case 57 | 54 | M | 1.80 | 85 | 1400 | 795.58 | 594.62 |
| Case 58 | 58 | F | 1.70 | 50 | 1120 | 649.98 | 463.02 |
| Case 59 | 66 | M | 1.80 | 80 | 1785 | 995.78 | 775.57 |
| Case 60 | 48 | M | 1.70 | 80 | 1550 | 873.58 | 665.12 |

M, male; F, female; BH, body height; BW, body weight; LW, liver weight; RLW, right lobe weight; LLW, left lobe weight; m, meter; kg, kilogram; g, gram.

from the right lobe graft weight obtained at the back table, divided by the proportion of the right lobe on the CT. Body height was found to be insignificant and a formula based on body weight and gender was set up.

Chouker *et al.* [9] found that the liver weight was best predicted in younger people (16–50 years) by body weight, age and gender. In contrast, in elderly people (51–70 years), the liver weight was best predicted by body weight and age only. Gender was found to be not a significant factor.

We built up the above model of splitting the cadaver liver into right and left lobe to identify a safer and cost-effective relationship among body weight, total liver, right and left lobe weight, as neither the body height nor gender has proved to be significant. Therefore, taking into account only the body weight and using a regression analysis we found out the total liver weight ($r = 0.96$). Subsequently, with the total liver weight, we found out a formula for the right and left lobe weight ($r = 0.98$). Our formula is more simple, straightforward, cost-effective and might be used in countries with both lack of financial resources and high technology computed tomography scans.

In conclusion, using only total donor body weight, it is possible to estimate donor right and left hepatic lobe weight for subsequent matching with the recipient body weight.

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