Transplant International

LETTER TO THE EDITOR

Inaccurate estimation of donor body weight, height and consequent assessment of body mass index may affect allocation of liver grafts from deceased donors

doi:10.1111/j.1432-2277.2008.00774.x

Within the Eurotransplant (ET) countries, size mismatch is one of the most common reasons for refusing a deceased donor liver offer. In 2006, 43% (584/1332) of liver offers refused across ET were rejected by individual transplant centers because of size mismatch (personal communication from ET). In our institution, during the period between January 2007 and June 2007, 50 liver offers were not accepted because of size mismatch alone, corresponding to 23% of the 216 total organ refusals in that period.

As body weight (BW) and body height (BH) correlate mathematically to liver size [1–4], these two simple yet critical parameters may dramatically influence the acceptance of a liver graft for a size-matched recipient, especially in cases of possible adult-pediatric split-liver, where a perfect size-match between donor and recipient of a partial graft is mandatory for a good post-transplant outcome. In our institution, BH is the major parameter for size-match when donor body mass index (BMI) is normal. Excessive BW with corresponding high BMI, however, usually requires a liver biopsy to exclude hepatic steatosis as it has been shown that BMI correlates to the degree of steatosis [4,5]. For these reasons, one would expect that BW and BH would be accurately measured during the allocation process. To determine whether this was the case, we surveyed 36 liver transplant centers within ET. Among the 17 responding centers, only three reported using actual measurement of BH (18%) and only one center (6%) reported directly measuring donor BW. Furthermore, those centers stating that they perform actual measurements included the caveat that it was only 'occasionally done'. All other responding centers only use estimated or reported data for BW and BH.

To demonstrate the consequences of estimation instead of exact measurement of BW and BH, we simulated a typical situation in which an ET coordinator approaches a deceased donor in the intensive care unit: i.e., estimating the anthropometric parameters of the potential donor. Fourteen different medical professionals acted as 'donor coordinators' for the study: eight physicians, four medical students, and two experienced nurses. The study sample consisted of 17 surgical patients (six women and 11 men). All patients gave their informed consent prior to their inclusion in the study. To mimic the situation of the first contact with the organ procurement coordinator, the patients were asked to lie supine on the bed wearing only a patient gown. After each investigator independently estimated BW (to the nearest kg) and BH (to the nearest cm), BW and BH were measured by a nurse (not involved in providing an estimation) using a Seca® (Hamburg, Germany) roll-up measuring band and a calibrated Seca® flat weighing scale. All estimated and measured data were reported in an Excel file and BMI (kg/m^2) was calculated. Patients were assigned to a weight classification according to their BMI [6]. When compared to the measured data, the estimated parameters were arbitrarily divided in three groups: (i) properly estimated (difference were within 5 kg for weight or 5 cm for height), (ii) over-estimated (difference were over 5 kg for weight or over 5 cm for height) or (iii) under-estimated (difference were under 5 kg for weight or under 5 cm for height). The data were compared by chi-squared test or student's *t*-test for categorical and continuous variables respectively. For all analyses, a two-tailed *P*-value of 0.05 or less was considered significant.

We found that proper estimation of BH was noted 80% of the time, while proper estimation of BW occurred only 40% of the time (Table 1). Under- and over-estimation of BW and BH ranged from −28% of actual BW to +46% of actual BW and from −8% of actual BH to +14% of actual BH. Estimating BW was more difficult, especially at higher BMI (comparing eight patients with BMI <25 to nine patients with BMI over 25, $P < 0.05$). The fact that fewer mistakes were observed in estimating BH could be explained by the fact the patients were lying in a 2-m-long bed (standard size in our hospital), which provided a visual aid for the investigator estimating the patient's BH. Accordingly, estimated BMI correlated with actual BMI in only 39% of patients.

Inaccurate estimation of BW and BH by the healthcare providers were also reported in 47% and 59% respectively in trauma patients and unresponsive stroke patients [7,8].

Table 1. Proper, over- and under-estimation of body weight and height in 17 patients.

	Proper estimation (%)	Over-estimation (%)	Quantification of over-estimation (%)	Under-estimation (%)	Quantification of under-estimation (%)
Weight	40	40	10 (1–46)	20	5 (1–28)
Height	80	18	4 (1–14)	2	2 (1–8)
BMI	39.1	30.7	0.5 (0.1–2.9)	30.2	0.5 (0.1–6.8)

In this study the range of under- or over-estimation of BW was up to 29 kg and the range of under- or over-estimation of height was up to 24 cm. Such a disparity between the estimation and measurement can influence proper organ allocation in terms of size-mismatch. Aside from refusal of a liver that may, in fact, have suited the recipient, livers initially accepted based on incorrect data result in cost of traveling for procurement and thereafter having to decline the organ intraoperatively for size (which consequently delays implantation of the liver with another recipient); in our experience, too big a liver may also mean being unable to close the abdomen, entailing additional surgery, etc.

Thus, an objective measurement of BH and BW should be advocated in order to facilitate the allocation of liver grafts. Many hospitals are equipped to weigh patients in bed. For those that are not, there are numerous, commercially available portable weight scales that could be used by a transplant coordinator (e.g., Seca® 656 multifunction scales, Seca® 984 electronic bed and dialysis scale and Detecto®-IB Series Electronic In-Bed Scales. The Seca® 984 electronic scale can be put into a personal car, which is very practical for sharing). If the portable weight scale is not available, the formula for estimating BW from measurements of BH waist and hip circumference, which is suggested by Lorenz *et al.* [8], should be applied. Despite an 80% rate of proper estimation of height, we still found a wide range of difference between estimation and measurement. To this end, there is no reason why an exact measurement of BH cannot be obtained at the bedside using a tape measure.

Funding sources

The study was supported by internal institutional funding.

Acknowledgement

We thank Dr M. Slot from Eurotransplant (ET) International Foundation for providing the organ allocation data for the ET area.

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