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ORIGINAL ARTICLE

A comparison of two validated scores for estimating risk of mortality of children with intestinal failure associated liver disease and those with liver disease awaiting transplantation

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Summary
Background and aims: To evaluate risk of mortality in children with intestinal failure associated liver disease (IFALD) compared with other liver disease using two validated scores.
Methods: Sixty-seven children listed for transplant were studied: cholestatic liver disease (CLDn23); liver disease secondary to other processes (LDsec n11); (IFALDn22), acute liver failure (ALFn11). Paediatric Hepatology Score (PHD) score and Pediatric end-stage liver disease score (PELD) were evaluated by Receiver Operating Curves (ROC), proportional hazards regression.
Results: The highest PHD and PELD scores were found in ALF; the lowest in LDsec. Both scores correlated well in identifying waiting list (WL) mortality in patients with CLD and ALF, but not in those with IFALD where PELD scores were lower. Cox proportional hazard regression of time spent on the waiting list prior to death or transplant/delisting showed significant associations with PHD ($P = 0.006$) and PELD ($P = 0.008$). WL mortality was strongly predicted by disease group (6/8 deaths in IFALD). ROC analysis of all data showed that a PHD score greater than 15.5 had sensitivity of 87.5% and specificity of 81% for waiting list mortality ($P < 0.001$); PELD greater than 8 had a sensitivity of 87.5% and specificity of 40%. Neither PHD nor PELD scores correlated with post-transplant mortality.

Abbreviations: IFALD, Intestinal failure associated liver disease; CLD, Cholestatic liver disease; NCLD, Non-cholestatic liver disease; ALF, Acute liver failure; PHD, Paediatric Hepatology Dependancy Score; PELD, Pediatric Endstage Liver Disease score; ROC, Receiver Operating Curve; WL, Waiting list; SI units, Système International d'Unités; PN, Parenteral Nutrition; MELD, Model for Endstage Liver Disease; UNOS, United Network for Organ Sharing; INR, International Normalised Ratio.

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Conclusion: PHD and PELD scores had the same sensitivity for identifying risk of WL mortality in all patients, but PELD failed to identify the sickest children with IFALD, lowering its specificity. The PHD score has the added advantage for European centres of being in SI units, not requiring a computer application to calculate and was simpler to use at bedside.

Introduction

Children with intestinal failure may be maintained with parenteral nutrition (PN) for many years but a proportion develop complications, (liver disease; recurrent catheter related blood stream infections; thrombosis of major veins) which threatens the viability of continued intravenous feeding. Identifying the point at which children might benefit from small bowel transplantation can be difficult, especially since the mortality of such children on the transplant list is as high as 50% [1—3].

A number of scoring systems in the setting of intensive care and liver transplantation have evolved [4—10] which have vastly improved the appreciation of patients' risk factors and have the potential to inform difficult clinical decisions about timing of referrals and allocation of scarce resources such as donated organs.

The Liver Unit at Birmingham Children's Hospital is a national centre for liver and small bowel transplantation. Since 1997, over 500 children have been assessed for orthotopic liver transplantation and 300 children for intestinal transplant with or without a liver graft depending on the degree of hepatic dysfunction. In order to audit the allocation of nursing and other resources, we developed a simple bedside dependency score (Paediatric Hepatology Dependancy score [PHD]) in which the sickest and most dependent children were identified. This score was developed and validated in a broad diagnostic group and published in 2007 [4]. The ten parameter score is obtained during ward rounds using a check list (Table 1) of routinely noted variables — a process similar to that of recording an Apgar score. A correlation between PHD score and length of stay in non-surgical patients was also found ($r = 0.733$, $P < 0.01$).

The Pediatric end stage liver disease (PELD) was introduced in North America in 2002 [11,12] in order to improve organ allocation and prioritise the sickest patients. It was modified several times [1,9,13—15]. PELD requires the input of traditional units and transformation into natural logarithms, but this process has been simplified by an on-line calculator, and recent evaluations suggest that it accurately provides a 90 day risk of mortality which achieves a concordance value of 0.9, i.e. 90% of deaths are predicted by PELD [16].

Having previously confirmed the utility and ease of use of the PHD score in our patients with liver disease [4], our aim was to compare the PHD score with the PELD score in order to determine its value in assessing risk of death on the transplant waiting list in patients with intestinal failure associated liver disease (IFALD) as well as those with other forms of liver disease as part of our audit programme.

Patients and methods

Retrospective PHD and PELD data were collected concurrently at the time of transplant assessment in all 70 children who were listed for organ transplantation between October 2006 and December 2007. Three children were excluded because they did not have any evidence of liver disease (two had oxalosis, and one had intestinal failure with a structurally normal liver and normal biochemistry). This period coincided with high waiting list mortality in young transplant candidates and led to changes in organ allocation rules in the UK [2], which may have reduced mortality in subsequent cohorts. The 67 children who were included had a median age of 2.3 years (range 0.03—16.9). The patients were categorised according to four broad diagnostic groups (Table 2): 23 had cholestatic liver disease, 11 had liver disease secondary to other processes as a result of disease arising in other tissues or organ systems, 22 had intestinal failure associated liver disease (IFALD) and 11 had acute liver failure. Organ allocation rules for liver grafts in the United Kingdom at the time of the study take account of disease category by recognising acute liver failure for priority access to transplant organs; with other categories such as IFALD, chronic liver disease (including cholestatic and liver disease secondary to other processes) being treated equally, with other factors such as deterioration whilst on waiting list and the timing of chemotherapy being taken into consideration by local teams [2].

The PHD score was calculated using ten parameters previously validated [4] (Table 1). Each parameter could score 0—4 and was added together using the calculation grid shown in Table 1 with a theoretical maximum of 40 with no further manipulations. PELD was calculated using the published formula (Table 1). Since 2008, the UNOS website has carried the recommendation that the age range, for which the adult based score Model for end-stage liver disease (MELD) is applicable, can be extended down to 12 years [17]. This was done to reflect wider concerns that the mortality risk of teenagers may be underestimated when depending on PELD parameters only [6,18]. We also compared PELD with MELD in the 13 children who were 12 years at the time their scores were calculated (Fig. 3). MELD was calculated using the published formula (Table 1).

In addition to comparing the PHD and PELD scores according to diagnostic grouping at time of listing, we also evaluated PHD and PELD by outcome in terms of waiting list mortality and post-transplant mortality. The following factors for pre- and post-transplant mortality were examined: age at listing; duration on transplant waiting list; diagnostic group, PELD and PHD score. And for post-transplant mortality only, the following risk factors were examined: