Selenium Homocholic Acid Taurocholate Scanning, Selenium-75-Labeled Bile Acid, a Novel Method for Testing the Function of the Terminal Ileum in Small Bowel Transplant Recipients: A Pilot Study


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ABSTRACT

Introduction. The terminal ileum (TI) is important for the active reabsorption of bile salts and is the site of allograft rejection; disruption of enterohepatic circulation (EHC) may give insights to inflammatory and other physiologic processes at the TI.

Subjects and methods. Four children aged 5 to 12 years who had received small bowel transplantation (SBTx), 3 recovering from post-transplant lymphoproliferative disease (PTLD) and 1 with acute rejection, were studied. Two of the 4 had stoma reversal. Another child (15 years) with progressive familial intrahepatic cholestasis (PFIC) and pruritus, despite liver transplantation and biliary diversion, was studied. Selenium homocholic acid taurocholate scanning (75SeHCAT) capsule was given orally (n = 3) or via introducer during endoscopy (n = 2); a baseline whole-body gamma camera scan was done 4 hours later and on days 1 to 5.

Results. The normal 3-day bile salt retention is 30% to 70% of baseline and normal adult biological half-life, t½ is 62 ± 17 hours. The results in children with a stoma were very low (0.1% at 7.6 hours; 5% at 17 hours). The children with reversed stoma had retention and t½ closer to the reference range (18% at 29 hours; 22% at 33 hours). The child with PFIC + biliary diversion had an initial very high gamma emission from the stoma bag suggesting excellent reabsorption of bile salts from his TI, but retention was 0.6% and t½ 9.8 hours, demonstrating efficient biliary diversion.

Conclusion. These results confirm children with stomas malabsorb bile acids, which can be ameliorated after stoma closure. SeHCAT demonstrated that the biliary diversion was working well and may be helpful in preoperative assessment of abnormal EHC. The role of SeHCAT in SBTx requires further evaluation.

Selenium homocholic acid taurocholate scanning (SeHCAT [75Se]) has been used to identify disorders of the TI in adults [1–3]. SeHCAT is a bile salt (taurocholic acid) that contains a medical isotope of selenium (75Se), which is a low-intensity gamma emitter with an atomic half-life of 120 days. The effective radiation dose varies according to the size of the patient (0.3 to 0.74 mSv), which is comparable to that delivered by plain abdominal radiograph (0.8 mSv [4]) or annual background radiation (1–3 mSv). The use of SeHCAT capsules in young children, and also after small bowel transplantation (SBTx), has not been reported before.

The aim of this study was to study the feasibility of SeHCAT in children with abdominal symptoms and to evaluate the enterohepatic circulation where there are symptoms suggestive of malabsorption.

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SUBJECTS AND METHODS

Subjects

Four children aged 5 to 12 years who received isolated SBTx 12 to 24 months earlier and who were hospitalized for evaluation of high stomal output/diarrhea were tested. One child was recovering from severe acute rejection and the other 3 from post transplant lymphoproliferative disease (PTLD). Another child aged 15 years with severe pruritus despite a biliary diversion after liver transplantation for PFIC (enterocutaneous fistula between the Roux-en-Y and abdominal wall) was also studied prior to revision surgery.

Methods

Children aged >8 years were able to swallow the SeHCAT capsule and the 2 children aged 5 and 5.5 years had the SeHCAT capsule placed in the stomach using an introducer at the time of orogastroduodenoscopy carried out at the same time. The children and stoma bag, if present, were scanned in the nuclear medicine department 4 hours after the capsule was administered; they sat 2 m from the uncollimated camera for 20 minutes according to a standardized protocol. The total acquired counts for anterior and posterior views were corrected for background counts and the net geometric mean counts calculated. In all patients, the baseline geometric mean was approximately 50,000 counts in 20 minutes. The children and stoma bags were rescanned every day until the increment above background was negligible. The percentage gamma emissions relative to baseline was calculated, and also the biological half-life $t_{1/2}$ (i.e., time in hours taken for baseline emission rate to fall by 50%). This was a pilot study carried out in the context of acute clinical conditions; ethical approval was not sought but approval from the Administration of Radioactive Substances Advisory Committee was obtained for each patient.

RESULTS

There are no healthy control data for children for either SeHCAT retention biological half-life; in healthy adults the 3-day retention is quoted as 33% to 75% [3] and $t_{1/2}$ is quoted at 62 ± 17 hours [5]. The 2 children with stomas after SBTx had a low retention of SeHCAT at 3 days and very low $t_{1/2}$ (0.1% at 7.6 hours; 5% at 17 hours). The 2 children with stomas closed had better 3-day retentions and $t_{1/2}$ (18% at 29 hours; 22% at 33 hours). The child with PFIC and pruritus after biliary diversion had improved by the time of his SeHCAT study, and his results confirmed excellent clearance of SeHCAT indicating good biliary drainage. See Fig 1.

DISCUSSION

It was possible to study the enterohepatic circulation in children quite simply, and where there is a pressing clinical concern, even very young children can be evaluated by means of an introducer administered at the same time as planned general anesthetic, with relatively little inconvenience to the child or clinical team. The rapid loss of SeHCAT from the intestinal tract in children with stomas is consistent with other studies of fat malabsorption and frequency of vitamin D deficiency in SBTx recipients; however, the bile salt losses appear to be much less in children after stoma reversal. The higher than expected reabsorption of bile salts from the terminal ileum of the boy with PFIC raises the possibility that this may be important in the pathophysiology of pruritus in this condition.

There are a number of limitations in our study to be acknowledged: children were evaluated when unwell or recovering from complications of immunosuppression; there are no normal data for this age group; and the results produced are semiquantitative only. The data in the literature usually refer to day 7 retention, but this not a useful parameter in this cohort with short biological half-life for SeHCAT. We propose that $t_{1/2}$ be quoted in addition to 3-day retention in future studies evaluating the function of the terminal ileum in children. SeHCAT may be helpful in preoperative assessment of abnormal enterohepatic recirculation and symptoms such as pruritus and diarrhea. The role of SeHCAT in SBTx requires further evaluation.

Fig 1. Biological half-life ($t_{1/2}$) of selenium homocholic acid taurocholate scanning (SeHCAT) and 3-day retention (%) in 4 children after bowel transplantation and 1 child after biliary diversion, compared with healthy adult controls. PFIC, progressive familial intrahepatic cholestasis; Orthotopic Liver Transplant (OLT).
REFERENCES


