disseminate best practices across centers while ensuring that all patients have access to necessary care.

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PACIFIC COAST SURGICAL ASSOCIATION

Liver Transplant Using Normothermic Machine Perfusion in Patients With High-Acuity Illness

Liver transplant (LT) is limited by donor organ availability and preservation. Normothermic machine perfusion (NMP) is revolutionizing LT by extending preservation time, limiting ischemia-reperfusion injury, and expanding the donor pool.[1,2]

Supplemental content

Limited use of extended criteria donors substantially reduces organ availability, prolonging waiting time, especially for patients with high-acuity illness.[3,4] While NMP can ameliorate ischemic injury and increase marginal donor-liver use, its use in the context of high-acuity LT (HILT) remains unproven.

Methods | This single-center retrospective analysis compared outcomes of adult LT using NMP vs propensity score–matched static cold storage (SCS) cases from November 1, 2022, to November 30, 2023. HILT was defined as a Model for End-Stage Liver Disease (MELD) 3.0 higher than 30, pre-LT vasopressors in the intensive care unit (ICU), multiorgan transplant, combined LT with cardiac surgery, or retransplant. The UCLA Institutional Review Board approved this case-control study and waived informed consent because deidentified data were used. We followed the STROBE reporting guideline.

Outcome measures included total preservation time (TPT), lactate clearance and bile production on NMP, lactate and base excess at end of LT, early allograft dysfunction (EAD, defined as aspartate aminotransferase [AST] >2000 IU/L [to convert to µkat/L, multiply by 0.0167]; bilirubin ≥10 mg/dL [to convert to µmol/L, multiply by 17.104]; or international normalized ratio ≥1.6 up to 7 days postoperatively), post-LT length of stay (LOS), 6-month unplanned reoperation and ischemic cholangiopathy rates, and 90-day and 6-month mortality. All tests were 2-sided; $P < .05$ was considered statistically significant. Analyses were performed using IBM SPSS Statistics 28 (IBM).

Results | There were 176 LTs performed (28 NMP; 148 SCS). Propensity score matching yielded 28 paired cases (16 females [29%], 40 males [71%]; mean [SD] age, 51 [14] years) for analysis. One NMP-preserved liver was rejected for transplant due to poor graft quality and not analyzed. More donation-after-cardiac-death livers were used with NMP vs SCS (32% vs 4%; $P < .01$). The NMP group had significantly longer TPT (716 vs 392 minutes; $P < .001$) with excellent lactate clearance (median [IQR], 4.63 [4.10-5.42] to 0.75 [0.41-1.10] mmol/L; $P < .001$) (**Figure**, A) and bile production (median [IQR], 50 [33-54] mL) on pump. NMP group had significantly lower median (IQR) lactate (2.7 [2.0-3.7] vs 4.7 [3.3-5.3] mmol/L; $P = .04$) (Figure, B), greater base excess (−2 vs −4; $P = .03$), lower median peak AST (333 vs 470 IU/L; $P = .003$) and alanine aminotransferase (314 vs 507 IU/L; $P = .002$) levels, and lower EAD incidence (7% vs 29%; $P = .04$) vs SCS group. No differences in unplanned reoperation, ischemic cholangiopathy, or post-LT LOS were observed (Figure, C).

Of 28 NMP cases, 17 (61%) had HILT indications; 9 (53%) had a MELD 3.0 score higher than 30, and 7 (41%) had pre-LT vasopressors in the ICU (**Table**). HILT outcomes using NMP were favorable, with low rates of postreperfusion syndrome

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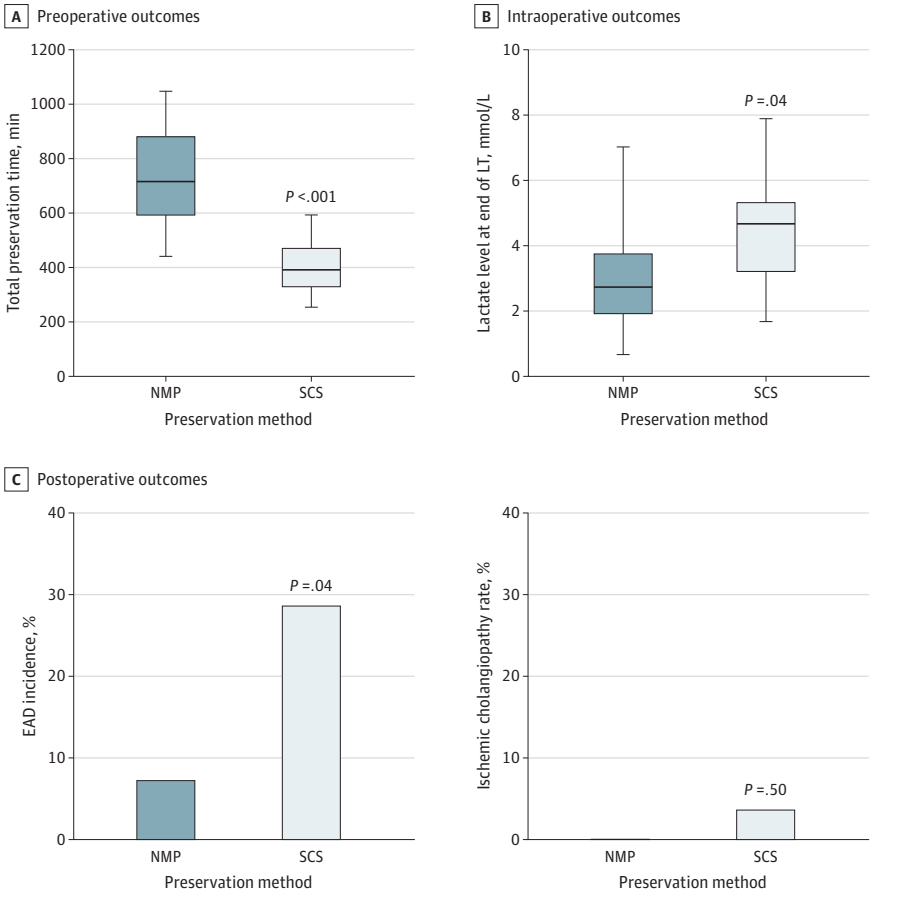
Figure. Adult Liver Transplant (LT) Outcomes Using Normothermic Machine Perfusion (NMP) vs Static Cold Storage (SCS)



Upper and lower ends of the boxes represent the 75th and 25th percentiles, respectively; horizontal lines inside the boxes represent the median; and upper and lower whiskers represent the 95th and 5th percentiles, respectively. EAD indicates early allograft dysfunction.

Table. High-Acuity Liver Transplant Indications

Indication	Cases, No. (%) (N = 17)
Preoperative characteristics	
MELD 3.0 score >30[a]	9 (53)
Pre-LT vasopressors in the ICU	7 (41)
Procedure	
LT	9 (53)
Liver retransplant	2 (12)
Combined heart-liver transplant	2 (12)
Simultaneous liver-kidney transplant	2 (12)
LT with CABG	2 (12)

Abbreviations: CABG, coronary artery bypass graft; ICU, intensive care unit; LT, liver transplant; MELD, Model for End-Stage Liver Disease.

[a] MELD 3.0 score range, 6 to 40, with higher scores indicating greater severity of a patient's liver disease and higher likelihood of dying from liver failure in the next 3 months.

(6%), EAD (6%), unplanned operation (12%), and 90-day and 6-month mortality (6%; 1 death due to cardiac tamponade).

Discussion | NMP is transforming modern LT by augmenting the donor pool, decreasing waiting list time, and enhancing dynamic perfusion time, allowing for optimization of LT for complex HILT. NMP use for HILT mitigates ischemic reperfusion injury of marginal organs, potentially limiting intraoperative complications and yielding favorable post-LT outcomes.[5,6] Prior studies excluding most HILT indications reported initial benefits of NMP vs SCS,[1,2] but the present study, to our knowledge, was the first and largest to analyze practical applications of NMP for complex HILT cases.

Although limited by small sample size and retrospective design, this study found that dynamic perfusion time gained by NMP allowed for LT with excellent outcomes using livers from extended criteria donors and complex care of patients with high-acuity illness and hemodynamic instability or who need multiorgan transplant, combined LT with cardiac surgery, or retransplant. Further investigation into optimizing use of and indications for NMP in complex patients is necessary to expand the limits of LT.

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PACIFIC COAST SURGICAL ASSOCIATION

Pain Assessment in Older Adults After Traumatic Injury

Optimal pain management is important in improving post-trauma outcomes.[1] Poor pain control can limit or prevent participation in rehabilitation both inpatient and after hospitalization. Older adults have been shown to receive inadequate pain management.[2,3] In a study of pain-related visits to the emergency department, older patients (≥75 years) received less analgesic treatment than middle-aged patients.[4] However, pain assessment variation in older patients is not well studied. We aimed to evaluate pain assessment frequency and pain score magnitude and variability by age among admitted trauma patients.

Supplemental content

Methods | This retrospective cross-sectional study included adult trauma patients admitted to Zuckerberg San Francisco General Hospital, an academic, level I trauma center from 2012 to 2022. The University of California San Francisco Institutional Review Board approved this study and waived informed consent because this study posed minimal risk to a retrospective population. We followed the STROBE reporting guideline except when precluded by brevity.

We compared frequency of pain assessment and pain score magnitude and variability between older and younger adults in medical-surgical floors, which have a policy with clearly defined pain assessment intervals (eMethods in Supplement 1). Primary analysis compared younger adults (18-64 years) with older adults (≥65 years; group 1). Secondary analysis compared younger adults with older adults (≥75 years; group 2). Linear and negative binomial regressions were used for continuous outcomes. Linear regression assumptions were assessed using quantile-quantile and residual plots. Given differences between age groups, we adjusted for characteristics, including sex, race and ethnicity, and insurance type. Patients with missing data were excluded from adjusted models. Two-sided $P < .05$ was considered significant. Analyses were done using Stata, version 16.1 (StataCorp LLC).

Results | The cohort consisted of 21 063 trauma patients (≥65 years, 32%) with a mean (SD) age of 53 (22) years, and 6504 females [31%]). More older adults had ICU admissions, while more younger adults underwent surgery (**Table 1**).

Compared with younger adults, the median (IQR) number of pain assessments per floor per day was significantly lower for group 1 (11.8 [7.8-16.0] vs 7.6 [5.3-10.8]) and group 2 (11.2 [7.3-15.7] vs 7.0 [5.0-10.0]) (**Table 2**). Similarly, compared with younger adults, the median (IQR) number of pain assessments per day of hospitalization was significantly lower for group 1 (10.1 [6.2-14.5] vs 6.4 [4.2-9.5]) and group 2 (9.9 [6.0-14.0] vs 6.0 [4.0-8.7]). After adjustment, the incident rate ratio (IRR) for number of pain assessments per floor per day was 0.80 (95% CI, 0.77-0.83) for group 1 and 0.83 (95% CI, 0.80 to 0.85) for group 2.

Pain score magnitude was significantly lower for older than younger adults. After adjustment, mean pain score magnitude across hospital stay was lower in group 1 (coefficient, −1.43; 95% CI, −1.55 to −1.31) and group 2 (coefficient, −1.17; 95% CI, −1.27 to −1.08) vs younger adults (Table 2).

Pain scores also varied less for older adults. After adjustment, the magnitude of median (IQR) pain scores was similar for groups 1 and 2 (group 1 coefficient: −0.83 [95% CI, −1.00 to −0.67]; group 2 coefficient: −0.82 [95% CI, −0.95 to −0.69]) compared with younger adults.

Discussion | Older adults (≥65 years) had less frequent pain assessments, lower pain scores, and less variance in pain scores than younger adults. Our finding of less frequent pain assessments for older adults accords with a study[5] wherein older trauma patients had pain assessed less frequently than hospital protocol. One study suggested that older adults may underreport pain to avoid procedures or maintain agency.[6]

Given the importance of pain management after traumatic injury, less frequent pain assessment and lower pain scores may result in less pain management for older adults. Our study was limited to a single, urban level I trauma center so

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