

1. DONOR RISK INDEX (DRI) predict quantitatively the risk of post-transplant graft failure in liver transplantation. Seven donor factors and two procurement factors were incorporated into the DRI model to calculate a quantifiable DRI.

These factors include donor age, race, height, death from cerebrovascular accident (CVA), donation after cardiac death (DCD), cause of death classified as “other” (excluding trauma, CVA, or anoxia), split or partial graft, cold ischemia time, and location of organs based on donor service area.

Calculation: DRI = $5 \exp([0.154 \text{ if age is } <40 \text{ to } < 50 \text{ years}] + [0.274 \text{ if age is } < 50 \text{ to } < 60 \text{ years}] + [0.424 \text{ if age is } <60 \text{ to } < 70 \text{ years}] + [0.501 \text{ if age is } <70 \text{ years}] + [0.079 \text{ if COD } \neq \text{ anoxia}] + [0.145 \text{ if COD } \neq \text{ CVA}] + [0.184 \text{ if COD } \neq \text{ other}] + [0.176 \text{ if race } \neq \text{ African American}] + [0.126 \text{ if race } \neq \text{ other}] + [0.411 \text{ if DCD}] + [0.422 \text{ if partial/split}] + [0.066 \cdot (170 - \text{height})/10] + [0.105 \text{ if regional share}] + [0.244 \text{ if national share}] + [0.010 \cdot 3 \text{ cold time}])$.

2. Suzuki Score for the Assessment of Liver Damage Following Hepatic Ischemia/Reperfusion

score	congestion	vacuolization	Necrosis
0	none	none	none
1	minimal	minimal	single cell necrosis
2	mild	mild	~30%
3	moderate	moderate	~60%
4	severe	severe	>60%

Suzuki S, Toledo-Pereyra LH, Rodriguez FJ, Cejalvo D. Neutrophil infiltration as an important factor in liver ischemia and reperfusion injury. Modulating effects of FK506 and cyclosporine. Transplantation, 1993; 55(6): 1265–72.

3. BRUNNER SCORE (bile duct damage)

Common bile duct epithelium shows considerable damage after cold ischemia with further damage occurring after reperfusion. The extent of epithelial damage can be quantified by our newly developed bile duct damage score and is a prognostic parameter for biliary complications and graft loss.

grade	description
0	regular monolayer of high prismatic cylinder epithelium
1	flattened but still present epithelial cells
2	Destroyed biliary epithelium but preserved subepithelial connective tissue
3	destroyed biliary epithelium combined with disrupted connective tissue without nuclei, indicating necrosis of the BD

Grade 0, grade 1 and less than 10% grade 2 or 3 damage were defined as group with “no relevant”, and specimens with more than 10% grade 2 or 3 damage were classified as group with “major” damage.

Brunner SM, Junger H, Ruenmelle P, Schnitzbauer AA, Doenecke A, Kirchner GI, Farkas SA, Loss M, Scherer MN, Schlitt HJ, Fichtner-Feigl S. Bile duct damage after cold storage of deceased donor livers predicts biliary complications after liver transplantation. J Hepatol. 2013 Jun;58(6):1133-9. doi: 10.1016/j.jhep.2012.12.022. Epub 2013 Jan 12. PMID: 23321317.

4. CONUT score

Controlling Nutritional Status Score calculation.

The Controlling Nutritional Status (CONUT) score is a screening tool to identify undernourished patients in the hospitalized population. The score is derived from the values of serum albumin, total cholesterol and lymphocyte counts.

For the calculation of CONUT score the following table is included.

Laboratory parameters	None	Light	Moderate	Severe
Serum albumin (g/dL)	Serum albumin (g/dL)	3.00-3.49	2.50-2.99	<2.50
Score	0	2	4	6
Total lymphocyte count	≥1600	1200-1599	800-1199	<800
Score	0	1	2	3
Total cholesterol (mg/dL)	≥180	140-179	100-139	<100
Score	0	1	2	3

(Ulíbarri, J. et al. CONUT: a tool for controlling nutritional status. First validation in a hospital population. Nutrición Hospitalaria 20, 38–45 (2005)

5. CARDIAC RISK SCORE

parameters: Age Gender Diabetes Hypertension Tobacco Pack Years Family History of Coronary Artery Disease* *Defined as history of coronary artery disease in a first-degree family member. Personal History of Coronary Artery Disease* *Defined as history of percutaneous coronary intervention, coronary artery bypass grafting and/or myocardial infarction.

For the calculation of cardiac risk score

factors	points
age	
<30	0

30-39	2
40-49	4
50-59	6
60-70	8
>70	10
sex	
male	0
female	-2
diabetes	
yes	2
no	0
tobacco pack years	
0-20	15
21-40	1
>40	2
family history of coronary artery disease	
yes	2
no	0
personal history of cad	
yes	7
no	0

Low risk: (-2) -- 3

Intermediate-Risk: 4-8

High Risk: 9-25

(Rachwan RJ, Kutkut I, Timsina LR, Bou Chaaya RG, El-Am EA, Sabra M, Mshelbwala FS, Rahal MA, Lacerda MA, Kubal CA, Fridell JA, Ghabril MS, Bourdillon PD, Mangus RS. CAD-LT score effectively predicts risk of significant coronary artery disease in liver transplant candidates. J Hepatol. 2021 Jul;75(1):142-149. doi: 10.1016/j.jhep.2021.01.008. Epub 2021 Jan 18. PMID: 33476745.)

6. SARCOPENIA EVALUATION

Patients prospectively enrolled should undergone an assessment of sarcopenia using two measurements:

A - Total Psoas Area (TPA) at the third lumbar vertebra.

TPA was measured according to the formula:

Psoas muscle area/height (mm²/m²).

Psoas muscle area corresponds to the sum of the areas of the left and right psoas muscles.

B. - Skeletal Muscle Index (SMI) (optional)

SMI was measured according to the formula: Skeletal Muscle Area/height (mm²/m²).

the Skeletal Muscle Area corresponds to the sum of the areas of the psoas, paraspinal, and abdominal wall muscles.

A temporal limit of up to 3 months between the single evaluated CT scan and the Liver Transplant date should be adopted.

All the measurements should be done at the intermediate part of the third lumbar vertebra. The vertebra level was identified on each scan based on midline sagittal images that were reformatted from the unenhanced axial CT dataset. On the corresponding axial image, the total cross-sectional areas of the psoas, paraspinal (left and right quadratus lumborum), and abdominal wall muscles (rectus abdominis, oblique, and transversus abdominis) should be determined.

7. RIFLE (RENAL DYSFUNCTION)

In the RIFLE criteria, the stratum of injury is defined by a doubling of serum creatinine or a reduction of urinary output below 0.5 ml/kg per h during at least 12 h. Importantly, of the patients who develop injury, >50% later will develop established renal failure

In RIFLE, failure is defined as a three-fold increase of serum creatinine or decrease in GFR of >75% or a urine output of <0.3 ml/kg per h for >24 h or anuria for >12 h. Alternatively, failure also is defined by a serum creatinine of >4 mg/dl (353.6 μmol/L) with an acute rise of 0.5 mg/dl (42.2 μmol/L).

For the calculation of RIFLE score the following table is included.

RIFLE score	GFR criteria	UO criteria	
Non-ARF	GFR decrease ≤ 25%	UO ≥ 0.5 mL/kg/h	0
Risk	Increase Crx1.5 or GFR decrease > 25%	UO < 0.5 mL/kg/h × 6 h	1

Injury	Increase Crx2 or GFR decrease > 50%	UO < 0.5 mL/kg/h × 12 h	2
Failure	Increase Crx3 or GFR decrease > 75% or Cr > 4 mg/dL	UO < 0.3 mL/kg/h × 24 h	3
Loss	Complete loss of kidney function > 4 week	-	-
End-stage renal disease	End-stage renal disease (> 3 months)	-	-

Hoste EA, Clermont G, Kersten A, Venkataraman R, Angus DC, De Bacquer D, Kellum JA: RIFLE criteria for acute kidney injury are associated with hospital mortality in critically ill patients: A cohort analysis. Crit Care 10 :R73– R83,2006

8. Modified Charlson Comorbidity INDEX (Volk et al. Liver Tx 2007)

The Charlson Comorbidity Index (CCI) was originally created to assess the survival rate of patients with chronic diseases (10-year survival), although it was modified and adopted in LTx recipients as CCI-OLT.

The Charlson Comorbidity Index is a method of categorizing comorbidities of patients based on the International Classification of Diseases (ICD) diagnosis codes found in administrative data, such as hospital abstracts data. This index take into account:

Addition of the selected points:		
Variable	Definition	Points
Myocardial infarction	History of definite or probable MI (EKG changes and/or enzyme changes)	1
Congestive heart failure	Exertional or paroxysmal nocturnal dyspnea and has responded to digitalis, diuretics, or afterload reducing agents	1
Peripheral vascular disease	Intermittent claudication or past bypass for chronic arterial insufficiency, history of gangrene or acute arterial insufficiency, or untreated thoracic or abdominal aneurysm (≥6 cm)	1
Cerebrovascular accident or transient ischemic attack	History of a cerebrovascular accident with minor or no residua and transient ischemic attacks	1
Dementia	Chronic cognitive deficit	1
Chronic obstructive pulmonary disease	-	1
Connective tissue disease	-	1
Peptic ulcer disease	Any history of treatment for ulcer disease or history of ulcer bleeding	1
Mild liver disease	Mild = chronic hepatitis (or cirrhosis without portal hypertension)	1
Uncomplicated diabetes	-	1
Hemiplegia	-	2
Moderate to severe chronic kidney disease	Severe = on dialysis, status post kidney transplant, uremia, moderate = creatinine >3 mg/dL (0.27 mmol/L)	2
Diabetes with end-organ damage	-	2
Localized solid tumor	-	2
Leukemia	-	2
Lymphoma	-	2
Moderate to severe liver disease	Severe = cirrhosis and portal hypertension with variceal bleeding history, moderate = cirrhosis and portal hypertension but no variceal bleeding history	3
Metastatic solid tumor	-	6
AIDS*	-	6

Plus 1 point for every decade age 50 years and over, maximum 4 points.

Note: liver disease and diabetes inputs are mutually exclusive (e.g. do not give points for both "mild liver disease" and "moderate or severe liver disease").

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The 1-yr mortality rates for the different scores were: "0", 12% (181); "1-2", 26% (225); "3-4", 52% (71); and "greater than or equal to 5", 85%. The percent of patients who died of comorbid disease for the different scores were: "0", 8% (588); "1", 25% (54); "2", 48% (25); "greater than or equal to 3", 59% (18).

Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis.* 1987;40(5):373-83. doi: 10.1016/0021-9681(87)90171-8. PMID: 3558716.

Definition:

- 1) Congestive heart failure—documented decreased left ventricular function or mean pulmonary artery pressure \geq 25 mm Hg as determined by stress echocardiography, including patients with portopulmonary hypertension.
- 2) Coronary artery disease—documented history of myocardial infarction, or coronary disease on angiography. All men above age 40 yr and all women above age 50 yr, as well as patients of any age with risk factors for coronary artery disease underwent a stress test. Patients with a positive stress test but negative angiography were not considered as having coronary artery disease.
- 3) Diabetes mellitus—chronic hyperglycemia requiring outpatient medications at any time during the month preceding transplantation.
- 4) Peripheral vascular disease—documented arterial disease by angiography or ankle-brachial index.
- 5) Cerebral vascular accident—history of stroke with residual neurological deficit.
- 6) Chronic obstructive pulmonary disease (COPD)—chronic lung disease with requirement for medications, documented forced expiratory volume in 1 second \leq 1.5 L, or a history of intubation for respiratory failure.
- 7) Connective tissue disease—diagnosis by a rheumatologist of systemic lupus, rheumatoid arthritis, scleroderma, or seronegative spondyloarthropathy. Patients with osteoarthritis, or arthralgias without objective evidence of inflammatory arthritis, were not considered as having connective tissue disease.
- 8) Renal insufficiency—serum creatinine of 1.5 mg/dL or greater on most recent pretransplantation testing, or a history of renal transplantation.
- 9) Malignancy—history of malignancy, excluding nonmelanoma skin cancer and hepatocellular carcinoma.

NOTES

- The CCI was calculated by assigning a weight of 2 to diabetes, stroke, renal insufficiency, and malignancy, and a weight of 1 to the other comorbidities, as previously described.¹⁵
- When each comorbidity was examined individually, no weighting was used.

9. Glasgow coma score

The Glasgow come score was calculated assigning points for each of the sections reported below (Eye opening, from 0 to 4; verbal response, from 0 to 5; best motor response, from 0 to 6).

Eye opening

Criterion	Observed	Rating	Score
Open before stimulus	✓	Spontaneous	4
After spoken or shouted request	✓	To sound	3
After finger tip stimulus	✓	To pressure	2
No opening at any time, no interfering factor	✓	None	1
Closed by local factor	✓	Non testable	NT

Verbal response

Criterion	Observed	Rating	Score
Correctly gives name, place and date	✓	Orientated	5
Not orientated but communication coherently	✓	Confused	4
Intelligible single words	✓	Words	3
Only moans / groans	✓	Sounds	2
No audible response, no interfering factor	✓	None	1
Factor interfering with communication	✓	Non testable	NT

Best motor response

Criterion	Observed	Rating	Score
Obey 2-part request	✓	Obeys commands	6
Brings hand above clavicle to stimulus on head neck	✓	Localising	5
Bends arm at elbow rapidly but features not predominantly abnormal	✓	Normal flexion	4
Bends arm at elbow, features clearly predominantly abnormal	✓	Abnormal flexion	3
Extends arm at elbow	✓	Extension	2
No movement in arms / legs, no interfering factor	✓	None	1
Paralysed or other limiting factor	✓	Non testable	NT

10. ICU risk SOFA II (early post-operative care)

Sequential Organ Failure Assessment (SOFA) severity of illness score for hospital mortality is a morbidity severity score and mortality estimation tool developed from a large sample of ICU patients throughout the world. Unlike other scoring systems, such as the SAPS II and APACHE II systems, the SOFA was designed to focus on organ dysfunction and morbidity, with less of an emphasis on mortality prediction. The authors designed the system with an emphasis on bedside applicability and simplicity using widely available variables.

For the calculation of SOFA score the following table is included.

-Respiratory system	
PaO2/FiO2 [mmHg (kPa)]	SOFA score
≥ 400 (53.3)	0
< 400 (53.3)	+1
< 300 (40)	+2
< 200 (26.7) and mechanically ventilated	+3
< 100 (13.3) and mechanically ventilated	+4
-Nervous system	
Glasgow coma scale	SOFA score
15	0
13–14	+1
10–12	+2
6–9	+3
< 6	+4
-Cardiovascular system	
Mean arterial pressure OR administration of vasopressors required	SOFA score
MAP ≥ 70 mmHg	0
MAP < 70 mmHg	+1
dopamine ≤ 5 µg/kg/min or dobutamine (any dose)	+2
dopamine > 5 µg/kg/min OR epinephrine ≤ 0.1 µg/kg/min OR norepinephrine ≤ 0.1 µg/kg/min	+3
dopamine > 15 µg/kg/min OR epinephrine > 0.1 µg/kg/min OR norepinephrine > 0.1 µg/kg/min	+4
-Liver	
Bilirubin (mg/dl) [µmol/L]	SOFA score
< 1.2 [< 20.53]	0
1.2–1.9 [20-32]	+1
2.0–5.9 [33-101]	+2
6.0–11.9 [102-204]	+3
> 12.0 [> 204]	+4
-Coagulation	
Platelets×103/µl	SOFA score
≥ 150	0
< 150	+1
< 100	+2
< 50	+3
< 20	+4
-Kidneys	
Creatinine (mg/dl) [µmol/L] (or urine output)	SOFA score
< 1.2 [< 110]	0
1.2–1.9 [110-170]	+1
2.0–3.4 [171-299]	+2
3.5–4.9 [300-440] (or < 500 ml/d)	+3
> 5.0 [> 440] (or < 200 ml/d)	+4

Interpretation:		
SOFA Score	Mortality if initial score	Mortality if highest score
0-1	0.0%	0.0%
2-3	6.4%	1.5%
4-5	20.2%	6.7%
6-7	21.5%	18.2%
8-9	33.3%	26.3%
10-11	50.0%	45.8%
12-14	95.2%	80.0%
>14	95.2%	89.7%
Mean SOFA Score	Mortality	
0-1.0	1.2%	
1.1-2.0	5.4%	
2.1-3.0	20.0%	
3.1-4.0	36.1%	
4.1-5.0	73.1%	
>5.1	84.4%	

1. Vincent JL, de Mendonça A, Cantraine F, et al. Use of the SOFA score to assess the incidence of organ dysfunction/failure in intensive care units: results of a multicenter, prospective study. Working group on "sepsis-related problems" of the European Society of Intensive Care Medicine. Crit Care Med. 1998;26(11):1793-800. PMID 9824069.
2. Ferreira FL, Bota DP, Bross A, et al. Serial evaluation of the SOFA score to predict outcome in critically ill patients. JAMA. 2001;286(14):1754-8.

11. Clavien Dindo (7 classes) – OUTCOME (hospital morbidity)

The therapy used to correct a specific complication is the basis of this classification in order to rank a complication in an objective and reproducible manner.

It consists of 7 grades (I, II, IIIa, IIIb, IVa, IVb and V). The introduction of the subclasses a and b allows a contraction of the classification into 5 grades (I, II, III, IV and V) depending on the size of the population observed or the of the focus of a study.

Complications that have the potential for long-lasting disability after patient's discharge (e.g.: paralysis of a voice cord after thyroid surgery) are highlighted in the present classification by a suffix ("d" for disability). This suffix indicates that a follow-up is required to comprehensively evaluate the outcome and related long-term quality of life.

(Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004; 240(2):205-213)

Grade I Any deviation from the normal postoperative course without the need for phcohortacological treatment or surgical, endoscopic, and radiological interventions.

Allowed therapeutic regimens are as follows: drugs as antiemetics, antipyretics, analgetics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside

Grade II Requiring phcohortacological treatment with drugs other than those allowed for grade I complications

Blood transfusions and total parenteral nutrition are also included

Grade III Requiring surgical, endoscopic, or radiological intervention

IIIa Intervention not under general anesthesia

IIIb Intervention under general anesthesia

Grade IV Life-threatening complication (including CNS complications)* requiring IC/ICU management

IVa Single-organ dysfunction (including dialysis)

IVb Multiorgan dysfunction

Grade V -Death

*Brain hemorrhage, ischemic stroke, and subarachnoid bleeding, but excluding transient ischemic attacks. CNS indicates central nervous system; IC, intermediate care; ICU, intensive care unit.

12. Comprehensive Complication Index

For the calculation of CCI the following table is included.

wC = Weight of Complication

$$CCI^{\circ} = \sqrt{(wC_1 + wC_2 \dots + wC_x)/2}$$

CCI ^o	wC	Single Value CCI ^o
Grade I	300	8.7
Grade II	1750	20.9
Grade IIIa	2750	26.2
Grade IIIb	4550	33.7
Grade IVa	7200	42.4

13. GRWR (graft/recipient weight ratio)

GRWR was calculated from the following equation (graft weight or volume in gram or ml/recipient weight in kg × 10)

14. L-GrAFT₁₀ score

L-GrAFT₁₀ score =

$$\begin{aligned} &+ 9.77 + \\ &- 0.429 \times (\text{AUC calculated from } \log_e \text{ of AST in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &+ 0.005 \times (\text{AUC}^2 \text{ calculated from } \log_e \text{ of AST in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &+ 4.607 \times (\text{slope calculated from } \log_e \text{ of AST in 1, 2, 3, 4, 5, 6, 7 POD}) + \\ &+ 4.413 \times (\text{slope}^2 \text{ calculated from } \log_e \text{ of AST in 1, 2, 3, 4, 5, 6, 7 POD}) + \\ &+ 0.890 \times (\log_e \text{ max of INR in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &- 0.049 \times (\text{AUC calculated from } \log_e \text{ of total bilirubin in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &+ 0.004 \times (\text{AUC}^2 \text{ calculated from } \log_e \text{ of total bilirubin in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &+ 5.336 \times (\text{slope calculated from } \log_e \text{ of total bilirubin in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &- 0.046 \times (\text{AUC calculated from } \log_e \text{ of platelet count in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &- 5.249 \times (\text{slope calculated from } \log_e \text{ of platelet count in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) + \\ &+ 13.086 \times (\text{slope}^2 \text{ calculated from } \log_e \text{ of platelet count in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 POD}) \end{aligned}$$

15. EASE score

EASE score =

$$\begin{aligned} &- 0.058 + \\ &+ 0.000534 \times (\text{AUC}^2 \text{ calculated from } \log_e \text{ of AST in 1, 2, 3, 7, 10 POD}) + \\ &- 0.093 \times (\text{AUC calculated from } \log_e \text{ of platelet count in 1, 3, 7, 10 POD}) + \\ &- 7.735 \times (\text{slope calculated from } \log_e \text{ of platelet count in 1, 3, 7, 10 POD}) + \\ &+ 0.735 \times (\text{slope calculated from bilirubin level in 1, 3, 7, 10 POD}) + \\ &+ 0.044 \times (\text{MELD at transplant}) + \\ &+ 0.065 \times (\text{number of PACKED RED BLOOD CELL transfused units during surgery}) + \\ &+ 2.567 \text{ (if arterial or portal thrombosis during days 1-10)} + \\ &- 0.402 \text{ (if center volume } \geq 70 \text{ cases x year)} \end{aligned}$$

Abbreviations. AUC, area under the curve; POD, post-operative day.

Notes. Forty data-entries are necessary to calculate the L-GrAFT₁₀ score and 17 data-entries to calculate the EASE-score. Differently from the L-GrAFT₁₀ score, for the EASE score the logarithmic transformation of bilirubin was not adopted.

The - 0.058 constant of the EASE score results from the algebraic sum of the constant obtained by the logistic regression (-0.958) and the constant added to calibrate the unsustainable risk cutoff at the 0 threshold (+ 0.3560).