The Prognostic Utility of Coronary Angiography in Pre-operative Evaluation for Liver Transplantation

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Background

- Coronary artery disease (CAD) is associated with increased mortality and morbidity in patients who have undergone orthotopic liver transplantation (OLT).[1]
- Coronary angiography (CA) is still recognized as the gold standard for CAD assessment, but non-invasive stress tests (NIST) and traditional risk factors are generally more widely used during the pre-OLT evaluation process.
- The purpose of our study was to assess the prognostic utility of coronary angiography in the pre-OLT evaluation process.

Methods

- We conducted a retrospective review of 420 OLT cases at our tertiary care facility from August 2009 to August 2020.
- 134 patients were referred for CA based on NIST results and traditional CAD risk factors.
- Coronary stenosis (CS) was defined as the presence of ≥50% diameter stenosis in at least 1 coronary artery.
- The primary outcome was a composite of all-cause mortality or major adverse cardiac events (MACE), which was defined as new-onset systolic heart failure, myocardial infarction, cardiac arrest, and stroke within 90 days of OLT.

Table 1. Coronary angiography and coronary stenosis

	Total cohort (n=420)	No CA (n=286)	CA (n=134)	*p*-value§	CA cohort (n=134)	No CS (n=84)	CS (n=50)	*p*-valueΨ
Background								
Age	55.1 [10.1]α	52.9 [10.6]	59.6 [7.3]	**<0.001**	59.6 [7.3]	59.18 [7.4]	60.34 [7.0]	0.372
Male	273 (65.0)β	176 (61.5)	97 (72.4)	**0.039**	97 (72.4)	60 (71.4)	37 (74.0)	0.903
Female	147 (35.0)	110 (38.5)	37 (27.6)	-	37 (27.6)	24 (28.6)	13 (26.0)	-
Social								
Family history of CAD	127 (30.2)	75 (26.2)	52 (38.8)	**0.012**	52 (38.8)	31 (36.9)	21 (42.0)	0.688
Smoking history	214 (51.1)	138 (48.3)	76 (56.7)	0.139	76 (56.7)	46 (54.8)	30 (60.0)	0.681
Medical history								
Hypertension	206 (49.0)	122 (42.7)	84 (62.7)	**<0.001**	84 (62.7)	46 (54.8)	38 (76.0)	**0.023**
Hyperlipidemia	63 (15.0)	36 (12.6)	27 (20.1)	0.061	27 (20.2)	14 (16.7)	13 (26.0)	0.280
Diabetes mellitus	144 (34.3)	72 (25.2)	72 (53.7)	**<0.001**	72 (53.7)	40 (47.6)	32 (64.0)	0.097
Chronic kidney disease	97 (23.1)	66 (23.1)	31 (23.1)	1.000	31 (23.1)	21 (25.0)	10 (20.0)	0.651
Connective tissue disease	12 (2.9)	9 (3.1)	3 (2.2)	0.836	3 (2.2)	2 (2.4)	1 (2.0)	1.000
Chronic obstructive lung disease	15 (3.6)	6 (2.1)	9 (6.7)	**0.036**	9 (6.7)	5 (6.0)	4 (8.0)	0.919
Myocardial infarction	5 (1.2)	1 (0.3)	4 (3.0)	0.066	4 (3.0)	1 (1.2)	3 (6.0)	0.290
HFrEF	0 (0.0)	0 (0.0)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	-
Prior CAD	10 (2.4)	1 (0.3)	9 (6.7)	**<0.001**	9 (6.7)	2 (2.4)	7 (14.0)	**0.025**
Stroke	6 (1.4)	3 (1.0)	3 (0.7)	0.605	3 (2.2)	2 (2.4)	1 (2.0)	1.000
HIV	4 (1.0)	3 (1.0)	1 (0.7)	1.000	1 (0.7)	1 (1.2)	0 (0.0)	1.000
Positive NIST	39 (9.6)	0 (0.0)	39 (29.1)	**<0.001**	39 (29.1)	25 (29.8)	14 (28.0)	0.984
Mortality or MACE	33 (7.9)	25 (8.7)	8 (6.0)	0.430	8 (6.0)	1 (1.2)	7 (14.0)	**0.008**

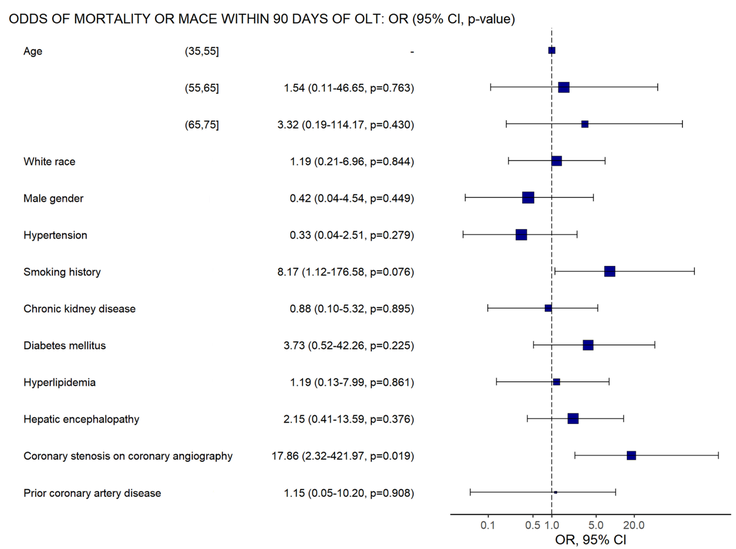
§ = *p*-value between non-CA and CA groups, ψ = p-value between no CS and CS groups, α = mean [standard deviation], β = n (%), CA = coronary angiography, CAD = coronary artery disease, HFrEF = heart failure with reduced ejection fraction, MACE = major adverse cardiac events, NASH = non-alcoholic steatohepatitis, NIST = non-invasive stress test, TIPS = trans-jugular intrahepatic portosystemic shunt

Table 2. Non-invasive tests and coronary stenosis

	CA cohort (n=134)	(-) NIST & (-) CS (n=59)	(-) NIST & (+) CS (n=36)	*p*-value§
Background				
Age	59.6 [7.3]α	60.38 [7.1]	60.48 [6.1]	0.942
Male	97 (72.4)β	43 (72.9)	27 (75.0)	1.000
Female	37 (27.6)	16 (27.1)	9 (25.0)	
Social				
Family history of CAD	52 (38.8)	21 (35.6)	12 (33.3)	0.998
Smoking history	76 (56.7)	35 (59.3)	20 (55.6)	0.883
Medical history				
Hypertension	84 (62.7)	33 (55.9)	29 (80.6)	**0.026**
Hyperlipidemia	27 (20.2)	9 (15.3)	10 (27.8)	0.224
Diabetes mellitus	72 (53.7)	28 (47.5)	23 (63.9)	0.178
Chronic kidney disease	31 (23.1)	16 (27.1)	6 (16.7)	0.357
Connective tissue disease	3 (2.2)	2 (3.4)	1 (2.8)	1.000
Chronic obstructive lung disease	9 (6.7)	4 (6.8)	3 (8.3)	1.000
Myocardial infarction	4 (3.0)	1 (1.7)	2 (5.6)	0.661
HFrEF	0 (0.0)	0 (0.0)	0 (0.0)	-
Prior CAD	9 (6.7)	0 (0.0)	5 (13.9)	**0.014**
Stroke	3 (2.2)	2 (3.4)	0 (0.0)	0.704
HIV	1 (0.7)	1 (1.7)	0 (0.0)	1.000
Mortality or MACE	8 (6.0)	1 (1.7)	6 (16.7)	**0.021**

§ = *p*-value between (-) NIST and (-) CS vs. (-) NIST and (+) CS; (+) NIST and (-) CS vs. (+) NIST and (+) CS, α = mean [standard deviation], β = n (%), CA = coronary angiography, CAD = coronary artery disease, CS = coronary stenosis, HFrEF = heart failure with reduced ejection fraction, MACE = major adverse cardiac events, NASH = non-alcoholic steatohepatitis, NIST = non-invasive stress test, TIPS = trans-jugular intrahepatic portosystemic shunt

Figure 1. Multivariate analysis of coronary stenosis



Results

- Of the 134 patients who underwent CA, 50 patients were found to have CS (Table 1).
- There was more mortality or MACE within 90 days of OLT in patients with CS compared to patients without CS (Table 1).
- 36 out of 134 patients (26.8%) who underwent CA were found to have CS even after negative NISTs (Table 2).
- In multivariate analysis, the presence of CS was independently associated with mortality or MACE after adjustment for traditional risk factors (Figure 1).

Conclusion

- Diagnosis of CS is critical for reducing mortality and MACE in patients undergoing OLT, and our study shows that CS was independently predictive of mortality or MACE.
- NISTs and traditional risk factors may not be as reliable in the OLT population compared to the non-OLT population based on cardiovascular changes that occur in end-stage liver disease.
- CA can definitively identify CAD and should be utilized on a broader scale than as a last resort.

References

1. Plotkin JS, Scott VL, Pinna A, Dobsch BP, De Wolf AM, Kang Y. Morbidity and mortality in patients with coronary artery disease undergoing orthotopic liver transplantation. Liver Transplantation and Surgery. 1996 Nov;2(6):426-30.