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Usefulness of indocyanine green florescent imaging guided-anatomic resection in robotic hepatectomy

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Purpose:

Indocyanine Green (ICG)-fluorescence imaging in hepatobiliary surgery field is widely used for visualization of extrahepatic bile duct anatomy, liver tumor detection and anatomic liver resection. In this study, we investigated feasibility and usefulness of ICG florescent imaging guided anatomic liver resection including robotic living donor hepatectomy.

Methods:

From January 2016 to July 2018, 46 patient underwent anatomic liver resection using ICG florescent imaging system (Firefly®) in Da Vinci Robot. ICG (5 mg/2ml) was administrated though direct (via portal vein after clamping by individual ligation of extrahepatic Glisson approach) or indirect method (via peripheral vein) during operation before about 5-10 minutes that confirm the anatomic segmentation or right/left liver.

Results:

There were 21 female patients and mean age was 37.5 years. Among them, 32 patients were healthy living donor. ICG was administrated through peripheral vein in 34 patients, and 38 patients (82.6%) were identified clear ICG demarcation line. Ten patients of them showed similar demarcation line for both gross vision and ICG imaging. In 9 patients, inferior part was similar, however, it was more clearly seen in superior part using ICG imaging. ICG imaging was found to be clearly seen in both inferior/superior part than gross vision in 9 patients. According to administration method, success rate of indirect method was higher than direct method (50% vs. 94.1%, p-value=0.002). In indirect method,

29.4% showed that gross vision and ICG imaging was identical. In 44.1% of patients, ICG imaging clearly seen than gross vision in superior part. In both superior/inferior part, 20.6 % of patients showed visual benefit in ICG imaging.

Conclusion:

ICG fluorescent imaging is able to provide more clear images than gross vision in anatomic liver resection. Large cohort and prospective control studies are mandatory to verify the efficacy of ICG guided anatomic liver resection in near future.

Table 1. Patients characteristics

Varibles (Mean ± SD)	Patients (N=46)	p
Sex		
Male	25 (54.3%)	
Female	21 (45.7%)	
Age (years)	37.5 ± 14.5	
Healthy Living Donor		
No	14 (30.4%)	
Yes	32 (69.6%)	
Liver Cirrhosis		
No	37 (80.4%)	
Yes	9 (19.6%)	
Final diagnosis		
Complicated liver cyst	2 (4.3%)	
HCC (HBV)	10 (21.7%)	
HCC (NBNC)	1 (2.2%)	
Healthy donor	32 (69.6%)	
Intraductal papillary neoplasm with high grade intraepithelial neoplasia	1 (2.2%)	
ICG Administration Method		
Direct (Portal vein)	12 (26.1%)	
Indirect(Peripheral vein)	34 (73.9%)	
ICG guided Demarcation Line		
No clearly visible	8 (17.4%)	
Clearly visible	38 (82.6%)	
ICG guided imaging resection Benefit		

Varibles (Mean ± SD)	Patients (N=46)	p
No clearly visible	8 (17.4%)	
Grossly and ICG , identical	10 (21.7%)	
ICG more clear than gross in superior part of liver	19 (41.3%)	
ICG more clear than gross in superior/inferior part of liver	9 (19.6%)	
Hospital stay(days)	8.9 ± 2.6	
BMI (kg/m^2)	22.3 ± 2.5	
Operation name		
Central lobectomy	1 (2.2%)	
Extended Right Posterior sectionectomy and wedge resection (S3)	1 (2.2%)	
Living donor Left hepatectomy	9 (19.6%)	
Living donor Right hepatectomy	23 (50.0%)	
Left hepatectomy	9 (19.6%)	
Rightt hepatectomy	3 (6.5%)	
Operation time (min)	464.5 ± 169.8	
Estimated blood loss (ml)	149.6 ± 257.3	
Postoperative Complications (≥ Clavien-Dindo Calssification I)		
No	33 (71.7%)	
Yes	13 (28.3%)	
Biloma		
No	45 (97.8%)	
Yes	1 (2.2%)	

Table 2. Success rate according to administration method of ICG

Administration Method	Direct Portal vein (N=12)	Indirect Peripheral vein (N=34)	p
ICG guided Demarcation Line			0.002
No clearly visible	6 (50.0%)	2 (5.9%)	
Clearly visible	6 (50.0%)	32 (94.1%)	
ICG guided imaging resection Benefit			0.003
No clearly visible	6 (50.0%)	2 (5.9%)	
Grossly and ICG , identical	0 (0.0%)	10 (29.4%)	
ICG more clear than gross in superior part of liver	4 (33.3%)	15 (44.1%)	
ICG more clear than gross in superior/inferior part of liver	2 (16.7%)	7 (20.6%)	