transplantology

MDPI

Article

Usefulness of T-Tube in Liver Transplantation: Still Effective or Outmoded Strategy?

Niccolò Incarbone [1,2,†], Riccardo De Carlis [1,*,†], Leonardo Centonze [1], Livia Palmieri [1,3], Giuseppe Cordaro [1,2], Alberto Ficarelli [1,4], Ivan Vella [1,4], Vincenzo Buscemi [1], Andrea Lauterio [1] and Luciano De Carlis [1,2]

[1] Department of General Surgery and Transplantation, ASST Grande Ospedale Metropolitano Niguarda, 20162 Milan, Italy; niccolo.incarbone@ospedaleniguarda.it (N.I.); leonardo.centonze@ospedaleniguarda.it (L.C.); livia.palmieri@ospedaleniguarda.it (L.P.); giuseppe.cordaro@ospedaleniguarda.it (G.C.); alberto.ficarelli@ospedaleniguarda.it (A.F.); ivan.vella@ospedaleniguarda.it (I.V.); vincenzo.buscemi@ospedaleniguarda.it (V.B.); andrea.lauterio@ospedaleniguarda.it (A.L.); luciano.decarlis@ospedaleniguarda.it (L.D.C.)
[2] Department of Medicine and Surgery, University of Milano-Bicocca, 20126 Milan, Italy
[3] Department of Medicine and Surgery, Sapienza University, 00185 Rome, Italy
[4] Department of Surgical Sciences, University of Pavia, 27100 Pavia, Italy
* Correspondence: riccardo.decarlis@ospedaleniguarda.it
† Contributed equally.

Abstract: Introduction: T-tube placement during liver transplantation (LT) is still debated. We performed a retrospective study to evaluate the usefulness of T-tube after LT in two cohorts differing in post-transplant risk. Methods: A total of 327 LTs performed between 2015 and 2018 were included in the analysis. LTs from donation after circulatory death and living donation, split-liver transplants, and LTs with hepaticojejunostomy were excluded. T-tube was reserved for marginal grafts, high-risk recipients, and bile duct size discrepancy. A balance of risk (BAR) score of $\leq$9 defined the low-risk cohort (232 patients, 68 with and 164 without T-tube), while a BAR score of >9 defined the high-risk cohort (95 patients, 43 with and 52 without T-tube). Postoperative complications were estimated with the comprehensive complication index (CCI). Postoperative biliary complications were classified in anastomotic stricture (AS), non-anastomotic stricture (NAS), and biliary leakage (BL). Results: In the low-risk cohort, LTs with and without T-tube had similar rates of NAS (0 vs. 2.9%, $p = 0.36$), AS (2.9 vs. 2.4%, $p = 0.83$), and BL (1.4 vs. 2.4%, $p = 0.64$). Analogous outcomes were found in the high-risk cohort: NAS (0 vs. 0), AS (0 vs. 5.7%, $p = 0.11$), and BL (0 vs. 1.3%, $p = 0.27$). There were more postoperative complications among patients with T-tube, in both the low-risk (CCI 29 vs. 21, $p < 0.001$) and high-risk (CCI 51 vs. 29, $p < 0.001$) cohort. No differences in primary non-function, hepatic artery thrombosis, and mortality were observed. Conclusions: T-tube placement did not influence postoperative biliary complications. Although the two cohorts were normalized for post-transplant risk, LT recipients with T-tube had a more complicated course.

Keywords: biliary drainage; biliary complications; post-liver transplant complications

Citation: Incarbone, N.; De Carlis, R.; Centonze, L.; Palmieri, L.; Cordaro, G.; Ficarelli, A.; Vella, I.; Buscemi, V.; Lauterio, A.; De Carlis, L. Usefulness of T-Tube in Liver Transplantation: Still Effective or Outmoded Strategy? *Transplantology* **2021**, *2*, 379–386. https://doi.org/10.3390/transplantology2040036

Academic Editor: Nobuhisa Akamatsu

Received: 14 August 2021
Accepted: 16 September 2021
Published: 24 September 2021

1. Introduction

Despite the global improvements achieved in recent years, liver transplantation (LT) has still high rates of postoperative morbidity and mortality [1]. Biliary complications (BCs) are frequently observed after LTs and can occur in approximately 15–20% of patients [2]. There are several risk factors associated with BC, and the most important include the use of grafts with extended criteria, prolonged cold ischemia time, and older donor age [3]. These features are currently accepted more and more often in an effort to fill the gap between available organs and patients on the waitlist [4]. Particularly, a linear increase in donor age has been observed, which could nonetheless be associated with a higher risk of ischemic-type biliary lesions [5,6].

The use of the T-tube has been classically advocated to lower the pressure of the biliary system and provide mechanical protection to the anastomosis, thus reducing the incidence of BCs [2,7,8]. Nevertheless, the routine use of the T-tube is highly debated, and there are currently no shared indications on its use. Two recent reviews and meta-analyses have shown that the T-tube does not significantly reduce BCs, and some authors have suggested reserving the use of the T-tube only for high-risk recipients [9–11]. A recent Italian survey has reported that 20% of centers entirely discontinued use of the T-tube; 25% still use it routinely; while the remaining 55% apply a selective policy based on technical complexity, graft quality, and recipient conditions [12].

In this study, therefore, we aim to retrospectively evaluate our LT series to assess the utility of the T-tube according to the risk associated with transplant.

2. Materials and Methods

2.1. Study Design

All consecutive LTs performed in our institution between 2015 and 2018 were retrospectively analyzed. LTs from donation after circulatory death (DCD) and living donation, split-liver transplants, and LTs with hepaticojejunostomy were excluded. To rank our data according to the post-transplant risk, we divided the initial population into two cohorts according to the balance of risk (BAR) score [13]. A balance of risk (BAR) score of $\leq$9 defined the low-risk cohort, while a BAR score of >9 defined the high-risk cohort. Within each cohort, post-transplant outcomes were compared according to the placement of the T-tube or not.

The main post-transplant outcomes were biliary complications, length of stay (LOS), postoperative complications, hepatic artery thrombosis (HAT), early allograft dysfunction (EAD), primary graft nonfunction (PNF), patient survival, and graft survival. In-hospital postoperative complications were estimated with the comprehensive complication index (CCI) [14]. Graft survival was not death-censored, and patient death was considered graft loss.

Data were collected retrospectively and anonymized before the analysis. The primary sources for data collection were donors' and recipients' operative reports, recipients' medical notes, laboratory tests during hospitalization, and post-transplant follow-up visits. All patients signed informed consent that data and follow-up will be potentially used for scientific analysis and publication. No formal ethical approval was required owing to the retrospective, observational, and anonymous nature of this study.

2.2. Biliary Reconstruction, T-Tube Management, and Follow-Up

We always performed end-to-end bile duct anastomosis and side-cut both the donor's and the recipient's stumps (even if they were equally sized) to prevent a stricturing effect of the suture line [15]. The T-tube was used depending on the surgeon's decision and reserved for marginal grafts, high-risk recipients, and bile duct size discrepancy. One of the three senior surgeons in our center performed or assisted in each procedure. After T-tube placement, we routinely performed a cholangiography on postoperative day 7. If negative, we proceeded with progressive closure. T-tube removal was scheduled 3 months post-transplant after another cholangiography.

For all patients, the immunosuppressive regimen included induction with basiliximab, tapered steroid, and tacrolimus with the addition of mycophenolate. The follow-up was weekly for the first month, monthly for the first year, then every 6 months. Magnetic resonance (MRCP) or endoscopic retrograde cholangiopancreatography (ERCP) were performed when clinical signs or symptoms of cholestasis were observed.

2.3. Definitions

Early allograft dysfunction (EAD) was defined according to Olthoff et al. [16]. BCs included biliary leakage (BL), anastomotic stricture (AS), and nonanastomotic strictures (NAS). BLs at the T-tube site were considered separately. AS was defined as a segmental narrowing around the anastomosis. NAS was defined as a proper alteration of the graft biliary system, according to Seehofer et al. [3].

2.4. Statistical Analysis

For statistical analysis, we used the SPSS 27.0 software (SPSS version 27.0 from IBM SPSS Statistics, Chicago, IL, USA). Quantitative variables were reported as medians and interquartile ranges (IQRs). Qualitative variables were reported as counts and percentages. Comparisons were performed using Fisher's exact test, the χ^2 test, and the Mann–Whitney test, as appropriate. Survival analysis was performed using the Kaplan–Meier estimator and log-rank test. A *p*-value of $\leq$0.05 was considered statistically significant.

3. Results

3.1. Study Population

Between 2015 and 2018, 401 LTs were performed at Niguarda Hospital (Milan, Italy). Seventy-four patients were excluded (LTs from donation after circulatory death (N = 28), living donation (N = 6), split-liver transplants (N = 21), and LTs with hepaticojejunostomy (N = 26)) and the remaining 327 were included in the analysis. The low-risk cohort (defined by a BAR score of $\leq$9) included 232 patients, 68 with T-tube and 164 without, while the high-risk cohort (BAR score > 9) included 95 patients, 43 with T-tube and 52 without (Figure 1). The median follow-up of the study population was 56.5 months. Baseline recipients' demographic characteristics were similar in both cohorts (Tables 1 and 2). The intraoperative variables were comparable in both cohorts, except for the operative time, which was significantly longer in the T-tube group (low-risk cohort, BAR $\leq$ 9).

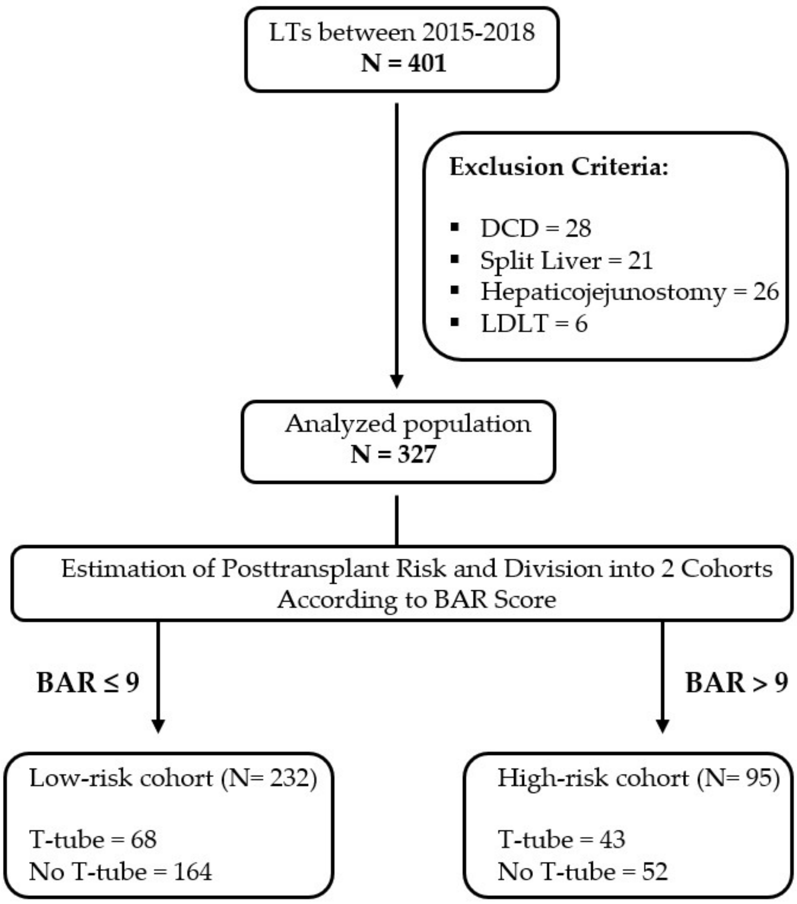

Figure 1. Flow chart of patient selection.

Table 1. Low-risk cohort (BAR ≤ 9): comparison of recipient variables and intra-operative data.

	T-Tube (N = 68)	No T-Tube (N = 164)	*p*
Age	57.3 (33–71)	56.4 (27–70)	0.34
Sex			
Male	51 (75%)	132 (80%)	0.35
Female	17 (25%)	32 (20%)	
Etiology			
HCC	33 (48.6%)	98 (59.8%)	
HCV	12 (17.7%)	13 (7.9%)	
ETOH	9 (13.3%)	26 (15.8%)	
NASH	2 (3%)	2 (1.2%)	0.27
PBC	1 (1.4%)	7 (4.3%)	
PLD	3 (4.4%)	6 (3.6%)	
HBV-HBV/HDV	4 (5.8%)	5 (3.1%)	
Other	4 (5.8%)	7 (4.3%)	
MELD	12.66 (6–25)	12.78 (6–25)	0.77
Operative time (mean, min)	477 (320–546)	430 (347–524)	0.003
CIT (mean, min)	488 (357–560)	467 (348–529)	0.062
Arterial anastomosis			
Termino-terminal	67 (98%)	159 (96%)	0.44
Supraceliac jump	1 (2%)	1 (0.6%)	
Infrarenal jump	0	4 (3.4%)	
Caval anastomosis			
Piggy-back	59 (86%)	150 (91%)	0.1
Standard	7 (10%)	10 (6%)	
Latero-lateral	2 (4%)	4 (3%)	

Table 2. High-risk cohort (BAR > 9): comparison of recipient variables and intra-operative data.

	T-Tube (N = 43)	No T-Tube (N = 52)	*p*
Etiology			
HCC	33 (48.6%)	98 (59.8%)	
HCV	12 (17.7%)	13 (7.9%)	
ETOH	9 (13.3%)	26 (15.8%)	
NASH	2 (3%)	2 (1.2%)	0.27
PBC	1 (1.7%)	7 (4.3%)	
POLYCYSTIC	3 (4.4%)	6 (3.6%)	
HBV-HBV/HDV	4 (5.8%)	5 (3.1%)	
Other	4 (5.8%)	7 (4.3%)	
Age	54.5 (32–70)	56.9 (38–69)	0.42
Sex			
Male	34 (80%)	40 (77%)	0.8
Female	9 (20%)	12 (23%)	
MELD	28.65 (16–41)	28.29 (15–39)	0.85
Operative time (mean, min)	466 (384–520)	419 (392–517)	0.06
CIT (mean, min)	508 (364–580)	492 (358–575)	0.24
Arterial anastomosis			
Termino-terminal	41 (95%)	50 (96%)	0.87
Supraceliac jump	0	0	
Infrarenal jump	2 (5%)	2 (4%)	
Caval anastomosis			
Piggy-back	37 (86%)	47 (90%)	0.49
Standard	3 (7%)	3 (5.7%)	
Latero-lateral	3 (7%)	2 (4.3%)	

3.2. *Biliary Complications*

3.2.1. Low-Risk Cohort

No differences in terms of BCs were observed in patients with or without T-tube (Table 3). The incidence of BL was 1.4% in the T-tube group and 2.4% in the no-T-tube group, while 2 (2.9%) patients in the T-tube group and 4 (2.4%) in the no-T-tube group experienced AS. No NAS were observed in the T-tube group, but 2 (1.2%) were detected in the no-T-tube group ($p = 0.36$). Two patients (2.9%) developed a BL at the T-tube site after tube removal.

Table 3. Low-risk cohort (BAR ≤ 9): comparison of biliary complications and T-tube-related complications.

	T-Tube (N = 68)	**No T-Tube (N = 164)**	***p***
Anastomotic complications			
Biliary leak	1 (1.4%)	4 (2.4%)	0.644
AS	2 (2.9%)	4 (2.4%)	0.826
Nonanastomotic complications			
NAS	0	2 (1.2%)	0.36
Biliary leak at T-tube site	2 (2.9%)	-	-

3.2.2. High-Risk Cohort

No BCs were observed in the T-tube group, but 4.4% of patients had a BL after T-tube removal. In the no T-tube group, 1 (1.9%) patient developed biliary leak, 3 (5.7%) patients had anastomotic strictures, and no NAS were detected (Table 4).

Table 4. High-risk cohort (BAR > 9): comparison of biliary complications and T-tube-related complications.

	T-Tube (N = 43)	**No T-Tube (N = 52)**	***p***
Anastomotic complications			
Biliary leak	0	1 (1.9%)	0.269
AS	0	3 (5.7%)	0.109
Nonanastomotic complications			
NAS	0	0	-
Biliary leak at T-tube site	3 (4.4%)	-	-

3.3. *Postoperative Outcome and Graft Survival*

3.3.1. Low-Risk Cohort

Postoperative complications were more frequent among patients with T-tube compared with those without T-tube, with a median CCI of 29 and 21, respectively ($p < 0.001$). The in-hospital stay was longer in the T-tube group (25 vs. 20 days, $p < 0.001$). Twenty-two patients (32%) developed EAD in the T-tube group and 20 (12.1%) in the no T-tube group ($p < 0.001$). No difference in terms of PNF, HAT, and 90-day mortality was found (Table 5). Overall graft survival was 75% for the T-tube group and 87% for the no T-tube group ($p = 0.11$), with a median follow-up of 56 months (IQR 30–72).

Table 5. Low-risk cohort (BAR ≤ 9): comparison of post-transplant outcomes.

	T-Tube (N = 68)	**No T-Tube (N = 164)**	***p***
EAD	22 (32%)	20 (12.1%)	<0.001
CCI	29	21	<0.001
LOS	25	20	<0.001
PNF	3 (4.4%)	3 (1.8%)	0.232
HAT	0	3 (1.8%)	0.265
In-hospital mortality	2 (2.9%)	5 (3%)	0.605
Graft survival	75%	87%	0.11

3.3.2. High-Risk Cohort

Postoperative complications and in-hospital stay were significantly higher in the T-tube group (CCI 51 vs. 29, $p < 0.001$; LOS 35 vs. 21 days, $p < 0.005$). The incidence of EAD was significantly higher among patients with T-tube (28% vs. 9.6%, $p = 0.02$). No difference was found in terms of PNF, HAT, and mortality (Table 6). Overall graft survival was 69% for the T-tube group and 89% for the no T-tube group ($p = 0.046$), with a median follow-up of 58 months (IQR 29–73) (Figure 2).

Table 6. High-risk cohort (BAR > 9): comparison of post-transplant outcomes.

	T-Tube (N = 43)	No T-Tube (N = 52)	*p*
EAD	12 (28%)	5 (9.6%)	<0.021
CCI	51	29	<0.001
LOS	35	21	<0.005
PNF	0	1 (1.9%)	0.27
HAT	0	3 (5.7%)	0.109
In-hospital mortality	4 (9%)	2 (3.8%)	0.27
Graft survival	69%	89%	0.046

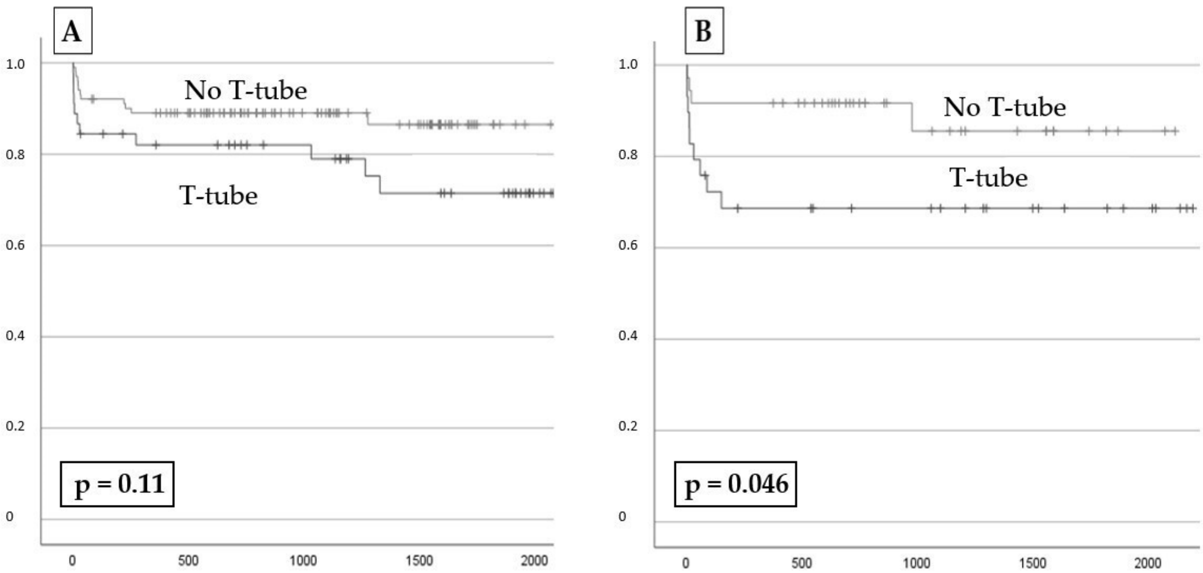

Figure 2. Graft survival: (**A**) low-risk cohort and (**B**) high-risk cohort.

4. Discussion

The use of the T-tube to prevent biliary complications after LT is still under debate. Lopez-Andujar et al., in a randomized clinical trial, found that BCs were less severe and required less aggressive treatment among patients with the T-tube. Moreover, while no difference in anastomotic BL was observed between groups, the incidence of ASs was significantly lower in the T-tube group. Therefore, the authors recommended using the T-tube in risky anastomoses, particularly in the case of duct caliber discrepancy [7]. On the other hand, a recent meta-analysis by Zhao et al. has shown no evidence supporting the systematical use of the T-tube in studies published in the last ten years, while its placement was associated with fewer biliary complications in studies before 2010 [9]. Interestingly, this meta-analysis suggested that, in this modern era, routine use of the T-tube might be anachronistic and should be reserved only for selective cases. Finally, two recent surveys have highlighted that there is still substantial heterogeneity among centers on the use of the T-tube, without shared and defined guidelines [12,17].

In Italy, T-tube placement is still a widespread practice. From the Italian survey, it emerged that 55% of centers selective use the T-tube, while 25% use it routinely [12].

The main criterium for its placement was the surgeon's decision, based on the technical complexity of the anastomosis, followed by a high donor (advanced age, pre-donation liver injury) or recipient risk (elevated MELD, prolonged cold ischemia time).

Therefore, to assess if this high-risk policy could be a reliable choice for the T-tube placement, we decided to analyze our LT population in different cohorts with different postoperative morbidity and survival, as defined by the BAR score. We used the BAR score as it is a widely accepted scoring system to predict outcomes after LT including both donor and recipient parameters. Dutkowski et al. have shown that a BAR score of >9 correlated with a linear increase of post-transplant morbidity. For this reason, we decided to use the same cut-off to stratify our initial population [18]. Theoretically, LTs of the high-risk cohort had a major risk of BCs, and the use of the T-tube should help reduce its incidence. To the best of our knowledge, there are no previous studies investigating the impact of T-tube placement in such cohorts.

We decided to exclude LTs from DCD as the current policy in our center is to always place the T-tube in such cases. Thus, the inclusion of such transplants might have represented a confounding factor.

Our results revealed that, in both cohorts, T-tube placement was not associated with a significant lowering of BCs. The fact that the postoperative course was longer in the T-tube group suggests that the T-tube could be a possible cause of discharge delay. Indeed, our data did not reveal a significant difference between the two groups, suggesting otherwise different conduct during decision-making for surgical strategy. These findings are particularly relevant, mainly in the high-risk cohort, as the T-tube has been suggested to help reduce BCs among these patients.

Another issue to be considered in decision-making is the possible occurrence of complications associated with the T-tube removal, such as BL at its insertion site, which has a reported incidence of 20–30% [19]. In our series, even if the incidence of BLs at the T-tube site was lower than reported in the literature, it was, however, higher than that of anastomotic BLs, and thus represented a not indifferent source of morbidity.

The main limitation of the current study is its retrospective nature, as no randomization was applied. Although discrepancies in the bile ducts' caliber, high-risk donors, or recipients were potential indications for placement of the T-tube, the final decision was based on the intraoperative surgeon's evaluation, which may constitute a bias. A further limitation is the possible concurrence of other factors in the development of postoperative biliary complications that were not considered in the BAR score model. Nevertheless, the surgical technique for biliary reconstruction is highly standardized in our unit, and LTs were performed by three senior surgeons with similar expertise. Finally, this is a single-center case series with a relatively restricted number of patients.

These possible biases restrain us from drawing any strong conclusion. Nevertheless, we do believe that these results should be considered in decision making, especially for high-risk transplants.

5. Conclusions

Our case series suggested that T-tube placement was ineffective in reducing BCs in both the high- and low-risk cohort. Besides, T-tube removal was associated with a certain incidence of BL.

Author Contributions: Conceptualization, N.I. and R.D.C.; formal analysis, N.I. and R.D.C.; data curation, N.I., L.C., L.P., G.C., A.F., V.B. and I.V.; writing—original draft preparation, N.I. and R.D.C.; writing—critical review and editing, A.L. and L.D.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study is in line with the Declaration of Helsinki. No formal ethical approval was necessary owing to the retrospective, observational, and anonymous nature of this study.

Informed Consent Statement: All the subjects involved in the study gave their explicit informed consent for data collection and publication.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy reasons.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Amador, A.; Charco, R.; Marti, J.; Ferrer, J.; Mans, E.; Fondevila, C.; Fuster, J.; Grande, L.; Visa, J.; Rimola, A.; et al. One thousand liver transplants: The hospital clinic experience. *Transplant. Proc.* **2005**, *37*, 3916–3918. [CrossRef] [PubMed]
2. López-Andújar, R.; Maupoey, J.; Escrig, J.; Granero, P.; Vila, J.; Ibáñez, J.M.; Boscá, A.; García-Eliz, M.; Benlloch, S.; Orbis, J.; et al. Selective indication of t-tube in liver transplantation: Prospective validation of the results of a randomized controlled trial. *Transplant. Proc.* **2019**, *51*, 44–49. [CrossRef] [PubMed]
3. Seehofer, D.; Eurich, D.; Veltzke-Schlieker, W.; Neuhaus, P. Biliary complications after liver transplantation: Old problems and new challenges. *Arab. Archaeol. Epigr.* **2013**, *13*, 253–265. [CrossRef] [PubMed]
4. Pirenne, J.; Monbaliu, D.; Van Gelder, F.; Van Hees, D.; Aerts, R.; Verslype, C.; Van Steenbergen, W.; Ferdinande, P.; Fevery, J.; Nevens, F.; et al. Liver transplantation using livers from septuagenarian and octogenarian donors: An underused strategy to reduce mortality on the waiting list. *Transplant. Proc.* **2005**, *37*, 1180–1181. [CrossRef] [PubMed]
5. Ferla, F.; De Carlis, R.; Mariani, A.; De Carlis, L. Liver transplant using octogenarian donors. *Liver Transplant.* **2016**, *22*, 1040–1041. [CrossRef] [PubMed]
6. Heidenhain, C.; Pratschke, J.; Puhl, G.; Neumann, U.; Pascher, A.; Veltzke-Schlieker, W.; Neuhaus, P. Incidence of and risk factors for ischemic-type biliary lesions following orthotopic liver transplantation. *Transpl. Int.* **2010**, *23*, 14–22. [CrossRef] [PubMed]
7. López-Andújar, R.; Orón, E.M.; Carregnato, A.F.; Suárez, F.V.; Herraiz, A.M.; Rodríguez, F.S.J.; Carbó, J.J.V.; Ibars, E.P.; Sos, J.E.; Suárez, A.R.; et al. T-tube or No T-tube in cadaveric orthotopic liver transplantation: The eternal dilemma results of a prospective and randomized clinical trial. *Ann. Surg.* **2013**, *258*, 21–29. [CrossRef] [PubMed]
8. Riediger, C.; Müller, M.W.; Michalski, C.W.; Hüser, N.; Schuster, T.; Kleeff, J.; Friess, H. T-tube or no T-tube in reconstruction of the biliary tract during orthotopic liver transplantation-systematic review and meta-analysis. *Liver Transplant.* **2010**, *16*, 705–717. [CrossRef] [PubMed]
9. Zhao, J.-Z.; Qiao, L.-L.; Du, Z.-Q.; Zhang, J.; Wang, M.-Z.; Wang, T.; Liu, W.-M.; Zhang, L.; Dong, J.; Wu, Z.; et al. T-tube vs no T-tube for biliary tract reconstruction in adult orthotopic liver transplantation: An updated systematic review and meta-analysis. *World J. Gastroenterol.* **2021**, *27*, 1507–1523. [CrossRef] [PubMed]
10. Bernardo, C.G.; Arrillaga, I.G.-P.; de León, A.M.; Rodrigo, V.C.; Dieguez, L.G.; Serra, L.B.; Velasco, L.V. T-tube Systematic Use in the Biliary Anastomosis: Comparison of Two Consecutive Series of Liver Transplantation. *Transplant. Proc.* **2016**, *48*, 3003–3005. [CrossRef] [PubMed]
11. Sun, N.; Zhang, J.; Li, X.; Zhang, C.; Zhou, X.; Zhang, C. Biliary tract reconstruction with or without T-tube in orthotopic liver transplantation: A systematic review and meta-analysis. *Expert Rev. Gastroenterol. Hepatol.* **2015**, *9*, 529–538. [CrossRef] [PubMed]
12. Pravisani, R.; De Simone, P.; Patrono, D.; Lauterio, A.; Cescon, M.; Gringeri, E.; Colledan, M.; Di Benedetto, F.; di Francesco, F.; Antonelli, B.; et al. An Italian survey on the use of T-tube in liver transplantation: Old habits die hard! *Updat. Surg.* **2021**, *73*, 1381–1389. [CrossRef] [PubMed]
13. Dutkowski, P.; Oberkofler, C.E.; Slankamenac, K.; Puhan, M.A.; Schadde, E.; Müllhaupt, B.; Geier, A.; Clavien, P.A. Are there better guidelines for allocation in liver transplantation? A novel score targeting justice and utility in the model for end-stage liver disease era. *Ann. Surg.* **2011**, *254*, 5. [CrossRef] [PubMed]
14. Slankamenac, K.; Graf, R.; Barkun, J.; Puhan, M.A.; Clavien, P.-A. The Comprehensive Complication Index: A novel continuous scale to measure surgical morbidity. *Ann. Surg.* **2013**, *258*, 1–7. [CrossRef] [PubMed]
15. Centonze, L.; Di Sandro, S.; Mangoni, I.; De Carlis, L. Biliary Reconstruction techniques: From biliary tumors to transplantation. In *Liver Transplantation and Hepatobiliary Surgery*; Springer: Cham, Switzerland, 2019; pp. 61–73. [CrossRef]
16. Olthoff, K.M.; Kulik, L.; Samstein, B.; Kaminski, M.; Abecassis, M.; Emond, J.; Shaked, A.; Christie, J. Validation of a current definition of early allograft dysfunction in liver transplant recipients and analysis of risk factors. *Liver Transplant.* **2010**, *16*, 943–949. [CrossRef] [PubMed]
17. Czigany, Z.; Scherer, M.N.; Pratschke, J.; Guba, M.; Nadalin, S.; Mehrabi, A.; Berlakovich, G.; Rogiers, X.; Pirenne, J.; Lerut, J.; et al. Technical aspects of orthotopic liver transplantation—A survey-based study within the Eurotransplant, Swisstransplant, Scandia-transplant, and British Transplantation society networks. *J. Gastrointest. Surg.* **2018**, *23*, 529–537. [CrossRef] [PubMed]
18. Dutkowski, P.; Schlegel, A.; Slankamenac, K.; Oberkofler, C.E.; Adam, R.; Burroughs, A.K.; Schadde, E.; Müllhaupt, B.; Clavien, P.-A. The use of fatty liver grafts in modern allocation systems: Risk assessment by the balance of risk (BAR) score. *Ann. Surg.* **2012**, *256*, 861–869. [CrossRef]
19. Wang, S.-H.; Lin, P.-Y.; Wang, J.-Y.; Lin, H.-C.; Hsieh, C.-E.; Chen, Y.-L. Predictors of Biliary Leakage After T-Tube Removal in Living Donor Liver Transplantation Recipients. *Transplant. Proc.* **2015**, *47*, 2488–2492. [CrossRef]