Optimizing Value-Conscious Care: Insight from a Pediatric Sedation Clinic

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Introduction

Pediatric ultrasound-guided percutaneous liver biopsy is a common procedure to diagnose liver pathology in children. It is safe, effective, has a high diagnostic yield, and a low complication rate. Due to its invasive nature, pain management and sedation methods are used.

The minimal invasiveness of liver biopsy allows the procedure to be performed with lower levels of sedation in appropriately selected pediatric patients. In 2021, the University of Wisconsin's Department of Radiology launched a dedicated Pediatric Interventional Radiology (IR) program, including sedation in a specialized pediatric clinic as well as general anesthesia in the operating room (OR) or hybrid OR. The sedation clinic includes rooms for minimally invasive procedures done bedside with non-operating room anesthesia (NORA).

This study retrospectively compares sedation methods used for pediatric ultrasound-guided liver biopsy and analyzes the direct costs of procedures performed in the OR/hybrid OR versus the sedation clinic.

Methods

A single-center retrospective review of 111 procedures performed by a board-certified interventional radiologist from June 2021 to April 2024 was conducted. Exclusion criteria included cases without timestamps (N=3) and those with multiple procedures (N=19). All procedures were technically successful, with 5% resulting in grade I complications (Clavien-Dindo scale).

Cost analysis used the time driven activity based costing (TDABC) method, mapping procedure components, tracking time, and applying a cost capacity rate (CCR) to calculate direct staff and room costs related to biopsies and complications, excluding indirect costs.

Data was analyzed using SPSS with propensity score matching (PSM) to reduce selection bias (Table 1). Logistic regression estimated propensity scores based on age, gender, ASA status, and inpatient status. Matched samples were compared using paired t-tests (Table 2). Limitations include potential unmeasured confounders, matching method choices, and reduced sample size due to matching without replacement.

Results

Among matched procedures, inpatient status, sex, weight, BMI, age, and ASA status were not statistically significant, indicating successful PSM. Post-procedure environment was statistically significant (p=0.01) with the majority of sedation clinic procedure patients remaining in the sedation clinic for recovery (72.4%) followed by the Floor (17.2%) and the IR campground (10.3%). The majority of OR procedure patients recovered in the IR campground (79.3%) followed by the PACU (17.2%), and an OR adjacent area (3.4%). In the OR group, total encounter time (255.38 ± 95.87, p<0.01), preop (111.96 ± 62.11, p<0.001), and procedure time (21.76 ± 18.22, p=0.03) were all higher and significantly significant. Average postop times were also greater in the OR group, but were not statistically significant (125.52 ± 74.00, p=0.20). Total costs were higher in the OR (2801.36 ± 1201.52, p<0.001), as well as total preop costs (537.27 ± 339.26 p<0.001), total procedure costs (2617.08 ± 1367.80, <0.001), and total postop costs (790.56 ± 555.96, p=0.02), and all were statistically significant. Total room costs were higher in the OR (2217.79 ± 1143.69, p<0.001), as well as preop room costs (462.68 ± 292.16, p<0.01), procedure room costs (1051.16 ± 880.50, <0.001), and postop room costs (703.95 ± 557.46, p=0.03), and all were statistically significant. Total staff costs were higher in the OR (583.56 ± 230.31, p<0.001), as well as preop staff costs (74.59 ± 47.10, p<0.001) and both were statistically significant. Procedure staff costs were higher in the OR, but were not statistically significant (399.28 ± 134.79, p=0.17). Postop staff costs were slightly higher in the sedation clinic, but were not statistically significant (87.32 ± 59.27, p=0.96) (Table 3).

Table 1: Demographics After Propensity Score Matching

Sample Characteristics	Matched Comparison		
	Peds Sedate	Hybrid OR/OR	p-Value
Procedures	29	29	
Inpatient	9	6	0.2785
Sex (female)	17	13	0.3476
Weight (lbs, avg)	127.28 ± 59.57	143.74 ± 79.90	0.3778
BMI (avg)	24.40 ± 7.21	25.92 ± 9.10	0.4843
Age (avg; range) (years)	12.21 ± 4.47; 2.08-18	12.84 ± 5.34; 0.42-18	0.6300
ASA			0.1281
1	0	1	
2	26	20	
3	3	8	
4	0	0	
Complication Grade			
I	1	2	0.28
II	0	0	
III	0	0	
IV	0	0	
V	0	0	
Post-procedure Environment			**0.01**
Sedation Clinic	21	0	
IR Campground*	3	23	
PACU	0	5	
OR Adjacent	0	1	
Floor	5	0	

Table 2: Matched Patient Outcomes, Procedural Times, and Costs

Procedural Data	Matched Comparison		
	Peds Sedate	Hybrid OR/OR	p-Value
Procedures	29	29	
Technical Success	29	29	
Complications	0	0	
Total Time (min)	177.41 ± 79.50	255.38 ± 95.87	**<0.01**
Preop	62.11 ± 42.25	111.96 ± 62.11	**<0.001**
Procedure	14.07 ± 4.99	21.76 ± 18.22	**0.03**
Postop	103.38 ± 48.89	125.52 ± 74.00	0.20
Total Overall Cost	1089.51 ± 384.34	2801.36 ± 1201.52	**<0.001**
Preop	302.41 ± 195.56	537.27 ± 339.26	**<0.01**
Procedure	1041.89 ± 383.96	2617.08 ± 1367.80	**<0.001**
Postop	502.83 ± 216.86	790.56 ± 555.96	**0.02**
Total Room Cost	732.38 ± 347.66	2217.79 ± 1143.69	**<0.001**
Preop	256.65 ± 184.30	462.68 ± 292.16	**<0.01**
Procedure	60.22 ± 21.37	1051.16 ± 880.50	**<0.001**
Postop	415.51 ± 217.36	703.95 ± 557.46	**0.03**
Total Staff Cost	357.13 ± 130.24	583.56 ± 230.31	**<0.001**
Preop	45.74 ± 25.98	74.59 ± 47.10	**<0.01**
Procedure	309.51 ± 134.79	399.28 ± 134.79	0.17
Postop	87.32 ± 59.27	86.60 ± 51.05	0.96

Conclusions

Using a TDABC analysis method provides a more precise way of analyzing the labor costs of healthcare procedures through using a methodical accounting approach, accounting for all provider and worker costs. Cost analyses along with patient outcomes and preferences will allow providers as well as patients and their families to determine the relative value of different healthcare options.

The reduced average total, preop, procedure, and postop times seen in the sedation clinic group could be due partly to the specificity of the dedicated sedation clinic, and providers who routinely practice this procedure in this space. Other factors such as NORA sedation methods and induction could play a role in shorter average times in the sedation clinic. This study shows that pediatric liver biopsies performed in a dedicated sedation clinic have the same technical success and complication rate, but lower overall costs associated with the procedure, even when controlling for various confounders.

Overall, the significantly lower average liver biopsy cost in sedation clinic procedures that was observed in this study highlights a dedicated sedation clinic as a safe and cost-effective location to perform liver biopsies. This is particularly relevant as NORA, including in a sedation clinic, is becoming more commonplace in medicine. However, it is important to note that each location has its place and role in pediatric liver biopsy, and individual patient needs should be considered when deciding on procedure location. Further research is needed to confirm the relative cost-effectiveness and potential benefits of performing pediatric liver biopsies in different locations.

- Pediatric liver biopsies performed in a dedicated sedation clinic have the same technical success and complication rate, but lower overall costs
- A dedicated sedation clinic is a safe and cost-effective location to perform pediatric liver biopsies
- Each location has its place and role in pediatric liver biopsy, and individual patient needs should be considered when deciding on procedure location