

The clinical and cost utility of cardiac catheterizations in bronchopulmonary dysplasia

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Introduction:

Pulmonary hypertension affects a significant number of premature and low-birth weight infants, and it is associated with increased morbidity and mortality. The standard of care currently recommends cardiac catheterization prior to initiation of pulmonary vasodilator therapies, including enteral sildenafil. This analysis sought to evaluate the cost-utility of catheterization-obligate treatment in pulmonary hypertension (PH), as compared to empiric initiation of sildenafil based on echocardiographic findings alone in preterm infants with bronchopulmonary dysplasia (BPD).

Methods:

A Markov-state transition model was constructed to simulate the clinical scenario of a preterm infant with echocardiographic evidence of PH associated with BPD (BPD-PH) and without congenital heart disease under consideration for the initiation of pulmonary vasodilator therapy via one of two modeled treatment strategies: (1) empiric or (2) catheterization-obligate. Transitional probabilities, costs and utilities were extracted from the literature. Forecast quality-adjusted life years (QALY) was the metric for strategy effectiveness. Sensitivity analyses for each variable were performed. A 1,000-patient Monte Carlo microsimulation was used to test the durability of our findings.

Results:

The catheterization-obligate strategy resulted in an increased cost of \$10,778 and 0.02 fewer QALY compared to the empiric treatment strategy.

Table I: Cost-utility analysis results.

Paradigm	Cost (SUSD)	Effectiveness (OALYs)	Incremental Cost	
Cath Obligate	\$825,125	40.01	\$10,778	
Empiric Treatment	\$816,357	40.03		

Empiric treatment remained the more cost-effective paradigm across all scenarios modeled through one-way sensitivity analyses and the Monte Carlo microsimulation (costeffective in 98% of cases).

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Results (cont.):

In varying the mortality of cardiac catheterization, the catheterization-obligate paradigm does become less costly than the empiric strategy when the probability of a catheterization-related mortality exceeds 2.9%, though remains less cost effective. A three-way sensitivity analysis varying the prevalence and clinical significance of "alternative diagnoses" when starting empiric sildenafil did not alter our findings.

Table II: Model assumptions and one-way sensitivity analyses range and results.

Costs	LIS dollars	One-way sensitivity	One-way sensitivity
	US dollars	range min	range max
Week in NICU	\$29,860	\$14,930	\$44,790
Week of sildenafil	\$17.18	\$9	\$10,000
Echocardiogram	\$736	\$368	\$1,104
Cardiac cath	\$27,115	\$13,557	\$40,672
Cath minor complication	\$12,744	\$6,372	\$19,116
Cath major nonlethal complication	\$38,737	\$19,369	\$58,106
Utilities	Utility	One-way sensitivity	One-way
NICLI bospitalization with BPD	0.71		
Sildenafil minor complication	_0.07	0.5	
Sildenafil complication with prohibitive diagnosis	-0.07	0	- <u> </u>
Cath minor complication	-0.07	0	- <u>1</u>
Cath major popletbal complication	-0.07	0	-1
	-0.15	0	-1
Times	Time	One-way sensitivity	One-way sensitivity
	CCA 26 weeks	range min	range max
Average age at entrance to model	CGA 36 WEEKS		14
Additional length of stay due to sildenafil complication with prohibitive diagnosis	3 days	0	14 days
Probabilities	Weekly transitional probability	One-way sensitivity	One-way sensitivity
	0.20	range min	range max
PH WITH BPD	0.010	0.001	0.5
New PH diagnosis after negative screen at CGA 36 weeks	0.018	0.001	1
Sensitivity of echo for identifying IWU>3*	0.917	0.5	0.99
specificity of echo for identifying IWU>3*	1	0.5	0.99
Sildenafil minor complication	0.44	0.01	0.5
Probability of a prohibitive diagnosis absent on echo being present on cath	0.00		
LV diastolic dysfunction	0.26		
Pulmonary vein stenosis	0.26		
Aortopulmonary collaterals	0.35		
Probability of prohibitive diagnosis resulting in significant harm when exposed to silden	atil		
LV diastolic dysfunction	0.41		
Pulmonary vein stenosis	0		
Aortopulmonary collaterals	0		
Cumulative probability of a prohibitive diagnosis being present and resulting in harm w	hen exposed to sildenafil		
LV diastolic dysfunction	0.11	0.01	0.5
Pulmonary vein stenosis	0	0.01	0.5
Aortopulmonary collaterals	0	0.01	0.5
Cath minor complication	0.06	0.01	0.25
Cath major non-lethal complication	0.01	0.001	0.25
Cath mortality	0.004	0.001	0.5
NICU discharge with mild BPD	0.14	0.001	0.1
NICU discharge with severe BPD	0.04	0.001	0.1
NICU death with mild BPD	0.0063	0.001	0.5
NICU death with severe BPD	0.0095	0.001	0.5
		O	O
Absorbing State Variables	Cost or QALY	range min	range max
Lifetime, severe BPD			
Cost	\$851,548	\$550,000	\$1,748,000
QALY	20.1	0	75
Lifetime, mild BPD			
Cost	\$503.047	\$298,000	\$960,000
COST	+=====	<i>4230,000</i>	<i>4366)666</i>

Results (cont.):

14000 -
12000 -
10000 -
8000 -
6000 -
4000 -
2000 -
0 -
-2000 -
-4000 -
-6000 -
-8000 -
-10000 -
-12000 -
-14000 -

Conclusion:

Empiric treatment with sildenafil in infants with BPD-PH is a superior strategy with both decreased costs and increased effectiveness when compared to catheterization-obligate treatment. These findings suggest that foregoing catheterization prior to initiation of sildenafil in "straight-forward" BPD-PH may be warranted.

