Sugammadex versus Neostigmine: Operating Room Time and Cost

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Background

The choice of neuromuscular blockade reversal agents impacts cost and operating room time. Currently, the two medications used to reverse neuromuscular blockade are Neostigmine and Sugammadex. These medications differ in both cost and pharmacologic profiles which effect the time and predictability of reversal (Carron, Zarantonello, Tellaroli, & Ori, 2016). Evaluating cost and time differences in reversal using Sugammadex and Neostigmine helps anesthesia providers select the appropriate medication. This evidence based practice project examined the difference in case length and operating room and reversal agent costs in cases using Sugammadex and Neostigmine at Providence Sacred Heart Medical Center.

Methods

- Retrospective, observational, evidence-based practice project
- Facility approved and IRB exemption determination granted
- Extracted case data deidentified and securely extracted into a HIPPA compliant REDCap database
- 11,944 cases evaluated from January 1, 2015 to December 31, 2018
- Inclusion criteria: ASA rating I, II, III; age <70; BMI <40; no diagnosed reduced pulmonary reserve conditions; no diagnosed pre-existing neuromuscular disease
- Cases removed: Surgical case duration not calculated; Neostigmine units <1 mg; Neostigmine units >5 mg; Sugammadex units >1000 mg; Sugammadex units <50 mg; Neither Neostigmine and Sugammadex used; Neostigmine and Sugammadex both used; Neostigmine given without Glycopyrrolate; Surgical procedures labeled '50'
- Analytical plan: Categorical variables described by frequency distributions; skewed continuous variables described by median and inter-quartile range. Average medication costs, operating rooms minutes, and estimated operating room costs/case reported by reversal agent.
- Simulation: Total operating room and reversal agent costs were projected using an estimated operating room rate. Sensitivity analysis was completed in which the estimated operating room rate was varied.

Findings

Table 1: Baseline Demographic and Clinical Characteristics (N=11,944)

		n	%
Gender	Male	4564	38%
	Female	7380	62%
ASA Rating	I	1308	11%
	II	7497	63%
	III	3139	26%
Kidney Disease		385	3%
Smokers		4588	38%
Surgical Service Line	General	2347	20%
	Orthopedic	1935	16%
	Neurosurgery	1646	14%
	Gynecology	1345	11%
	Obstetrics	1308	11%
	Urology	839	7%
	Plastics	624	5%
	ENT	373	3%
	Vascular	356	3%
	Gynecology Oncology	247	2%
	Cardiology	206	2%
	Other Procedures*	718	1%
Surgical Procedure in 2015		2679	22%
Surgical Procedure in 2016		2846	24%
Surgical Procedure in 2017		3148	26%
Surgical Procedure in 2018		3271	27%
		Median	**IQR**
Duration of Surgery (min)		126	92-175

*Other procedures with <1% include: Interventional radiology, cardiothoracic, gastroenterology, dental, ophthalmology, pulmonary, oral surgery, maxillofacial, cardiovascular, robotic, oncology, medical, pain, podiatry

Table 2: Neuromuscular Blockade Reversal Agent Cost Analysis (N=11,944)

Metric	Sugammadex (n=7,199)	Neostigmine & Glycopyrrolate (n=4,745)
Average Reversal Agent Medication Cost/Case*	$99.13	$32.55
Average Operating Room Minutes/Case**	150 minutes	153 minutes
Estimated Operating Room Cost/Case***	$14,623	$14,901
Projected Cost of Each Reversal Agent Used Exclusively Over Four Years	$174,662,835	$177,981,292

* Using Providence Sacred Heart Medical Center contracted medication prices
** Total surgical case duration
*** Using Providence Sacred Heart Medical Center operating room cost per minute of $97

Findings (cont.)

The choice of Sugammadex over Neostigmine as a neuromuscular blockade reversal agent resulted in lower operating room and reversal agent costs in simulated analyses in which the operating room cost per minute was varied.

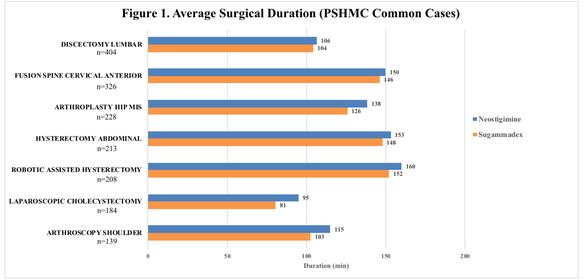
Table 3. Operating Room Cost Per Minute Sensitivity Analysis

OR Cost/Min	Sugammadex	Neostigmine	Amount Saved Using Sugammadex
$30	$54,837,286	$55,314,321	$477,035
$40	$72,721,696	$73,622,824	$901,128
$50	$90,606,107	$91,931,327	$1,325,220
$60	$108,490,517	$110,239,830	$1,749,313
$70	$126,374,927	$128,548,334	$2,173,407
$80	$144,259,338	$146,856,837	$2,597,499
$90	$162,143,748	$165,165,340	$3,021,592
$100	$180,028,159	$183,473,843	$3,445,684
$110	$197,912,569	$201,782,347	$3,869,778

* Cost if one reversal agent was used exclusively across all cases for the past four years. Cost savings generated using average total cost per case (case duration, operating room cost per minute and medication cost)

Average surgical duration (minutes) differed by choice of reversal agent used.

Figure 1. Average Surgical Duration (PSHMC Common Cases)



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Discussion

Operating room (OR) time and cost of neuromuscular blockade reversal agents were compared among cases in which either reversal agent could be used. The average reversal agent cost per case using Sugammadex was $99.13 compared to cases using Neostigmine/Glycopyrrolate at $32.55 per case. A side by side comparison between Sugammadex and Neostigmine for like surgeries found that Sugammadex shortened surgical case duration for most procedures. Across all project cases the average surgical case duration for cases reversed using Sugammadex was 150 minutes (estimated operating room costs $14,623 per case). Neostigmine reversed cases averaged 153 minutes for surgical case duration (estimated operating rooms costs $14,901 per case).

In simulated models, exclusive use of Sugammadex across all cases for the past four years would have resulted in cost savings across a range of estimated OR costs per minute. The findings of this observational project showed an average of about three minutes were saved in OR time when using Sugammadex versus Neostigmine. Surgical case duration is complex and multi-factorial. The results of this observational project signal a difference in OR time and agent costs as the result of reversal agent choice. Further randomized investigations are warranted.

References

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