THE TREND, OUTCOMES, AND RESOURCES UTILIZATION OF SURGICAL STAPLERS USED IN PATIENTS TREATED WITH ROBOTIC GASTRIC SLEEVE PROCEDURES

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INTRODUCTION

Few studies have shown the feasibility of using laparoscopic endoscopic staplers in robotic procedures. [1,2] One study also showed the effectiveness of bedside staplers in bariatric robotic procedures. [3]

This study aims to report trends and evaluate the effectiveness (outcomes) and efficiency (resource utilization (RU)) by types of staplers in robotic gastric sleeve (RGS) procedures.

METHODS

Data Sources: PINC AI™ Healthcare Data 2018-2022

Study population: Patients who underwent primary gastric sleeve with robotic system used either bedside staplers (**BS**, Medtronic Signia™,Endo-GIA™, Tri-staple™) or robotic staplers (**RS**, Intuitive Sureform™ stapler. Inclusions: elective procedures with non-zero costs.

CPT and ICD 10 diagnosis and procedure codes were used to identify procedures, comorbidities, and complications. In addition, the ICD 10 procedure and hospital charge file were used to identify robotic surgery and the type of staplers. All costs were converted to 2022 USD according to the consumer price index for hospital services.

We used the Structure-Process-Outcome Quality Framework to conduct the study. [4]

Figure 1 Structure-Process-Outcome Quality Framework

Statistical Analyses

Univariate and bivariate analysis: Chi-square or Fisher exact test, and t-test or ANOVA for reporting baseline characteristics and evaluating the bivariate association between covariates and outcomes.

Multivariable analyses: Multivariable general linear mixed models (GLMMs) with respective gamma or binomial distribution and log-link function were used to obtain adjusted outcomes variations between BS and RS.

Sensitivity analysis was done using propensity score matching methods with caliper 0.2, 1 to 1 matched without replacement [5]

Statistical software: All analyses were conducted using SAS 9.4 and Stata 18.0 using 2-sided statistical tests.

RESULTS

Trend: 2018-2022

Robotic staplers were rapidly adopted in RGS. The adoption rate is from 4.1% to 72.5% of total RGS in 2018 and 2022, respectively. (Figure 2)

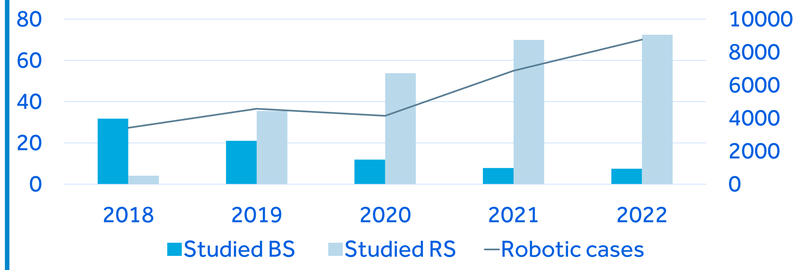
Patients and provide characteristics:

The baseline was significantly different between the two types of staplers (Table 1)

Clinical outcomes and resources utilization

BS patients were **less** likely to have a **blood transfusion**, had lower costs(**$3,084 less**) and OR time (**21 minutest less**) than RS patients, who had slightly more LOS. (Table 2)

Figure 2: Types of staplers adoption rates by year



DISCUSSION

A study using 2021 data showed similar results for bedside staplers used in robotic bariatric procedures.[3] Our study using multiple years of data further confirmed that using BS results in lower blood transfusion rates, costs, and OR time than RS, albeit with slightly longer stays in patients who received RGS, a purely stapling procedure. This discovery could shift the perspective on the resource utilization benefits of BS. The PINC AI™ was used to evaluate this, as each stapling company's product could be individually assessed, but staple height and staple line reinforcement could not be accurately accounted for. Therefore, the outcomes were unable to account for these factors.

CONCLUSIONS

Robotic staplers have quickly been adopted in RGS but are significantly costly, less effective, and less efficient. Bedside staplers, a cost-saving, more efficient stapler use, could be considered in the resource-limited healthcare environment.

Table 1: Baseline variations

Total	Description	BS No.	BS %	RS No.	RS %	Sig
	N = 18892	3740	19.80	15152	80.20	
Comorbidities	0-2	3447	92.17	14232	93.93	*
	3+	293	7.83	920	6.07	
APR severity	Minor	2444	65.35	12416	81.94	*
	Moderate to Severe	1296	34.65	2736	18.06	
Provider region	Northeast	635	16.98	5869	38.73	*
	Midwest	489	13.07	2086	13.77	
	South	1795	47.99	5856	38.65	
	West	821	21.95	1341	8.85	
Provider bed size	<300 beds	1349	36.07	6892	45.49	*
	300-499 beds	301	8.05	3885	25.64	
	>= 500 beds	2090	55.88	4375	28.87	
Provider teach status	Yes	1628	43.53	9085	59.96	*

*p<0.001

Table 2: Adjusted clinical outcomes and resource utilization

Reference BS	Main GLMMs model		Sensitivity analysis	
Clinical Outcomes	Odds (95%CI)	P-value	Odds (95%CI)	P-value
Blood transfusion	1.55(1.02, 2.36)	0.04	3.02(1.35, 6.73)	0.007
Bleeding	0.72(0.52, 1.01)	0.06	1.24(0.82, 1.86)	0.30
Anastomotic Leak	2.25(0.86, 5.93)	0.10	1.33(0.30, 5.97)	0.74
ICU visit	1.81(1.00, 3.29)	0.05	2.01(0.86, 4.70)	0.11
Resources Utilization	Diff(95%CI)	P-value	Diff(95%CI)	P-value
Total Costs (USD)	$3084 ($2860,$3309)	<0.001	$2820 ($2494, $3146)	<0.001
OR time (MIN)	21.1(18.6,23.5)	<0.001	14.0(10.3, 17.6)	<0.001
LOS(DAY)	-0.15(-0.21, -0.10)	<0.001	-0.1(-0.16, -0.04)	<0.001

*Odds: odds ratios; RS: Robotic stapler; BS: Bedside staple, DIFF: difference = RS-BS, CI: confidence interval, OR: operating room

See supplemental material for references

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