Biliary self-expandable metal stents do not adversely affect pancreaticoduodenectomy

Lianne K. Cavell, M.D.[1], **Peter J. Allen, M.D.**[2], **Cjloe Vinoya**[1], **Anne A. Eaton, M.S.**[3], **Mithat Gonen, Ph.D.**[3], **Hans Gerdes, M.D.**[1], **Robin B. Mendelsohn, M.D.**[1], **Michael I. D'Angelica, M.D.**[2], **T. Peter Kingham, M.D.**[2], **Yuman Fong, M.D.**[2], **Ronald DeMatteo, M.D.**[2], **William R. Jarnagin, M.D.**[2], **Robert C. Kurtz, M.D.**[1], and **Mark A. Schattner, M.D.**[1]

[1] Gastroenterology and Nutrition Service, Department of Medicine, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

[2] Department of Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

[3] Department of Epidemiology and Biostatistics, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

Abstract

Corresponding Author: Lianne K. Cavell, M.D. Gastroenterology and Nutrition Service, Department of Medicine Memorial Sloan-Kettering Cancer Center 1275 York Avenue New York, NY 10021 cavelll@mskcc.org Tel: 212-639-8286 Mobile: 646-369-9882 Fax: 212-639-2766.

Objectives—Controversy exists regarding whether to place a plastic or metal endobiliary stent in patients with resectable pancreatic cancer who require biliary drainage. Although self-expandable metal stents (SEMS) provide better drainage compared to plastic stents, concerns remain that SEMS may compromise resection and increase postoperative complications. Our objective was to compare surgical outcomes of patients undergoing pancreaticoduodenectomy (PD) with SEMS in place versus plastic endoscopic stents (PES) and no stents (NS).

Methods—We performed a retrospective analysis from a prospective database of all patients undergoing either attempted or successful PD with SEMS, PES, or NS in place at the time of operation. Patients were compared with regards to perioperative complications, margin status, and the rate of intraoperative determination of unresectability.

Results—593 patients underwent attempted PD. 84 patients were locally unresectable intraoperatively and 509 underwent successful PD, of which 71 had SEMS, 149 had PES, and 289 had NS. Among patients who had a preoperative stent, SEMS did not increase overall or serious postoperative complications, 30 day mortality, length of stay, biliary anastomotic leak, or positive margin, but was associated with more wound infections and longer operative times. In those with adenocarcinoma, intraoperative determination of local unresectability was similar in the SEMS group compared to other groups, with 16 (19.3%) in SEMS, compared to 29 (17.7%) in PES (p = 0.862), and 31 (17.5%) in NS (p = 0.732).

Conclusion—Placement of SEMS is not contraindicated in patients with resectable pancreatic cancer who require preoperative biliary drainage.

Introduction

Biliary obstruction is a frequent problem in patients with pancreatic cancer awaiting pancreaticoduodenectomy (PD). A recent well publicized study showed that routine biliary drainage prior to PD is not indicated and associated with increased complications. [1] However, if the bilirubin is markedly elevated, the patient is symptomatic, or surgery needs to be delayed to optimize medical comorbidities or to administer neoadjuvant therapy, preoperative biliary drainage may still be required.

In patients with unresectable pancreatic cancer, SEMS have become the preferred method of biliary drainage as they provide more durable patency, lower incidence of cholangitis, and are cost effective when compared to PES.[2-4] However, in patients awaiting PD, traditional practice has been to place a PES due to concerns that SEMS may interfere with resection resulting in more operative complications and compromise of clear surgical margins (R0 resection). With recent studies showing promising outcomes with the use of neoadjuvant therapy, delay in PD for neoadjuvant treatment is becoming more common. [5] PES may not provide adequate patency in patients receiving neoadjuvant therapy, resulting in interruptions of treatments and further delay of surgery. [6] Routine use of PES in patients awaiting PD has recently been challenged, and several small studies have shown that SEMS do not result in increased operative and postoperative complications. [7-11] The aim of our study was to compare surgical outcomes of a large group of patients undergoing attempted PD with SEMS in place versus plastic endoscopic stents (PES) and no stents (NS).

Methods

We retrospectively reviewed a prospectively maintained database which included all patients who underwent attempted or successful PD at Memorial Sloan-Kettering Cancer Center between March of 2008 and July of 2011. From this database, we extracted patient demographics, presence of a biliary stent at the time of surgery, operative details, peri-operative complications, and pathology including tumor characteristics and margin status. Each peri-operative complication was graded on a previously validated severity scale from 1 to 5 as described in Table 1. [12] Patients were included if they were 18 years or older and underwent successful PD, or deemed locally unresectable intraoperatively. Excluded were those with percutaneous biliary drainage and those deemed unresectable intraoperatively due to metastatic disease.

Electronic medical records were reviewed to determine the type of biliary stent in place at the time of operation and to assess comorbidities. The overall level of comorbid diseases was determined by the documented pre-operative ASA (American Society of Anesthesiologists) physical status classification. In those that were deemed unresectable at the time of surgery, medical records were reviewed to determine the cause.

All operations were performed by an experienced pancreatic surgeon on faculty at Memorial Sloan-Kettering Cancer Center. Preoperatively, each case and pertinent radiology were reviewed at a multi-disciplinary conference to determine resectability. All final pathology was reviewed and confirmed. This study was approved by the Institutional Review Board at Memorial Sloan-Kettering Cancer Center.

Variables were summarized for each stent type group using median and range for continuous variables and frequency and percent for categorical covariates. Differences across the three stent types groups (SEMS, PES, and NS) and between the SEMS and PES groups were assessed using Fisher's exact test (for categorical covariates) and ANOVA (for continuous covariates). Length of stay and estimated blood loss were log-transformed for the ANOVA to increase normality and two patients with estimated blood loss of 0 ml were assigned to 10 ml to allow transformation. A sensitivity analysis was performed using the Kruskal-Wallis test on un-transformed EBL values and results were similar. Unresectability rates were summarized for the three stent type groups and Fisher's exact test was used to compare the unresectability rate in the SEMS group to the rate in each of the other groups.

Multivariate logistic regression models were used to assess the effect of stent type on complications, serious complications, and R0 resection after adjusting for other important covariates. Within the subset of patients with adenocarcinoma, a multivariate regression model adjusted for age, ASA class and neoadjuvant chemotherapy was used to assess the association between stent type and unresectability.

Results

A total of 593 patients who underwent either successful or attempted PD were identified and reviewed. Eighty four were deemed unresectable intraoperatively and 509 underwent

successful PD. Among the 509 who had successful PD, 71 patients had SEMS, 149 had PES, and 289 had NS.

Demographic data including age, gender, ASA class, diagnosis of adenocarcinoma, and use of neoadjuvant therapy in those who had undergone PD are listed in Table 2. There were no statistically significant differences in gender between the three groups. The preoperative ASA class was higher, class 3 or 4, in the SEMS group compared to the PES group (p=0.029). Patients with either SEMS or PES tended to be older than the NS group (p=0.038). Sixty seven (94.4%) of the SEMS group had adenocarcinoma, compared to 145 (50.2%) of those in the NS group (p<0.001). There was no statistically significant difference the in rate of adenocarcinoma between the SEMS and PES groups (94.4% in SEMS group versus 90.6% in PES group, P = 0.436). The pathology of those without adenocarcinoma primarily included other neoplasms including carcinoid, neuroendocrine tumors, sarcoma, IPMN and benign findings such as cystic disease and pancreatitis. Among patients with adenocarcinoma, twenty three (34.3%) of the SEMS group received neoadjuvant therapy, compared to 10 (7.4%) of the PES group, and 14 (9.7%) of the NS group (p<0.001).

Comparisons of operative and perioperative outcomes including length of stay, operative duration, estimated blood loss, any complication, serious (grade 3 or higher) complication, biliary anastomotic leak, pancreatic anastomotic leak, wound infection, 30 day mortality, and positive margin on pathology are listed in Table 3. No differences were found between all 3 groups in regards to length of stay, overall complications, and serious (grade 3 or higher) complications. A positive margin based on final pathology occurred in 6 (8.5%) of the SEMS group, 24 (16.3%) of the PES group, and 29 (10.2%) of the NS group (p = 0.129). Post-operative wound infection rates differed by stent type (p<0.001) with infection occurring in 22 (31.0%) in the SEMS group, compared to 19 (12.8%) in the PES group (SEMS vs PES p = 0.003), and 18 (6.2%) in the NS group. There was a small yet statistically significant difference in operative times between the SEMS group (median 279 min) compared to the PES group (median 253 min, p=0.03). Median operative time was 241 min in the NS group, and the difference across the three groups was significant (p <0.001). Additionally, there was a small increase in estimated blood loss in the SEMS and PES groups compared to the NS group (median loss of 500cc in both the SEMS and PES groups versus 400cc in the NS group (p = 0.028).

Of the SEMS, all except one case were 10mm diameter. Twenty five were covered, 44 were uncovered, and 2 cases were missing data. There were no differences in complications, which occurred in 15 (60%) with covered stents compared to 29 (66%) with uncovered stents (p=0.794), and no difference in serious (grade 3 or higher) complications which occurred in 3 (12%) with covered stents vs 9 (20%) in uncovered stents (p=0.515). In regards to stent length, 20 were 40mm in length, 47 were 60mm in length, 2 were 80mm in length, and 4 cases were missing this data. Again, there were no differences in regards to overall complications between the three groups, which occurred in 13 (65%) of the 40mm length stents, 30 (64%) or the 60mm stents, and 1 (50%) of the 80mm stents (p=1.00). Additionally, there were no differences in serious (grade 3 or higher) complications which occurred in 3 (15%) of the 40mm length, 9 (19%) of the 60mm length, and 0 in the 80mm length (p=1.00).

Table 4 shows the rates of local unresectability by stent type. Of the 84 patients who were deemed locally unresectable intraoperatively, 17 had SEMS in place at the time of surgery, 32 had PES, and 35 had NS. The rate of an intraoperative finding of locally unresectable disease was greater in the SEMS group (19.3%) compared to the NS group (10.8%, p=0.045), but similar compared to the PES group (17.7%, p=0.7391). However, of those with adenocarcinoma, there were no differences in unresectability rates between the three groups, which occurred in 19.3% in the SEMS group, compared to 17.5% in the NS group (SEMS vs NS p = 0.732), and 17.7% in the PES group (SEMS vs PES p = 0.862). Additionally, in a multivariate regression model, there was no effect of stent type (SEMS vs NS and SEMS vs PES) on unresectability in those with adenocarcinoma when adjusting for ASA class, age, and neoadjuvant therapy (p=0.958)

In a multivariate regression model, SEMS had overall more postoperative complications than the NS group when adjusting for ASA class, age, diagnosis of adenocarcinoma and neoadjuvant therapy. (Table 6) However, there were no differences in serious (grade 3 or higher) complications. (Table 7) There were no significant difference in either overall complications or serious complications between SEMS and PES when adjusting for the same covariates. ASA class had significantly impacted the risk of both any complications and serious complications, and benign pathology was associated with an increased risk of any complication; no other covariate was significantly associated with these outcomes. (Tables 6 and 7) A multivariate regression model of the effect of stent type on the presence of a positive margin showed no difference between SEMS, NS, or PES on R0 resection when adjusting for ASA class, age, and neoadjuvant therapy (p = 0.115).

Discussion

Among patients who are undergoing a pancreaticoduodenectomy who require endoscopic preoperative biliary drainage, this study found that the use of preoperative SEMS did not compromise R0 resection or increase overall or serious post-operative complications. These findings were observed in both univariate and multivariate analyses. Additionally, there were no differences in the rates of an intraoperative finding of locally unresectable disease (non therapeutic laparotomy) between the three groups in patients with pancreatic adenocarcinoma. We did observe an increase in post-operative wound infections and longer operative times in the SEMS group, as well as more overall complications in the SEMS compared to the NS group in the multivariate analysis.

Routine pre-operative biliary drainage in patients with pancreatic cancer undergoing PD has not been found to be beneficial. Several retrospective studies have associated preoperative biliary drainage with increased postoperative complications, including studies from our own institution showing higher rates of infectious complications, including postoperative wound infections. [13-15] In a recent randomized controlled trial, preoperative biliary drainage was compared to early PD alone, and showed an overall increase in complications in the stent group, primarily attributed to cholangitis, stent dysfunction, and need for repeated stent exchange. [1]

Although it has become generally accepted that routine biliary stenting prior to PD is not indicated, many patients still require biliary drainage while awaiting surgical resection, including those needing delay PD to correct comorbidities, those symptomatic from hyperbilirubinemia, or those receiving neoadjuvant therapy. Once the decision is made for biliary drainage, it is imperative that the stent chosen has the best patency profile and not interfere with resection.

It is well established that SEMS are superior to PES in regards to patency. Multiple studies in patients with unresectable pancreatic cancer comparing SEMS to PES have shown that SEMS have better patency profiles, with fewer incidences of cholangitis, stent occlusion, and need for re-intervention. [2, 3, 16] More recent studies have shown similar patency advantages of SEMS in patients awaiting PD. [7, 8, 11, 17] In particular, as more patients are undergoing neoadjuvant therapy, PES do not provide adequate stent patency, resulting in interruptions of neoadjuvant treatments, need for hospitalizations, and repeated endoscopic procedures. [6] This is has led to critique of the previous studies that concluded increased complications in patients who underwent preoperative biliary drainage, as they did not include patients undergoing neoadjuvant therapy, and they solely utilized PES. Additionally, although SEMS are more expensive compared to PES, SEMS appear to be cost effective in patients awaiting PD when the greater incidence of cholangitis associated with PES is taken into account. [7, 8, 18]

Despite the support in the literature that SEMS provide faster relief of jaundice and have more durable patency than PES, concerns persist that SEMS result in greater operative and postoperative complications, and create technical difficulties which may compromise R0 resection, interfere with biliary reconstruction, or prohibit resection altogether. These theoretical complications arise in part from concerns of local inflammation that SEMS may cause. [19] Several small studies have shown that SEMS do not increase operative complications in patients who have undergone PD, but no study has investigated the impact on the R0 resection rate or the rates of non therapeutic laparotomy. [7-10, 17, 20] In our study, we sought to compare the surgical outcomes, including margin status on pathology, and compare the rates of unresectability of a relatively large group of patients undergoing PD with SEMS in place compared to those with PES and NS. Our study was not designed to evaluate the efficacy of biliary stenting, but to investigate the surgical outcomes of SEMS when in place at the time of PD.

In patients who required endoscopic biliary stents, our study found that placement of a SEMS did not increase overall post-operative complications including more severe (grade 3-4) complications, biliary or pancreatic anastomotic leak, and 30 day mortality. On the contrary, there was an increase in wound infection in the SEMS group compared to both the NS and PES groups. However, this did not result in any difference of length of stay or severity of adverse events, inferring these infections were managed medically and were without further complications. These findings may be the cause of the increase in overall complications in the SEMS group compared to the NS group in the multivariate model. There was an increase in operative times in the SEMS group, but again this had minimal clinical impact given the lack of difference in length of stay and overall postoperative complications. Moreover, the patients in the SEMS group had significantly more

comorbidities, and were more likely to have received preoperative chemotherapy which may have contributed to the differences in wound infection. Additionally, since neoadjuvant chemotherapy is generally reserved at our institution for those with borderline resectable or locally unresectable tumors it is not surprising that longer operative times were encountered in this group. Although there was a statistically significant difference in estimated blood loss, the difference was quite small, and there was no difference seen between the stent types.

In comparing the patients that were deemed locally unresectable intra-operatively, although there was a significant difference in unresectability rates between the SEMS and NS group for all patients, there was no difference seen when the subgroup of patients with adenocarcinoma were analyzed. These findings persisted in a multivariate regression model.

Lastly, there were no differences in overall or serious complications when comparing the different SEMS types. Although there were no differences in complications between stent length, we recommend choosing the shortest length required to bridge the obstruction while leaving enough common hepatic duct for the biliary anastomosis.

Limitations of this study include the retrospective design resulting in the inability to equalize patient demographics, and a relatively small number of patients who received SEMS. However to our knowledge this is the largest group of SEMS investigated in a comparative study. Another limitation is that our patient population did not exclusively have pancreatic adenocarcinoma, however the majority of non-adenocarcinoma patients were in the NS group which we expect to be healthier and have lower risk of perioperative complications. Rates were nonetheless similar between NS and SEMS for most types of complications, indicating that SEMS did not lead to increased risk.

In conclusion, once the decision has been made to place a biliary stent in a patient with pancreatic cancer awaiting PD, a SEMS can be placed without the risk of increased overall or serious perioperative complications, risk of unresectability, or compromise of R0 resection. Although our study shows SEMS result in longer operative times and increase postoperative wound infections, we feel the advantages of SEMS outweigh these potential risks. Based on our results, there is no contraindication to placing SEMS in the common bile duct of patients anticipating PD.

References

1. van der Gaag NA, et al. Preoperative biliary drainage for cancer of the head of the pancreas. N Engl J Med. 2010; 362(2):129–37. [PubMed: 20071702]
2. Moss AC, Morris E, Mac Mathuna P. Palliative biliary stents for obstructing pancreatic carcinoma. Cochrane Database Syst Rev. 2006; (2):CD004200.
3. Arguedas MR, et al. Biliary stents in malignant obstructive jaundice due to pancreatic carcinoma: a cost-effectiveness analysis. Am J Gastroenterol. 2002; 97(4):898–904. [PubMed: 12003425]
4. Kaassis M, et al. Plastic or metal stents for malignant stricture of the common bile duct? Results of a randomized prospective study. Gastrointest Endosc. 2003; 57(2):178–82. [PubMed: 12556780]
5. Abrams RA, et al. Combined modality treatment of resectable and borderline resectable pancreas cancer: expert consensus statement. Ann Surg Oncol. 2009; 16(7):1751–6. [PubMed: 19390900]

6. Boulay BR, Gardner TB, Gordon SR. Occlusion rate and complications of plastic biliary stent placement in patients undergoing neoadjuvant chemoradiotherapy for pancreatic cancer with malignant biliary obstruction. J Clin Gastroenterol. 2010; 44(6):452–5. [PubMed: 20179612]

7. Wasan SM, et al. Use of expandable metallic biliary stents in resectable pancreatic cancer. Am J Gastroenterol. 2005; 100(9):2056–61. [PubMed: 16128952]

8. Mullen JT, et al. Pancreaticoduodenectomy after placement of endobiliary metal stents. J Gastrointest Surg. 2005; 9(8):1094–104. discussion 1104-5. [PubMed: 16269380]

9. Lawrence C, et al. Delayed pancreaticoduodenectomy for cancer patients with prior ERCP-placed, nonforeshortening, self-expanding metal stents: a positive outcome. Gastrointest Endosc. 2006; 63(6):804–7. [PubMed: 16650542]

10. Singal AK, et al. Self-expanding metal stents for biliary drainage in patients with resectable pancreatic cancer: single-center experience with 79 cases. Dig Dis Sci. 2011; 56(12):3678–84. [PubMed: 21750930]

11. Aadam AA, et al. Efficacy and safety of self-expandable metal stents for biliary decompression in patients receiving neoadjuvant therapy for pancreatic cancer: a prospective study. Gastrointest Endosc. 2012

12. Grobmyer SR, et al. Defining morbidity after pancreaticoduodenectomy: use of a prospective complication grading system. J Am Coll Surg. 2007; 204(3):356–64. [PubMed: 17324768]

13. Mezhir JJ, et al. A matched case-control study of preoperative biliary drainage in patients with pancreatic adenocarcinoma: routine drainage is not justified. J Gastrointest Surg. 2009; 13(12): 2163–9. [PubMed: 19774424]

14. Heslin MJ, et al. A preoperative biliary stent is associated with increased complications after pancreatoduodenectomy. Arch Surg. 1998; 133(2):149–54. [PubMed: 9484726]

15. Povoski SP, et al. Preoperative biliary drainage: impact on intraoperative bile cultures and infectious morbidity and mortality after pancreaticoduodenectomy. J Gastrointest Surg. 1999; 3(5): 496–505. [PubMed: 10482706]

16. Levy MJ, et al. Palliation of malignant extrahepatic biliary obstruction with plastic versus expandable metal stents: An evidence-based approach. Clin Gastroenterol Hepatol. 2004; 2(4): 273–85. [PubMed: 15067620]

17. Decker C, et al. Biliary metal stents are superior to plastic stents for preoperative biliary decompression in pancreatic cancer. Surg Endosc. 2011; 25(7):2364–7. [PubMed: 21373939]

18. Chen VK, Arguedas MR, Baron TH. Expandable metal biliary stents before pancreaticoduodenectomy for pancreatic cancer: a Monte-Carlo decision analysis. Clin Gastroenterol Hepatol. 2005; 3(12):1229–37. [PubMed: 16361049]

19. Vakil N. Expandable metal stents: principles and tissue responses. Gastrointest Endosc Clin N Am. 2011; 21(3):351–7. vii. [PubMed: 21684458]

20. Pop GH, et al. Bridge to surgery using partially covered self-expandable metal stents (PCMS) in malignant biliary stricture: an acceptable paradigm? Surg Endosc. 2011; 25(2):613–8. [PubMed: 20632189]

Study Highlights

Current knowledge:

- SEMS have better patency profiles than plastic stents.

- SEMS would be the preferred stent of choice in those awaiting Whipple; however concerns persist that SEMS may interfere with resection.

What is new here:

- Among those that need biliary decompression, SEMS do not increase overall or serious postoperative complications.

- SEMS do not compromise R0 resection or increase the risk of local unresectability.

- SEMS can be placed preoperatively in those awaiting Whipple.

Table 1

Complication Criteria

Grade	Definition
0	No complications
1	Oral medications or supportive care
2	IV medical therapy with resolution or antibiotics or specialized nutritional support
3	IR, endoscopic, or operative intervention
4	Chronic deficit or disability associated with sequelae of this event
5	Death associated with sequelae of this event

Table 2

Demographic characteristics of successful PD by stent type

Variable N (%) or Median (range)	SEMS n=71	PES n=149	NS n=289	p-value	SEMS vs PES p-value
Gender: Female	36 (50.7%)	64 (43.0%)	140 (48.4%)	0.447	0.312
Age	67 (38-89)	68 (39-92)	65 (19-88)	0.038	0.858
ASA class 3 or 4	48 (67.6%)	76 (51.4%)	164 (57.1%)	0.073	0.029
Pathology: Adenocarcinoma	67 (94.4%)	135 (90.6%)	145 (50.2%)	<0.001	0.436
Neoadjuvant Therapy[*]	23 (34.3%)	10 (7.4%)	14 (9.7%)	<0.001	<0.001

ASA, American Society of Anesthesiologist Physical Status Classification System

[*] Neoadjuvant therapy rates were summarized and compared in the subset of patients with adenocarcinoma

Table 3

Clinicopathologic data and peri and post-operative complications by stent type

Variable	SEMS n = 71	PES n = 149	NS n = 289	p-value	SEMS vs PES p-value
N (%) or Median (range)					
Operative duration	279 (142 - 506)	253 (101 - 597)	241 (78 - 594)	<0.001	0.030
Estimated blood loss (ml)	500 (100 - 2500)	500 (50 - 5000)	400 (0 - 3500)	0.028	0.806
Positive Margin	6 (8.5%)	24 (16.3%)	29 (10.2%)	0.129	0.143
Length of stay (days)	8 (5 - 63)	8 (4 - 63)	8 (4 - 88)	0.305	0.740
Any complication	45 (63.4%)	82 (55.0%)	148 (51.2%)	0.180	0.307
Grade 3 or higher complication	12 (16.9%)	30 (20.1%)	73 (25.3%)	0.234	0.714
Pancreatic anastomotic leak	5 (6.9%)	19 (12.6%)	41 (14.1%)	0.266	0.182
Biliary anastomotic leak	0 (0.0%)	1 (0.7%)	6 (2.1%)	0.478	1.000
Wound infection	22 (31.0%)	19 (12.8%)	18 (6.2%)	<0.001	0.003
30 day mortality	0 (0.0%)	0 (0.0%)	4 (1.4%)	0.460	NE

NE indicates not evaluable due to no events

Table 4

Locally unresectable intraoperatively rates by stent type, in whole cohort and in subset with adenocarcinoma

	SEMS	PES	NS	SEMS vs NS p-value	SEMS vs PES p-value
Total	17 (19.3%)	32 (17.7%)	35 (10.8%)	0.045	0.739
Adenocarcinoma	16 (19.3%)	29 (17.7%)	31 (17.5%)	0.732	0.862

Table 5

Multivariate Model: Any Complication

Covariate	OR (95% CI)	p-value
ASA class [*]	1.740 (1.180 - 2.575)	0.005
Age	1.009 (0.992-1.026)	0.297
Stent Type		
NS vs SEMS	0.519 (0.285-0.944)	0.032
PES vs SEMS	0.763 (0.411-1.416)	0.391
Pathology and neoadjuvant therapy [**]		
Adenocarcinoma with neoadjuvant therapy vs adenocarcinoma without neoadjuvant therapy	0.998 (0.506-1.968)	0.995
Benign vs adenocarcinoma without neoadjuvant therapy	1.607 (1.030-2.506)	0.037

[*] Class 3 or 4 vs class 1 or 2

[**] Only patients with adenocarcinoma were eligible for neoadjuvant therapy

Table 6

Multivariate Model: Serious Complications

Covariate	OR (95% CI)	p-value
ASA class [*]	1.807 (1.126-2.898)	0.014
Age	0.998 (0.978-1.018)	0.833
Stent Type		
NS vs SEMS	1.608 (0.761-3.398)	0.213
PES vs SEMS	1.457 (0.666-3.186)	0.346
Pathology and neoadjuvant therapy [**]		
Adenocarcinoma with neoadjuvant therapy vs adenocarcinoma without neoadjuvant therapy	1.291 (0.575-2.899)	0.535
Benign vs adenocarcinoma without neoadjuvant therapy	1.424 (0.856-2.369)	0.174

[*] Class 3 or 4 vs class 1 or 2

[**] Only patients with adenocarcinoma were eligible for neoadjuvant therapy