Risk factors contributing to cardiac events following general and vascular surgery

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1. Introduction

Postoperative cardiac events (CE) are associated with significant morbidity and mortality [1–4]. It is estimated that of the 100,000 patients undergoing noncardiac surgery worldwide, approximately 500,000 to 900,000 experience perioperative CE [2]. In-hospital mortality rates have ranged from 15% to 25% for myocardial infarction [2,3], and as high as 65% for cardiac arrest [4]. The high mortality and morbidity rates associated with postoperative CE make it a necessity to improve surgical outcomes through risk stratification and optimal perioperative management.

Previous studies have proposed cardiac risk indices in patients undergoing noncardiac surgery [5–15]; however, their application and generalizability is debatable. For example, the first substantiated cardiac risk index, published by Goldman and colleagues [5] in 1977, has been criticized for having a low positive predictive value of 21.6% [3]. Similarly, the revised cardiac index by Lee and colleagues [6] overestimated patients who underwent thoracic and orthopedic surgery [3] and has insufficient likelihood ratio for identifying patients with greater cardiac risks [16], limiting its accurate prediction of CE in general or

Abbreviations: CE, cardiac events; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction

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https://doi.org/10.1016/j.amsu.2018.08.001

Received 13 February 2018; Received in revised form 2 July 2018; Accepted 1 August 2018

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vascular surgery patients. In fact, even the accepted revised cardiac risk index by the American Heart Association and the American College of Cardiologists has been noted to underestimate the risk of CE in patients undergoing major noncardiac surgery [7].

In view of limitations of previous CE risk indices, the present study seeks to understand and define in greater depth risk factors that accurately predict postoperative CE after major general and vascular surgery to allow for appropriate preoperative optimization, surgical management and informed consent. It is the hope of the authors that tailored perioperative management that targets identified risk factors will be employed to decrease CE-associated morbidity and mortality.

2. Methods

Adult patients, aged 18 years and older, who underwent major surgery from 2013 to 2016 at an urban teaching hospital were retrospectively reviewed. Patients who had general or vascular surgery were included. The list of types of operations included in the study and their current procedural terminology (CPT) codes is shown in Table 7. Patients excluded were those with missing variables of interest. Fig. 1 shows a flow chart for patients included and excluded in the study.

The primary outcome in this analysis was 30-day postoperative CE, defined as myocardial infarction or cardiac arrest within the 30-day postoperative period.

Preoperative and operative variables analyzed included age, gender, body mass index, race, American Society of Anesthesiologists (ASA) status, emergency surgery, diabetes, smoking history, dyspnea, dependent functional status, ventilator dependence, congestive heart failure, chronic obstructive pulmonary disease, hypertension, acute renal failure or dialysis, disseminated cancer, wound infection, steroid use, weight loss, bleeding disorder, preoperative red blood cell (RBC) transfusion, systemic sepsis, serum sodium, blood urea nitrogen, creatinine, albumin, total bilirubin, aspartate aminotransferase (SGOT), alkaline phosphatase, white blood count, hematocrit, platelet count, partial thromboplastin time, international normalized ratio, and operative time.

30-day outcomes analyzed included mortality, pulmonary complications (pneumonia, unplanned reintubation, prolonged mechanical ventilation), renal failure, neurological complications (stroke or cerebrovascular accidents), thrombotic complications (deep venous thrombosis, pulmonary embolism), wound infection, postoperative RBC transfusion, readmission, unplanned return to operating room, and prolonged hospitalization (length of hospital stay > 8 days).

3. Statistical analysis

Statistical analyses were performed using SPSS software (Version 22, Chicago, IL, USA). Patients were classified into those who experienced at least one postoperative CE and those who did not. Univariate analysis was performed on patient demographics, preoperative variables and postoperative outcomes. Baseline characteristics were compared using $X^2$ tests for categorical variables and two-tailed t-test for continuous variables. Variables with $P$ values less than 0.05 in the univariate analysis were included in a stepwise multivariate regression model. The stepwise multivariate regression models were utilized to identify predictors of UPR and the associations between CE and other postoperative outcomes. Additional subgroup analyses were conducted by classifying patients into surgical specialties-general or vascular surgery. All regression models were assessed using the Hosmer-Lemeshow test and $C$ statistic for excellent goodness-of-fit and discrimination.

The study was approved by the Mount Sinai Beth Israel Hospital Institutional Review Board. This work has been reported in line with the STROCSS criteria [17].
4. Results

This study included 8441 patients who underwent vascular and general surgeries from 2013 to 2015 at our large urban teaching hospital, 157 (1.9%) of which experienced postoperative CE. In terms of demographics, patients who experienced postoperative CE were significantly older, white, less likely to be female, and were more likely to have comorbid conditions than those who did not (Table 1).

Major predictors of CE included age > 65 years (OR 4.9, 95%CI 3.4–6.9, p < 0.01), ASA > 3 (OR 12.0, 95%CI 8.5–16.9, p < 0.01), emergency surgery (OR 3.7, 95%CI 2.7–5.1, p = 0.01), CHF (OR 11.2, 95%CI 6.4–16.7, p = 0.02), COPD (OR 3.9, 95%CI 2.4–6.4, p = 0.04), Acute renal failure or dialysis (OR 8.0, 95%CI 5.2–12.1, p = 0.04), weight loss (OR 3.3, 95%CI 1.7–6.7, p < 0.01), preoperative creatinine > 1.2 mg/dL (OR 5.1, 95%CI 3.7–7.1, p = 0.01), hematocrit < 34% (OR 4.0, 95%CI 2.8–5.7, p < 0.01), and operative time > 240 min (OR 2.0, 95%CI 1.3–3.3, p = 0.02) (Table 1).

Following surgery, CE was associated with increased mortality (OR 3.5, 95%CI 1.2–6.5, p < 0.01), pulmonary complications (OR 5.0, 95%CI 3.1–8.9, p < 0.01), renal complications (OR 2.3, 95%CI 1.9–4.5, p < 0.01), neurologic complications (OR 2.5, 95%CI 1.4–5.2, p < 0.01), systemic sepsis (OR 2.2, 95%CI 1.7–4.0, p < 0.01), postoperative RBC transfusion (OR 4.4, 95%CI 2.7–6.5, p < 0.01), unplanned return to operating room (OR 4.0, 95%CI 2.3–6.9, p < 0.01), and prolonged hospitalization (OR 5.5, 95%CI 3.1–8.8, p = 0.03) (Table 2). The association between CE and postoperative outcomes were similar when patients were stratified into general and vascular surgery groups (Tables 4 and 6).
Table 2
Postoperative outcomes contributing to CE following general and vascular surgery, univariate and multivariate analyses.

| Postoperative outcomes | Univariate | Multivariate |
|------------------------|------------|--------------|
|                        | CE n = 157 | No CE n = 8284 | P        | OR (95% CI) | P      |
| Mortality              | 55.4%      | 0.9%          | < 0.01   | 3.5(1.2-6.5) | < 0.01 |
| Pulmonary complications | 59.2%      | 2.6%          | < 0.01   | 5.0(3.1-8.9) | < 0.01 |
| Renal complications    | 17.2%      | 1.2%          | < 0.01   | 2.3(1.9-4.5) | < 0.01 |
| Neurologic complications| 3.2%       | 0.1%          | < 0.01   | 2.5(1.4-5.2) | < 0.01 |
| Thromboembolic complications | 2.5%      | 0.7%          | < 0.01   | 3.8(1.4-8.6) | 0.58   |
| Systemic sepsis       | 33.1%      | 2.6%          | < 0.01   | 2.2(1.7-4.0) | < 0.01 |
| Wound infection        | 10.8%      | 3.5%          | < 0.01   | 3.4(2.0-5.6) | 0.59   |
| Postoperative RBC transfusion | 32.5%    | 4.9%          | < 0.01   | 4.4(2.7-6.5) | < 0.01 |
| Unplanned return to operating room | 9.6%     | 2.6%          | < 0.01   | 4.0(2.3-6.9) | < 0.01 |
| Readmission            | 5.1%       | 4.0%          | 0.47     |              |        |
| Length of stay > 8days | 63.1%      | 16.7%         | < 0.01   | 5.5(3.1-8.8) | 0.03   |

Abbreviation: CE, cardiac events; RBC, red blood cell.

Table 3
Patient characteristics contributing to CE following general surgery, univariate and multivariate analyses.

| Patient characteristics | Univariate | Multivariate |
|-------------------------|------------|--------------|
|                        | CE n = 124 | No CE n = 6743 | P        | OR (95% CI) | P      |
| Age > 65years          | 67.3%      | 29.5%         | < 0.01   | 4.9(3.2-7.6) | 0.38   |
| BMI > 30 kg/m²         | 24.2%      | 28.8%         | 0.34     |              |        |
| Female gender          | 48.0%      | 52.7%         | 0.35     |              |        |
| Race                    | 1.0%       | 5.0%          |          |              |        |
| White                  | 67.3%      | 64.2%         | < 0.01   | 4.1(1.8-8.9) | 0.40   |
| Black                  | 23.5%      | 16.8%         | < 0.01   | 4.1(2.7-10.4) | 0.01   |
| Asian                  | 8.2%       | 13.9%         |          |              |        |
| Other                  | 1.0%       | 5.0%          |          |              |        |
| ASA > 3                | 63.3%      | 6.8%          | < 0.01   | 2.5(1.4-3.8) | < 0.01 |
| Emergency surgery      | 58.2%      | 23.2%         | < 0.01   | 4.6(3.1-6.9) | 0.07   |
| Diabetes               | 24.5%      | 13.8%         | < 0.01   | 2.0(1.3-2.4) | 0.69   |
| CHF                    | 3.1%       | 0.4%          | < 0.01   | 7.9(2.3-11.4) | 0.06   |
| COPD                   | 9.2%       | 2.2%          | < 0.01   | 4.4(2.2-4.9) | 0.33   |
| Hypertension           | 69.4%      | 39.9%         | < 0.01   | 3.4(2.1-5.3) | 0.68   |
| Acute renal failure or dialysis | 15.3%    | 1.1%          | < 0.01   | 2.0(1.8-3.8) | < 0.01 |
| Disseminated Cancer    | 9.2%       | 1.4%          | < 0.01   | 4.6(1.1-9.1) | 0.35   |
| Steroid                | 12.2%      | 2.8%          | < 0.01   | 5.1(2.5-8.4) | 0.01   |
| Weight loss            | 9.2%       | 1.9%          | < 0.01   | 6.8(3.7-12.4) | 0.27   |
| Bleeding Disorder      | 13.3%      | 2.2%          | < 0.01   | 11.9(5.7-14.8) | 0.10   |
| Preoperative RBC transfusion | 9.2%     | 0.8%          | < 0.01   | 10.7(7.1-16.1) | < 0.01 |
| Systemic sepsis       | 52.0%      | 9.2%          | < 0.01   | 10.7(7.1-16.1) | 0.01   |

Abbreviations: CE, cardiac events; BMI, body mass index; ASA, American Society of Anesthesiologists; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; RBC, red blood cell; BUN, blood urea nitrogen; SGOT, aspartate aminotransferase; WBC, white blood count; INR, international normalized ratio; PTT, partial thromboplastin time.
**Table 4**

Postoperative outcomes contributing to CE following general surgery, univariate and multivariate analyses.

| Postoperative outcomes | Univariate | Multivariate |
|------------------------|------------|--------------|
|                        | CE n = 124 | No CE n = 6743 | P | OR (95% CI) | P |
| Mortality              | 60.2%      | 0.9%          | 5.1(1.6-7.7) | < 0.01 |
| Pulmonary complications| 59.2%      | 2.6%          | 5.0(3.1-8.9) | < 0.01 |
| Renal complications    | 16.3%      | 1.0%          | 8.7(5.4-13.5) | 0.09 |
| Neurologic complications| 1.0%       | 0%            | 4.9(2.1-7.9) | 0.02 |
| Thrombotic complications| 2.0%       | 0.7%          | 0.13 |
| Systemic sepsis        | 41.8%      | 2.7%          | 5.6(1.7-9.2) | < 0.01 |
| Wound infection        | 12.2%      | 3.7%          | 3.6(2.0-6.7) | 0.86 |
| Postoperative RBC transfusion| 29.6% | 3.5% | 3.5(1.3-8.1) | 0.02 |
| Unplanned return to operating room | 6.1% | 1.5% | 4.2(1.8-9.9) | < 0.01 |
| Readmission            | 4.1%       | 3.6%          | 0.80 |
| Length of stay > 8days | 62.2%      | 12.8%         | 2.2(1.4-4.0) | 0.19 |

Abbreviation: CE, cardiac events; RBC, red blood cell.

**Table 5**

Patient characteristics contributing to CE following vascular surgery, univariate and multivariate analyses.

| Patient characteristics | Univariate | Multivariate |
|-------------------------|------------|--------------|
|                        | CE n = 33  | No CE n = 1541 | P | OR (95% CI) | P |
| Age > 65years           | 81.4%      | 63.4%         | 0.01 | 2.5(1.3-4.9) | < 0.01 |
| BMI > 30 kg/m²           | 29.1%      | 23.0%         | 0.29 |
| Female gender           | 50.8%      | 43.7%         | 0.28 |
| Race                    | 74.6%      | 70.0%         | 0.57 |
| White                   | 18.6%      | 24.9%         | 0.75 |
| Black                   | 6.8%       | 4.4%          | 0.28 |
| Asian                   | 0%         | 0.7%          | 0.38 |
| ASA > 3                 | 78.0%      | 56.8%         | 0.01 | 2.7(1.4-5.0) | 0.82 |
| Emergency surgery       | 33.9%      | 25.0%         | 0.28 |
| Diabetes                | 71.2%      | 52.2%         | 0.01 | 5.9(3.1-10.4) | < 0.01 |
| Smoke                   | 18.6%      | 26.1%         | 0.01 | 2.3(1.4-4.0) | 0.01 |
| Dyspnea                 | 6.8%       | 5.8%          | 0.01 | 7.0(3.6-13.7) | < 0.01 |
| Dependent functional status| 55.9%  | 32.0%         | 0.01 | 2.7(1.6-4.6) | 0.19 |
| Ventilator Dependence   | 34.2%      | 35.1%         | 0.01 | 2.9(1.4-5.8) | < 0.01 |
| CHF                     | 22.0%      | 3.9%          | 0.01 | 7.0(3.6-13.7) | < 0.01 |
| COPD                    | 16.9%      | 8.9%          | 0.01 |
| Hypertension            | 91.5%      | 86.6%         | 0.01 | 2.7(1.5-4.9) | 0.05 |
| Acute renal failure or dialysis | 25.4% | 11.3% | 0.01 |
| Disseminated Cancer     | 0%         | 0.5%          | 0.01 | 2.9(1.4-5.8) | < 0.01 |
| Wound infection         | 32.2%      | 22.3%         | 0.01 |
| Steroid                 | 3.4%       | 3.8%          | 0.01 |
| Weight loss             | 0%         | 1.1%          | 0.01 |
| Bleeding Disorder       | 25.4%      | 21.3%         | 0.01 | 3.9(1.5-10.4) | 0.18 |
| Preoperative transfusion| 8.5%       | 2.3%          | 0.01 | 3.9(2.1-7.3) | 0.01 |
| Systemic sepsis         | 23.7%      | 7.4%          | 0.01 | 3.9(2.1-7.3) | 0.01 |

Abbreviations: CE, cardiac events; BMI, body mass index; ASA, American Society of Anesthesiologists; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; RBC, red blood cell; BUN, blood urea nitrogen; SGOT, aspartate aminotransferase; WBC, white blood count; INR, international normalized ratio; PTT, partial thromboplastin time.
There was no significant difference between the incidence of CE among general and vascular surgery patients (p = 0.44). However, predictors of CE differed in patients who underwent general surgery compared to vascular surgery (Tables 3 and 5). Notably, ASA > 3, dependent functional status, ventilator dependence, acute renal failure or dialysis, weight loss, creatinine > 1.2 g/dL, hematocrit < 34%, INR > 1.5, and PTT > 35 s were all independent predictors of CE in patients undergoing general surgery. Significant predictors of CE after vascular surgery included age > 65 years, emergency surgery, diabetes, ventilator dependence, CHF, systemic sepsis, hematocrit < 34%, and operative time > 240 min.

5. Discussion

Even though the 1.9% incidence of CE found in this study is consistent with previous reports [6,13,14,18], the observed CE-associated mortality of 55.4% was higher than expected [2,3,8]. Overall, CE was associated with significant adverse postoperative outcomes. Identified predictors of postoperative CE in general and vascular surgery included advanced age, higher ASA status, emergency surgery, CHF, COPD, ARF or dialysis, weight loss, decreased preoperative creatinine, anemia, and prolonged operative time.

Most of the identified predictors of CE in this study have been thoroughly discussed in literature; however, a few predictors notably preoperative anemia is less reported. Still, the fact that preoperative anemia contributed to CE is least surprising because its predictive prognostic values on overall postoperative adverse outcomes is well published.

Anemia is a common preoperative condition with variable etiology that has been consistently shown to impact perioperative surgical management and outcomes. It has been observed that even mild decrease in hematocrit from normal range, such as a 1% decrease, results in significant morbidity and mortality [19,20]. In a study by Musallam and colleagues [20] that analyzed 227,425 patients undergoing noncardiac surgery, they observed higher crude postoperative mortality (4.6% vs 0.8%) and morbidity (15.7% vs 5.3%) in preoperative anemic patients who underwent major noncardiac surgery. Beattie and colleagues [21] also observed a more than a two-fold increase in mortality in anemic patients undergoing noncardiac surgery, after adjusting for confounders.

A major point to note is that anemia was significantly associated with CE, irrespective of the impact of blood transfusion. It is sometimes debated that the shared interaction between anemia and RBC transfusion contributes to anemia’s association with adverse outcomes [22]. However, since blood transfusion was not a significant predictor of postoperative CE, the present study provides credence to previous studies [21] that report the detrimental effects of preoperative anemia in noncardiac surgery patients, irrespective of blood transfusion.

Additionally, the present study corroborates reports studies [7] that recommend separate predictive CE risk indices and risk stratification among different surgical subspecialties. Predictors for CE greatly differed between general surgery and vascular surgery patients in our patient population. Among patients undergoing major general surgery, predictors of CE included higher ASA status, dependent functional status, ventilator dependence, acute renal failure or dialysis, weight loss, anemia, decreased serum creatinine, increased INR and increased PTT, while predictors of postoperative CE in vascular surgery included advanced age, emergency surgery, diabetes, ventilator dependence, CHF, systemic sepsis, anemia and prolonged operative time.

Findings of this study should be interpreted in the context of its strengths and limitations. First, the present study is observational in nature, which limited our ability to definitively determine causation. Second, data was obtained from a single institution, raising concerns for external validity. Last, the retrospective nature of the study did not allow us to evaluate all possible patient variables and co-morbidities. It is therefore possible that some unidentified predictors may contribute to postoperative CE after general or vascular surgery. These limitations notwithstanding, this present study provides a more vigorous dataset that utilized a relatively large sample size and contained several surgical procedures in patients with different co-morbidities. Results from this study can therefore be used to inform surgeons on risk stratification and optimization of perioperative surgical management.

6. Conclusion

Postoperative CE greatly increase morbidity and mortality following major general and vascular surgery. Results of this large single-center study confirm previously published predictors of CE in patients undergoing noncardiac surgery. It is the hope of the authors that results published herein provides useful information to surgeons and allows for the necessary resources to be focused on identified at-risk patients to decrease improve surgical outcomes.
| Surgical Procedure | CPT |
|--------------------|-----|
| **Vascular Procedures** | |
| Amputation | 28805, 27880, 27882, 27884, 27886, 27590, 27592, 27594 |
| Ankle disarticulation | 27889 |
| Bypass graft, with other vein (Abdominal aortic and peripheral) | 35546, 35647, 35673, 35662, 35666, 35661, 35661, 35656, 35671, 35540, 35531, 35522, 35521, 35566, 35556, 35571, 35585 |
| Fasciotomy | 27600, 27602, 27496, 11044, 11043, 11042 |
| Thrombectomy or Embolectomy | 35875, 34421, 34101, 34201, 34203, 34151 |
| Thrombendarterectomy | 35331, 35361, 35371, 35372, 35355, 35341, 35302, 35305 |
| Cerebrovascular | 37215, 37216, 35301 |
| Transluminal angioplasty of renal or visceral artery | 35471 |
| Phlebectomy of varicose veins | 37765 |
| **Open upper extremity aneurysm** | 30111, 35045 |
| **Open abdominal aortic aneurysm** | 35102, 35131 |
| **Open abdominal aortic aneurysm rupture** | 35141 |
| **Endovascular- abdominal aorta** | 34800, 34802, 34803, 34804, 34805, 34812, 34826, 34825 |
| **Endovascular- thoracic** | 34900, 37225, 37224, 37227, 37226, 37220, 37221, 37229, 37228, 37231, 37233, 27232 |
| **Open lower extremity aneurysm** | 35226, 33877, 35883, 35881, 35761 |
| **Open thoracic aorta** | 33877 |
| **Excision- abdominal graft** | 35907 |
| **Excision- extremity graft** | 35903 |
| **AV fistula** | 37700, 37607, 37722 |
| **Other** | 37799, 27301, 27603, 49561, 49560, 64818, 35860, 49010 |
| **General Surgery** | |
| Peritoneal abscess drainage, open | 49020, 49060 |
| Ablation, radiofrequency | 47380 |
| Adrenalectomy | 60545, 60540, 60650, 60660 |
| Parathyroidectomy | 60505, 60502, 60500 |
| Appendectomy | 44950, 44960, 44970, |
| Incisional hernia repair | 49657, 49656, 49655, 49666, 49656, 49656, 49561, 49560 |
| Ventral hernia repair | 49654 |
| Umbilical hernia repair | 49653, 49652, 49587, 49585, 49582 |
| Inguinal hernia repair | 49651, 49650, 49525, 49521, 49520, 49507, 49505, |
| Spigelian hernia repair | 49590 |
| Epigastric hernia repair | 49572, 49570 |
| Femoral hernia repair | 49555, 49553, 49550 |
| Pararectoplaegia hernia repair | 43282, 43281 |
| Diaphragmatic hernia | 39541 |
| Fundoplication | 42320, 42329 |
| Esophagectomy | 43122, 43117, 43112, 43107 |
| Hepaticojunostomy | 47760, 47780 |
| Roux-Y cholangiojunostomy | 47785 |
| Lymphadenectomy- axillary, cervical, transtubal, pelvic, inguinofoemoral | 38745, 38740, 38724, 38780, 38770, 38765, 38760, 38570, |
| Splenectomy | 38120, 38115, 38100 |
| Cholecystectomy | 47610, 47600, 47562, 47563, |
| Choledochectomy | 47420 |
| Gynecectomy | 27080 |
| Thyroidectomy | 45220, 60252, 60254, 60240, 60260, 60270, 60271, 60210 |
| Esophagectomy | 43107 |
| Breast reconstruction | 19364, 19367 |
| Enterostomy closure | 44650, 44620, 44625, 44626, 44227 |
| Enterectomy | 44120, 44125, 44202 |
| Enterotomectomy | 44130 |
| Enterolysis | 44005, 44180 |
| Enterotomy | 44020, 44021, 44110 |
| Omentectomy | 49255 |
| Extrahepatic lesion excision | 47711, 47712 |
| Excision of breast or chest wall lesion, cyst, tumor, fibroadenoma | 19125, 19271, 19120 |
| Excision or destruction of abdominal lesions | 48120, 44800, 49203, 49204, 49205, 43611 |
| Excisions- other | 25111, 55040, 49215, 45130, 51500, 15931, 25076, 27619, 27047, 27048, 27327, 24075, 24076, 48148, 45903 |
| Laparotomy | 49000, 44050, 43605 |
| Pancreateojunostomy | 48548 |
| Pancreatectomy | 48155, 48153, 48150, 48145, 48140, 48120, 48105, 48100 |
| Mastectomy | 19301, 19302, 19303, 19304, 19307 |
| Mastotomy | 19020 |
| Breast reconstruction | 19357, 19367 |
| Nipple exploration | 19110 |
| Fistula (enterovesical, gastrocolic, intestinal, rectovaginal) closure | 44661, 44660, 43880, 44640, 57300, 43880, 44640, 44650 |
| Gastrectomy | 43631, 43632, 43633, 43622, 43621, 43775, 43774, 43771, 43770, 43644, 43633, 43632, 43631, 43622, 43621, 43620 |
| Gastrojejunostomy | 43860, 43848, 43820 |
| Gastrotomaphy | 43840 |

(continued on next page)
Table 7 (continued)

| Surgical Procedure                           | CPT                      |
|----------------------------------------------|--------------------------|
| Gastrostomy                                  | 43501, 43600             |
| Hepatectomy                                  | 47130, 47125, 47120      |
| Colectomy                                    | 44160, 44140, 44145, 44146, 44144, 44150, 44121, 44211, 44208, 44207, 44206, 44205, 44204, 44160, 44157, 44155, 44151, 44150 |
| Coledectomy                                  | 44520, 44540, 44545, 44546, 44548             |
| Ileostomy or jejunostomy                     | 44314, 44310, 44187      |
| Debridement                                  | 11004, 11005, 11006, 11044, 11043, 11042, 11043 |
| Fasciectomy                                  | 27892, 27497, 27600      |
| Prolactomy                                   | 45397, 45395             |
| Prolactomy with sigmoid resection            | 45402, 45400             |
| Duodenectomy                                 | 44510                    |
| Others                                       | 43999, 43659, 43739, 44238, 38129, 58956, 48100, 60600, 20102, 49010, 15757, 20005, 21501, 23031, 24077, 26990, 27301, 27365, 27372, 27603, 27604, 60660, 98957, 58956, 5894057300, 55175, 55040, 50240, 49425, 49422, 49402, 49525, 49524, 49522, 49215, 48500, 47300, 46060, 46045, 46040, 44900, 44850, 43505, 43530, 37722, 37700, 37228, 37227, 37226, 37224, 34001, 34203, 35301, 33661, 35571, 35800 |

Provenance and peer review

Not commissioned, externally peer-reviewed.

Conflicts of interest

None.

Funding

None.

Ethical approval

Exempt.

Research registration number

researchregistry3695.

Trial registration number – ISRCTN

None.

Author contribution

Study design: Acheampong Leitman, Lavarias, Inabnet, Mills, Pechman.
Data Acquisition: Acheampong, Leitman, Lavarias, Mills, Pechman, Guerrier.
Manuscript preparation: Acheampong, Leitman, Boateng, Mills, Lavarias, Inabnet, Guerrier.
Critical revision of manuscript: Acheampong, Leitman, Inabnet, Mills, Guerrier, Boateng.
Final approval of manuscript: Acheampong, Leitman, Guerrier, Lavarias, Pechman, Mills, Boateng, Inabnet.

Guarantor

Leitman.

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