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Time Course of Postoperative Complications in Low-Risk Women after Planned Cesarean Section

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Abstract

Objectives: Length of hospital stay after cesarean section is today much shorter than previously, and a stay of only 1 day is used in many departments. However, complications requiring immediate treatment must be diagnosed before leaving hospital. We assessed the time interval from planned cesarean section to diagnosis of major complications in low-risk women to estimate a safe time of discharge. **Methods:** We performed a retrospective observational study among 5633 women undergoing planned cesarean section from 2001-2017 at Aarhus University Hospital, Denmark. The inclusion criterion was postoperative complication graded as Clavien-Dindo ≥ II. Exclusion criteria were preoperative comorbidity or problems during surgery indicative of need for prolonged stay. Time from cesarean section to suspicion of a postoperative complication was the primary endpoint. **Results:** The study population consisted of 116 women with unexpected postoperative complications, 47 classified as Clavien-Dindo II and 69 as Clavien-Dindo III-IV. In 63 of the 116, the diagnoses were suspected within 24 hours (Clavien-Dindo II: 25, Clavien-Dindo III-IV: 38). These included all cases of relaparotomy and uterine atony with immediate need of medical treatment. Acute colonic pseudo-obstruction was diagnosed within 2 days, while other complications were suspected and treated 2 to 10 days postoperatively. **Conclusions:** Among low-risk women with a postoperative complication, all cases requiring relaparotomy and medically treated uterine atony were suspected within 24 hours after surgery. Discharge 24 hours after planned cesarean section seems safe in low-risk patients.

Keywords

Cesarean Section, Postoperative Complications, Postoperative Hemorrhage, Early Discharge, Length of Hospital Stay

1. Introduction

Postpartum length of hospital stay has decreased significantly over time [1]. After vaginal delivery, women may be discharged after a few hours of observation [2]. Also, the postpartum observation after cesarean section (CS) has been significantly shortened due to the introduction of enhanced recovery after surgery [3]-[8]. Thus, discharge the day after CS has been reported in the literature, and a recent randomized trial from our group found that this could be implemented with preserved parental sense of security [9] [10] [11] [12].

CS represents open abdominal surgery, and early discharge requires that major postoperative problems have been suspected and diagnosed before the woman leaves the hospital. Life-threatening complications with urgent need of treatment are a major concern. These include severe abdominal bleeding leading to relaparotomy and uterine atony. Studies indicate that cases with need of relaparotomy due to bleeding are diagnosed and treated within 11 hours [13] [14]. However, these studies did not include other complications with urgent need of intervention, such as medically treated uterine atony.

Comparison of complications after CS across studies has been compromised by use of various methods to classify postoperative complications. The system introduced by Clavien-Dindo (C-D) is widely implemented in several surgical fields [15] [16]. However, it has rarely been used to classify complications after CS. In this study, we used the C-D system to classify complications after planned CS, thereby contributing to a simple and standardized reporting of postoperative complications. Overall, the aim of the study was to assess the time interval from CS to diagnosis of major complications (C-D ≥ II) to determine whether low-risk women (women without preoperative comorbidity or problems during surgery) can be safely discharged from hospital 24 hours after planned CS.

2. Materials and Methods

The study population was identified among deliveries registered in the Aarhus Birth Cohort (2001-2012) [17] [18] and the Aarhus University Hospital database (2012-2017) [19] [20]. The study population consisted of women who had experienced a postoperative complication graded as C-D ≥ II (for definition of grades see **Table 3**) after a planned CS [15] [16]. Planned CS was defined by the procedure *KMCA10B planned cesarean section performed prelabor,* based on the Nordic coding system [21] [22]. Furthermore, patients with the unspecific procedure code, *KMCA10 cesarean section,* were included if CS was scheduled more than 8 hours after a decision to perform surgery had been taken. The di-

agnoses, surgical procedures, and treatments that could entail postpartum complications are listed in Table S1. We included complications diagnosed within 10 days after CS. Exclusion criteria were multiple pregnancies, preterm birth before week 37 + 0, and stillbirths (Figure 1).

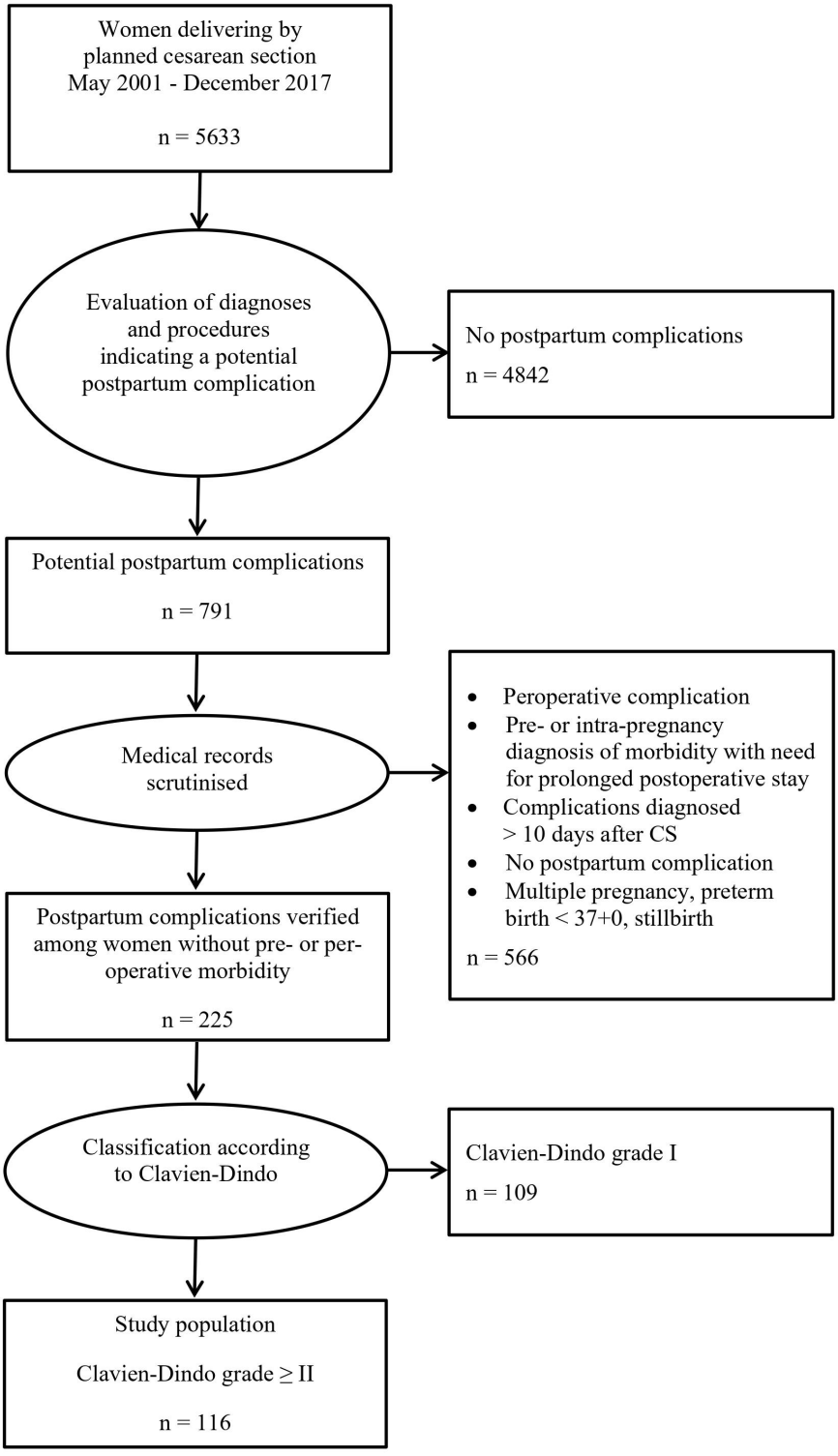

Figure 1. Flowchart describing the process used to identify the study population.

Women with postoperative complications had their medical records scrutinized by at least two authors (AK, AF, NU and/or IS), and women with preoperative comorbidities and/or problems during surgery that indicated need of prolonged stay were excluded. These included preoperative maternal or fetal comorbidity or complications during the surgical procedure (including bleeding ≥ 1000 ml) requiring prolonged postoperative observation (n = 126, **Table 1**). Thus, our study population consisted of women in whom no increased risk of postoperative complications was anticipated (**Figure 1**). Postoperative complications were categorized according to the C-D classification [15] [16]. C-D I complications were excluded. If a patient had more than one C-D complication, she was classified according to the most severe. The first time a suspected complication was mentioned in the medical record was used to define the time from surgery to complication and categorized as less than 24 hours or as number of days if later than 24 hours after surgery. Furthermore, Danish legislation on data protection implies that patient groups must generally contain at least three cases. Therefore, small patient groups were termed as "less than four".

Table 1. Criteria for exclusion from study group.

Pre-operative morbidity		
Anticoagulant treatment and cardiac disease	12	
Inflammatory bowel disease	13	
Type 1 diabetes mellitus and insulin-treated gestational diabetes mellitus	10	
Severe thrombocytopenia or hemophilia	9	
Pre-eclampsia or hypertension	4	
Maternal disability or malformation	4	
Malignant disease	<4*	
Renal/kidney disease	<4*	
Chronic pain problems	<4*	
Severe mental disorder, use of benzodiazepine	<4*	
Anemia incl. sickle cell anemia	<4*	
Other conditions or diseases	8	
Total		**74**
Per-operative complications		
Bleeding ≥ 1000 ml	43	
Other surgical complications	9	
Total		**52**
In total		**126**

*This notation is used to avoid potential identification of single cases (see methods).

Statistical analyses were performed using STATA 15 (STATA Corp., College Station, TX, USA). Normally distributed continuous variables were given as mean values with standard deviations and categorical variables as distributions within the groups.

The study was approved by The Danish Data Protection Agency in Central Denmark Region (1-16-02-512-15, October 2015) and the Danish Patient Safety Authority (3-3013-1312, December 2015). According to Danish legislation, approval from an Ethics Committee was not required for this type of study.

3. Results

During the study period, 5633 women gave birth by planned CS (Table 2). Among 791 patients with diagnoses or procedures that could indicate postpartum complications, we identified a study population of 116 women (2% of women undergoing CS) with no preoperative comorbidity or complications during surgery who experienced a complication graded C-D ≥ II within the first 10 days (Figure 1 and Table 2). Data on gestational age, birth weight, and blood loss were missing in less than 2% of the individuals in both groups (all women undergoing CS and study group). Due to missing data on body mass index (52%) and smoking (27%), these variables were omitted.

Table 2. Basic characteristics of the study population (Clavien-Dindo ≥ II after planned cesarean section) and the total population (all planned cesarean sections).

	Study population[a] (*N* = 116)	Total population[b] (*N* = 5633)
Maternal age *years, at birth* (*SD*)	33.5 (4.4)	32.9 (4.6)
Primiparas *%*	27.6	29.2
Gestational age[c] *weeks, at birth* (*SD*)	38.6 (0.94)	38.5 (0.84)
Previous CS *%*	45.7	46.9
Blood loss ≥ 1000 ml during CS *%*	0	2.5
Birth weight *g* (*SD*)	3527 (504)	3497 (510)
Small for gestational age[c] (z-score < −2.0) *%*	0.9	1.0
Fetal macrosomia (≥4500 g) *%*	3.4	3.7
Placenta previa *%*	3.4	3.2
Fetal malpresentation[d] *%*	16.4	15.6

[a]Missing values: birth weight *n* = 2. [b]Missing values: blood loss *n* = 1; birth weight *n* = 17. [c]Calculations based on completed weeks of gestation. [d]Transverse, oblique and breech presentation included. SD: standard deviation.

Forty-seven of the 116 women (41%) had a C-D II complication (Table 3). Of these, 22 women had atonic postpartum bleeding treated with uterotonics but without further intervention. This complication was suspected within 24 hours in all 22. Less than four women without per- or postoperative bleeding had anemia requiring blood transfusion within 1 to 4 days without other complications. The amount of blood transfused in this group ranged from two to three units. Eight women had endometritis diagnosed 1 to 9 days after CS and were treated with antibiotics. Less than four women had wound hematoma/infection without need of surgical intervention. Additional complications included mastitis (n = 4), post lumbar puncture headache (n < 4), pneumonia (n < 4), postpartum hypertension (n < 4), and fever of unknown origin (n < 4).

Table 3. Number of postoperative complications after planned cesarean section, presented by time of suspicion within vs. after 24 hours among 116 women. Complications within 10 days are included.

	≤24 h	>24 h
Clavien-Dindo grade II complications (n = 47) *Requiring pharmacological treatment with drugs other than such allowed for grade I complications.** Blood transfusions are included*		
Atonic postpartum bleeding	22	0
Pneumonia	<4*	0
Endometritis not requiring surgical intervention	<4*	8
Postpartum anemia requiring blood transfusion	<4*	<4*
Mastitis	0	4
Wound hematoma/infection not requiring surgical intervention	0	<4*
Fever of unknown origin	0	<4*
Postlumbar puncture headache	0	<4*
Postpartum hypertension	0	<4*
Clavien-Dindo grade III-IV complications* (n = 69) *III: Requiring surgical, endoscopic, or radiological intervention* *IV: Life-threatening complication requiring ICU management and organ dysfunction*		
Atonic postpartum bleeding	15	8
Wound hematoma/infection without need of immediate surgery	5	14
Bleeding from abdominal wound requiring immediate surgical intervention	11	0
Bleeding from uterine incision requiring immediate surgical intervention	<4*	0
Unrecognized bladder lesion	<4*	0
Wound dehiscence/burst abdomen	<4*	<4*
Acute colonic pseudo-obstruction	<4*	<4*
Endometritis with retained blood clots/placental membranes	0	5
In total	**63**	**53**

*This notation is used to avoid potential identification of single cases (see methods). **Allowed therapeutic regimens grade I: drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes and physiotherapy.

Sixty-nine of the 116 women (59%) had a C-D III-IV complication (**Table 3**). Thirty-seven had postpartum bleeding due to atony or bleeding from the abdominal or uterine incisions, with need for immediate surgical intervention. This complication was suspected within the first 24 hours in 29 of the 37 women. Less than four women were transferred to the intensive care unit (C-D IV). All had relaparotomy performed within the first 24 hours. Eight patients experienced significant vaginal bleeding 2 to 9 days postpartum and underwent evacuation of retained blood clots/placental membranes. Five of these patients had been discharged and then readmitted. Among the 69 women with C-D III-IV complications, 19 had wound hematomas/infection, where surgical intervention was performed on the following day. These complications were suspected within 1 to 10 days. Less than four women developed acute colonic pseudo-obstruction (Ogilvie's syndrome) [23], all diagnosed within 2 days. Four women experienced wound dehiscence, which was diagnosed within 1 to 6 days after CS. Furthermore, five women had endometritis with retained blood clots/placental membranes.

A relaparotomy was performed in 12 of the 116 women (10%), in most cases due to atonic bleeding or bleeding from surgical incisions. Procedures performed in less than four cases included B-Lynch suture, postpartum hysterectomy, or repair of bladder lesions. All 12 women undergoing relaparotomy had clinical signs of major complications within the first 24 hours postoperatively. Twenty-five of the 116 women (22%) received a blood transfusion, 22 (88%) of whom had had another complication besides anemia diagnosed before transfusion.

In total, 63 of the 116 women (54%) with C-D complications ≥ II had their diagnoses suspected within 24 hours after CS (C-D II: 25, C-D III-V: 38, **Table 3**). These included all cases of relaparotomy and uterine atony with immediate need of medical treatment. Acute colonic pseudo-obstruction was diagnosed within 2 days, while other complications were suspected and treated 2 to 10 days postoperatively (**Figure S1**).

4. Discussion

Our study showed that in a university clinic performing 5633 planned CS during a period of almost 17 years, 116 patients (2% of all women undergoing CS) without preoperative comorbidity or problems during surgery experienced an early postoperative complication C-D II-IV within 10 days. All complications requiring relaparotomy or uterine atony treated medically were suspected within 24 hours after surgery.

Strengths of the study include the large size of the study group. Our data were derived from the Aarhus Birth Cohort and the Aarhus University Hospital database. The Aarhus Birth Cohort comprises more than 96% of all eligible patients registered in the Danish National Patient Database, where codes are considered of high quality [19] [20] [24]. Moreover, we used the C-D classification to cate-

gorize postoperative complication. The strength of this approach is its simplicity and categorization according to need for therapeutic intervention. Thorough review of the medical records was performed during this process.

Limitations of our study include the retrospective design, with potential selection bias because risk factors were identified by authors aware of the outcome. The time from the CS procedure to suspected early postoperative complications was defined as less than 24 hours, but our data did not allow for a more precise assessment. Only complications diagnosed within the first 10 days were included because our aim was to study the time interval from CS to complications in a setting in which low-risk women could have been discharged. Patients readmitted to other departments may have been missed because access to the medical records was restricted for legal reasons to the Department of Obstetrics and Gynecology at Aarhus University Hospital. Problems handled solely by the general practitioner were not registered, but these complications were assumed to be of minor relevance since readmission was not needed. Another limitation is that our study concerned only maternal complications; thus, studies on neonatal risks associated with early discharge are needed. The risk of neonatal readmission due to jaundice is of concern, but factors such as readmission thresholds and confounding by indication should be kept in mind when evaluating readmission in relation to a reduced length of hospital stay [6] [25] [26].

Efficient primary health care is needed when early discharge after CS is considered, even in low-risk patients [27]. Our results were obtained in patients in the Danish public health care system, which may impair the external validity. Standardized postpartum care in Denmark includes early contacts and visits from a primary health care nurse within the first week and easy access to health care after discharge. In our study, secondary postpartum bleeding (>24 hours) occurred during the rest of the pre-defined 10-day postpartum study period. Other studies found that CS is not a risk factor for secondary postpartum bleeding in comparison with vaginal delivery [28] [29]. Thus, the risk of secondary postpartum bleeding does not constitute an indication for prolonged hospital stay after CS. Similar considerations apply for acute colonic pseudo-obstruction as these patients typically presented with abdominal distension and pain [23] that ensure timely contact to health care providers. Furthermore, the Danish primary health care system ensures that patients with infections/hematomas are promptly readmitted [30].

5. Conclusion

We observed that postoperative bleeding with need of relaparotomy (C-D III and IV) and medically treated atonic bleeding (C-D II) were diagnosed and treated within the first 24 hours after surgery in low-risk patients undergoing planned CS at term. According to these data, discharge the day after surgery seems safe in low-risk patients provided that efficient primary health care is available.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Supplementary Material

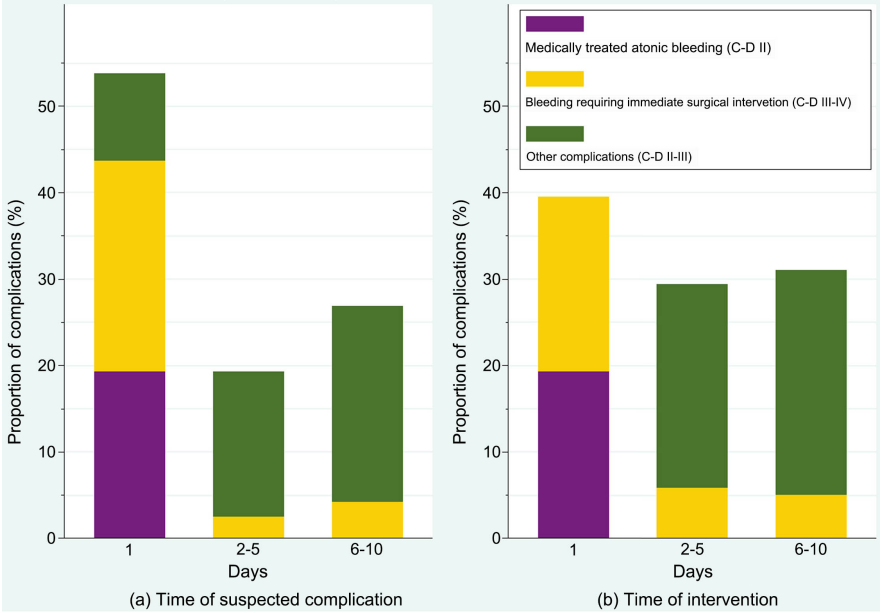

Figure S1. Time of suspected complication (a) and intervention (b) among low-risk women with a postoperative complication (Clavien-Dindo grade II-IV, $n = 116$) during the first 10 days after planned cesarean section. Day 1 is the day of cesarean section. Other complications include wound hematoma/infection without need for immediate intervention, endometritis with or without retained tissue, rupture of the fascia, fever of unknown origin, unrecognized bladder lesion, acute colonic pseudo-obstruction, postpartum anemia requiring blood transfusion, mastitis, post-lumbar puncture headache, pneumonia, and postpartum hypertension.

Table S1. Diagnoses, surgical procedures, and treatments indicating potential postpartum complications based on the International Classification of Diseases 10th Revision (ICD-10) and the Nordic coding system.

Diagnoses	
G970	Cerebrospinal fluid leak from spinal puncture
K519	Ulcerative colitis, unspecified
K560	Paralytic ileus
K566	Other and unspecified intestinal obstruction
N719	Inflammatory disease of uterus, unspecified
O100	Pre-existing essential hypertension complicating pregnancy, childbirth and the puerperium
O266	Liver disorders in pregnancy, childbirth and the puerperium
O679	Intrapartum hemorrhage, unspecified
O720	Third-stage hemorrhage
O721	Other immediate postpartum hemorrhage
O722	Delayed and secondary postpartum hemorrhage
O723	Postpartum coagulation defects

Continued

O731	Retained portions of placenta and membranes, without hemorrhage
O85	Puerperal sepsis
O860	Other puerperal infections
O860	Infection of obstetric surgical wound
O864	Pyrexia of unknown origin following delivery
O868	Other specified puerperal infections
O894	Spinal and epidural anesthesia-induced headache during the puerperium
O900	Disruption of cesarean section wound
O902	Hematoma of obstetric wound
O908	Other complications of the puerperium, not elsewhere classified
O909	Complication of the puerperium, unspecified
O912	Nonpurulent mastitis associated with childbirth
O925	Suppressed lactation
O927	Other and unspecified disorders of lactation
O984	Viral hepatitis complicating pregnancy, childbirth and the puerperium
O990	Anemia complicating pregnancy, childbirth and the puerperium
O992	Endocrine, nutritional and metabolic diseases complicating pregnancy, childbirth and the puerperium
O995	Diseases of the respiratory system complicating pregnancy, childbirth and the puerperium
O996	Diseases of the digestive system complicating pregnancy, childbirth and the puerperium
O998	Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium
R101	Pain localized to upper abdomen
R102	Pelvic and perineal pain
R520	Acute pain
T810	Hemorrhage and hematoma complicating a procedure, not elsewhere classified
T814	Infection following a procedure, not elsewhere classified
T819	Unspecified complication of procedure
T889	Complication of surgical and medical care, unspecified
Surgical procedures	
KCH00	Suture of bladder
LCD00	Hysterectomy
LWC00	Reoperation for deep infiltration in gynecological surgery
LWD00	Reoperation for superficial hemorrhage in gynecological surgery
LWE00	Reoperation for deep hemorrhage in gynecological surgery
MBA00	Vacuum aspiration from uterus after delivery or abortion

Continued

MBA03	Curettage of uterus after delivery or abortion
MBA10	Manual exploration of delivered uterus
MBA96	Other removal of retained products of conception after delivery or abortion
MBB10	Packing of delivered uterus
MBB96	Other manual procedure on delivered uterus
MBW96	Other operation after delivery or abortion
MWA00	Repair of wound dehiscence in obstetric surgery
MWB00	Reoperation for superficial infection in obstetric surgery
MWD00	Reoperation for superficial hemorrhage in obstetric surgery
MWE00	Reoperation for deep hemorrhage in obstetric surgery
MWF00	Reoperation for insufficiency of anastomosis or suture in obstetric surgery
MWW96	Other reoperation in obstetric surgery
TAB30	Epidural blood patch
UJF32	Coloscopy
UJF42	Flexible sigmoidoscopy
UKC02	Cystoscopy
ULC02	Hysteroscopy
Classification of treatment and care	
BIAD7	Treatment with rectal tube/catheter
BIAZ00	Insertion of nasogastric tube
BIAZ07	Insertion of rectal tube/catheter