

Clinical Study

Implementation of an Accelerated Rehabilitation Protocol for Total Joint Arthroplasty in the Managed Care Setting: The Experience of One Institution

Nicholas B. Robertson,¹ Tibor Warganich,¹ John Ghazarossian,² and Monti Khatod²

¹Harbor UCLA Medical Center, Department of Orthopaedics, 1000 W. Carson Street Box 422, Torrance, CA 90245, USA

²Kaiser West Los Angeles, Department of Orthopaedics, 6041 Cadillac Avenue, Los Angeles, CA 90034, USA

Correspondence should be addressed to Monti Khatod; monti.x.khatod@kp.org

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Accelerated rehabilitation following total joint replacement (TJR) surgery has become more common in contemporary orthopaedic practice. Increased utilization demands improvements in resource allocation with continued improvement in patient outcomes. We describe an accelerated rehab protocol (AR) instituted at a community based hospital. All patients undergoing total knee arthroplasty (TKA) and total hip arthroplasty (THA) were included. The AR consisted of preoperative patient education, standardization of perioperative pain management, therapy, and next day in-home services consultation following discharge. Outcomes of interest include average length of stay (ALOS), discharge disposition, 42-day return to Urgent Care (UC), Emergency Department (ED), or readmission. A total of 4 surgeons performed TJR procedures on 1,268 patients in the study period (696 TKA, 572 THA). ALOS was reduced from 3.5 days at the start of the observation period to 2.4 days at the end. Discharge to skilled nursing reduced from 25% to 14%. A multifaceted and evidence based approach to standardization of care delivery has resulted in improved patient outcomes and a reduction in resource utilization. Adoption of an accelerated rehab protocol has proven to be effective as well as safe without increased utilization of UC, ER, or readmissions.

1. Introduction

Total joint arthroplasty has historically not been considered an outpatient surgery among the majority of orthopedic surgeons. Some estimate the average cost per hospital stay to be \$24,170 for primary total hip arthroplasty. In 2005, in an academic US practice, ALOS for revision versus primary THA was 6.5 and 5.6 days, respectively [1]. A recent study utilizing the national registry in Denmark quoted an average length of stay (ALOS) of 7.4 days after total hip arthroplasty (THA) and 8.0 days after total knee arthroplasty (TKA) [2]. A United States based study in 2004 revealed that a rapid recovery protocol decreased the average length of stay from 3.9 to 2.8 days while also decreasing readmission rates [3]. More recently, an accelerated rehabilitation (AR) protocol reduced ALOS an average of 1.36 days following primary THA (3.38 days for standard rehabilitation and 2.06 days for the AR

protocol) [4]. Previous studies have evaluated the use of mini-incision THA and ALOS. Mears et al. found no advantage to mini-incision arthroplasty surgery regarding early discharge [5]. Ogonda et al. found that mini-incision THA does not improve early postoperative outcomes [6]. More important than the size of the incision, an aggressive pain protocol and patient education and in-home care preparation are key components to accelerated rehabilitation protocols.

Parvataneni et al. previously demonstrated in a randomized control trial that multimodal pain therapy alongside a periarticular injection could safely and effectively be used as an alternative to conventional pain control modalities [7]. The purpose of this investigation is to report the reduction in ALOS following primary THA and TKA in a US community hospital utilizing an intraoperative periarticular injection and multimodal perioperative pain protocol in conjunction with patient and family preparation for rapid rehabilitation.

TABLE 1

Number of surgeries	572	696	1,268
Number of patients	522	621	1,130
Age			
Average	68.0	71.0	69.6
Min.	26.0	41.0	26.0
Max.	96.0	96.0	96.0
Gender			
Male	186	213	398
Female	336	408	732
Total	522	621	1,130
Gender %			
Male	35.6%	34.3%	35.2%
Female	64.4%	65.7%	64.8%
Total	100.0%	100.0%	100.0%

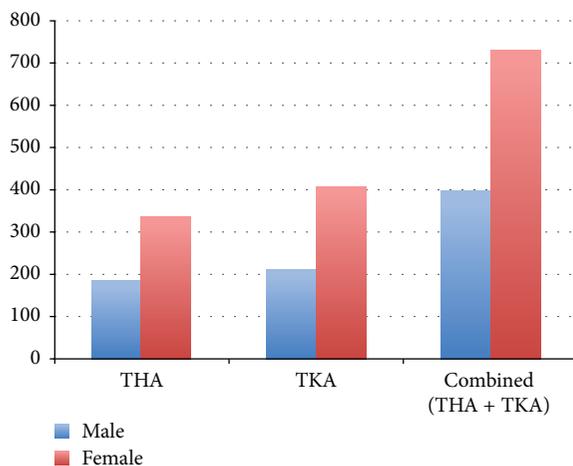


FIGURE 1: Gender demographics of patients receiving TJA.

At our institution in January 2011, we adopted a comprehensive, multidisciplinary approach to total joint replacement. Over a three-and-a-half-year period, we present the results of the implementation of an AR protocol and the effect of ALOS, placement in skilled nursing facilities (SNF), and decreased rehospitalizations, Emergency Department (ED), and Urgent Care (UC) visits within 42 days of the procedure. A secondary outcome is the rate of transfusion.

2. Materials and Methods

After obtaining approval by the institutional review board, a retrospective review was conducted on a total of 1,268 patients who received a total joint replacement from January 1, 2011, to July 31, 2014 (696 TKA and 572 THA). Demographic data including the age and gender of the patients can be seen in Appendix B, Table 1. The average age of the patients in the entire cohort is 69.6 (26–96). Of the patients in the cohort 35.2% were male and 64.8% were female. A graphical representation of gender can be seen in Appendix B, Figure 1.

Utilizing the Kaiser Permanente West Los Angeles patient database, patients who had undergone “knee replacement” or “hip replacement” were utilized for the database query between January 2012 and July 2014. This was conducted using the data source system clarity optime. For the query, “knee replacement” included “Knee Replacement Total,” “Knee Replacement Revision Total, Cemented,” and “Knee Replacement Revision, All Component.” “Hip replacement” consists of “Hip Replacement Total,” “Hip Replacement Revision, Femoral Component,” “Hip Replacement Revision, Both Acetabular And Femoral Component,” “Hip Replacement Revision, Total,” and “Hip Replacement Revision, Acetabular Liner And Femoral Head.” For simplicity, the groups will be referred to as TKA and THA, respectively.

The patient information that was evaluated in this search included the ALOS, transfusion rates, readmission rates to the Urgent Care, Emergency Department, or inpatient hospitalization for the 42 days postoperatively. Secondary outcomes evaluated include discharge location (SNF, home ± home health), PE, DVT, mortality, and deep infection.

A total of four surgeons perform hip and knee arthroplasty surgery at this institution. All four surgeons adopted and implemented the accelerated rehabilitation protocol in January 2011. The advanced rehabilitation protocol involves a multidisciplinary approach to total joint replacement. This comprehensive program is standardized among the participating surgeons, physical therapists, nurses, anesthesiologists, and pharmacy. The key to the success of the program is an integrated system based approach and appropriate education of these multiple teams. Each member plays a crucial part in the success of the AR protocol. The rehabilitation protocol involves preoperative patient education (instruct patient on importance of ambulation on postoperative day 0 and prepare for next day hospital discharge), preoperative pain control administered in PACU, education to the ancillary staff (nursing and therapists) to anticipate a LOS of 24–48 hrs, intraoperative administration of local anesthesia, and physical therapy initiated on postoperative day 0 for transfer and gait training. Please see Appendix A for details.

A protocol to decrease the number of transfusions was also implemented by adopting a standardized protocol including the use of restrictive transfusion triggers. During the preoperative visit, if patients have a hemoglobin (Hb) > 13, no blood donation is required. For patients with a preoperative Hb of 10–13, patients are encouraged to donate 1 unit of blood. Patients with a preoperative Hb < 10 are referred to Internal Medicine for anemia work-up. All patients start iron supplementation (FeGluc 325 mg PO BID) at time of being scheduled for a total joint replacement. At time of surgery, patients without a contraindication are given one weight-based, preoperative dose of tranexamic acid prior to skin incision and one at the conclusion of the procedure in the PACU. Hb and hematocrit are drawn on the morning of POD#1, 2, and 3. Patients are transfused one unit of PRBC if Hb < 7. If Hb is between 7 and 9 and patient is symptomatic (tachycardia at rest or orthostatic hypotension), the patient is first resuscitated with fluids. If symptoms persist after fluid resuscitation, then the patient is transfused with 1 u PRBC. If Hb > 9, then patients are administered fluids only.

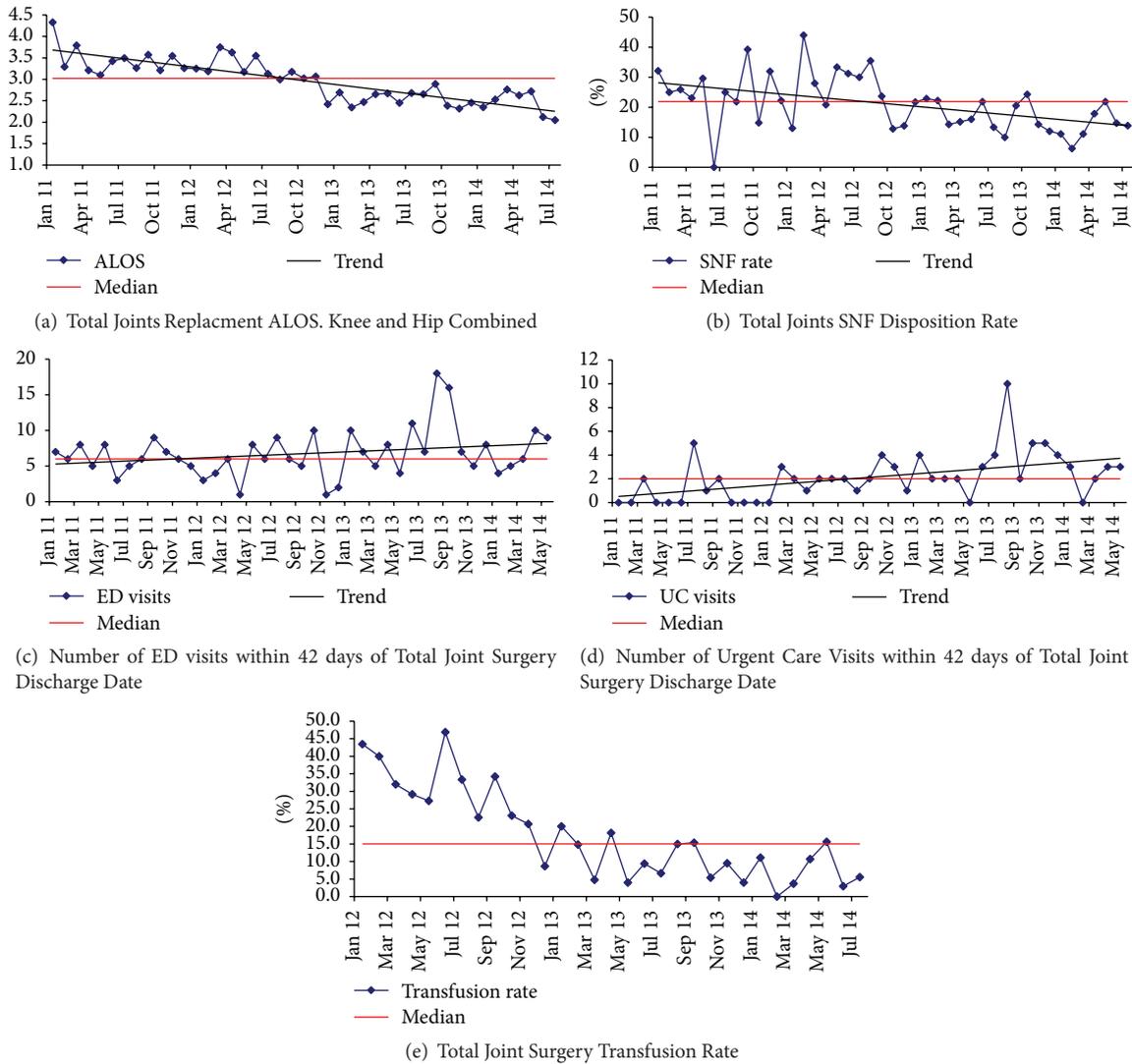


FIGURE 2: (a) Total Joints ALOS. (b) Total Joints Disposition to SNF rate. (c) Emergency Department Visits within 42 days of total joint arthroplasty. (d) Emergency Department Visits within 42 days of total joint arthroplasty. (e) Total Joint Transfusion Rate.

3. Results

A total of 1,268 patients underwent hip or knee arthroplasty during the study period. There were 696 (54.9%) patients in the TKA group and 572 (45.1%) patients in the THA group.

In analyzing the entire group, the patients stayed a total of 3,725 hospital days with an ALOS of 2.9 days during the study period. With the implementation of the accelerated rehabilitation protocol, the ALOS was decreased from 3.5 in 2011 to 2.4 at the conclusion of the study period in 2014 (see Figure 2(a)). Postoperatively, 264 (20.8%) patients were discharged from the hospital to a SNF. The trend was for a decreased rate of SNF placement from 2011 to 2014, with 25% of patients discharged to SNF at start of study and 14% discharged at conclusion of the study (see Figure 2(b)). In total there were 276 (21.8%) visits to the ED, 87 (6.9%) visits to the UC, and 57 (4.5%) rehospitalizations within 42 days of surgery. In 2011, there were 75 visits (24%) to the ED and

at the conclusion of the study there were 34 visits (16%) (see Figure 2(c)). In 2011, there were 10 UC visits (3%) and in 2014 there were 11 visits to UC (5%) (see Figure 2(d)). The number of IP admissions was 18 (6%) in 2011 and 7 (3%) in 2014.

During the study period, 696 patients underwent TKA, revision, or primary. These patients combined to a total of 2005 days hospitalized after surgery. The ALOS decreased each year from 2011 to 2014, 3.4, 3.2, 2.5, and 2.3, respectively. In 2011 and 2012 the rate of discharge to SNF was 26%. In 2013 and 2014 these numbers decreased to 16% and 13%, respectively. This group had a total of 165 ED visits, 45 UC visits, and 26 inpatient hospitalizations within 42 days of surgery during the study period. In 2011, there were 48 ED visits (25%) and 7 UC visits. In 2014 there were 19 ED visits (16%) and 7 UC visits (6%). The number of inpatient admissions decreased from 11 (6%) in 2011 to 6 (1%) in 2014.

Regarding the THA group, 572 surgeries were conducted during the study period for revision or primary. These

patients had a sum of 1720 days hospitalized postoperatively. The rate of discharge to a SNF was 22% and 25% in 2011 and 2012, respectively. These rates decreased to 20% in 2013 and 14% in 2014. The ALOS also decreased from 3.6 in 2011 to 2.5 in 2014. In 2011 there were 27 (22%) ED visits and 3 (2%) UC visits. In 2014 there were 15 (4%) ED visits and 4 (4%) UC visits. There were 7 (6%) IP admissions in 2011 and 6 (6%) IP admission in 2014.

The transfusion rate was analyzed from 2012 to 2014, with 954 patients having undergone total joint replacement. In 2012, 106 (30.1%) patients were transfused. In 2013, 43 (11.1%) patients were transfused and in 2014, 15 (6.9%) patients were transfused (see Figure 2(e)).

4. Discussion

Primary total joint arthroplasty is an extremely successful operation with an inherently low risk for complications [8]. The epidemiologic data indicates that the demand for total joint arthroplasty will increase exponentially over time. Khatod et al. previously reported on the increased incidence of TKA from 1995 through 2004 at a rate of 5% per year [9]. Kurtz et al. project that by 2030 the demand for THA will grow by 174% and the demand for TKA will grow by 673% [10]. The increase in demand as well as the already extremely successful nature of the procedure requires that attention and effort be reallocated to the delivery of the perioperative care, including pain control, rehabilitation, and transfusion requirements. It has been shown in the critical care literature that protocols and standardization of medical practice lead to superior outcomes in the care of the critically ill patient [11]. The experience at our institution has been to persistently improve outcomes through the use of standardization in the delivery of care. The field of arthroplasty is particularly well positioned to benefit from standardization. A decrease in the ALOS in the hospital postarthroplasty is one area that can be improved as long as short-term outcomes are not compromised. This study is meant to present the early findings of the administration of a multidisciplinary action to improve the delivery of healthcare surrounding arthroplasty surgery at a single institution. Our findings indicate that the accelerated rehabilitation protocol alongside multimodal anesthesia therapy using an intraoperative periarticular injection can result in a decrease in the ALOS.

The ALOS in our study was reduced from 3.5 to 2.4 upon administration of the accelerated rehabilitation protocol. This required many system modifications to achieve. Some of these modifications include consensus among operating surgeons, anesthesia providers, in-hospital nursing, inpatient PT, home health nursing, and PT as well as preoperative patient education buy-in.

We also found a decrease in acute ED visits from 24% to 16% and a decrease in inpatient readmissions from 6% to 3%. There was no significant change in the number of UC visits. This provides evidence that the adoption of the accelerated rehabilitation program to decrease the ALOS did not shift the burden to the ED, nor did it result in readmissions. In fact, the number of visits had decreased throughout this study period. There also was a decrease in admission to SNF after

surgery. This rate decreased from 25% in 2011 to 14% in 2014. This decrease in SNF admission was purposeful. Prior data revealed a reduction in perioperative complications when patients returned home versus a SNF after adjusting for patient comorbidities [12]. We utilized this information to guide our patients preoperatively to find adequate support for home discharge with the utilization of in home services provided by our institution. Further, the accelerated rehabilitation instilled confidence in the patients regarding their postoperative ambulation as well as performing activities of daily living. This resulted in many more patients feeling comfortable going home rather than to a SNF.

At the same time the accelerated rehabilitation protocol was administered and a transfusion protocol was also adopted. This was specifically to address the exceedingly high number of transfusions that were administered following arthroplasty procedures. Our results show a dramatic decrease in the rate of transfusion from 30.1% in 2012 to 6.9% in 2014. This dramatic decrease is likely due to the adoption of a transfusion protocol based on specific triggers as well as to the more widespread adoption of the use of tranexamic acid amongst all of the surgeons at the institution [13]. Transfusions have been shown to increase risk of prosthetic joint infection [14]. Adoption of an accelerated rehab protocol at our institution has proven to be safe, while the reduction in ALOS, transfusions, and reduction in SNF transfer translate into significant cost savings to the total joint program at our institution.

5. Conclusion

Standardization of care inclusive of perioperative patient education, aggressive pain management, blood management, and rapid discharge has led to improved patient outcomes as well as reduced length of stay. The standardization needs to be evidence based and a consensus must be reached by all participating surgeons at an individual facility to minimize variation.

Appendices

A. TKA and THA Rehab Protocol

A.1. Total Joint Clinical Pathway Optimization. At time of surgery scheduling one has the following:

- (1) total joint education packet given to patient (including DVD of the shared decision making process),
- (2) first date patient wishing to have surgery entered into the surgery request,
- (3) adequate X-rays are completed for templating within 12 months,
- (4) blood management protocol initiated:
 - (a) males with Hb over 13 and females with Hb over 12, no pre-donation,
 - (b) for males with Hb less than 13 and females with Hb less than 12, referral for anemia work-up,

- (c) all patients starting iron supplementation at time of surgery scheduling: FeGluc 325 mg PO BID,
- (5) documenting the need/request for autologous blood in the progress note,
- (6) patient getting a handout with the options for treatment, goals of treatment, risks of surgery which is also documented in the progress note at time of surgery scheduling (Informed Consent),
- (7) patients with multiple medical problems (MI or stroke in the past, any cardiac disease, or over 60 years old) getting an Internal Medicine referral for preoperative risk stratification/optimization,
- (8) all patients having the progress note forwarded to their PCP informing them that the patient will be undergoing total joint replacement and may be seen for medical optimization prior to surgery,
- (9) patient signing up for kp.org with MA or confirming that account already exists,
- (10) surgery scheduler ensuring the following:
 - (a) patient having a ride home on POD#1 or 2,
 - (i) writing name of person in the chart,
 - (ii) writing phone number of person in the chart,
 - (b) patient having assistance at home for 1 week following surgery,
 - (c) having all financial questions answered:
 - (i) cost of procedure,
 - (ii) cost of hospital stay,
 - (iii) cost of potential rehab stay,
 - (d) confirming that the patient has kp.org account active.

At time of preoperative visit one has the following:

- (1) off work/activity form/caregiver forms given to patient and caregiver,
- (2) placing orders for day of surgery in preoperative area, including preemptive analgesia:
 - (a) Ancef 2 grams IV,
 - (b) Mobic 15 mg po,
 - (c) Percocet 1 or 2 tabs po,
 - (d) Tramadol 50 mg po,
 - (e) Pepcid 20 mg IV,
- (3) placing outpatient PT referral with date of surgery,
- (4) educating patient on importance of early gait and transfer training on day of surgery,
- (5) education of the patient that the anticipated date of discharge will be postoperative day #1.

In the OR one has the following:

- (1) pain protocol:
 - (a) Total Hip Replacement:
 - (i) preemptive analgesia:
 - (1) Mobic 15 mg po on call to OR,
 - (2) Percocet 1 or 2 tabs po on call to OR,
 - (3) Tramadol 50 mg po on call to OR,
 - (4) Pepcid 20 mg IV on call to OR,
 - (ii) immediately prior to incision:
 - (1) tranexamic acid 1000 mg or 1500 mg IV to be ordered by MD prior to entering OR,
 - (iii) intraoperative periarticular injection with an 18-gauge spinal needle ordered prior to entering OR:
 - (1) Ropivacaine 250 mg,
 - (2) Epinephrine 0.5 mg,
 - (3) Ketorolac 30 mg,
 - (4) Clonidine 0.08 mg,
 - (5) total volume to 100 mL,
 - (b) Total Knee Replacement:
 - (i) preemptive analgesia:
 - (1) Mobic 15 mg po on call to OR,
 - (2) Percocet 2 tabs po on call to OR,
 - (3) Tramadol 50 mg po on call to OR,
 - (4) Pepcid 20 mg IV on call to OR,
 - (ii) intraoperative:
 - (1) tranexamic acid 1000 mg or 1500 mg IV when tourniquet is taken down,
 - (iii) intraoperative periarticular injection with an 18-gauge spinal needle ordered prior to entering OR,
 - (iv) pericapsular/periarticular injection:
 - (1) Ropivacaine 250 mg,
 - (2) Epinephrine 0.5 mg,
 - (3) Ketorolac 30 mg,
 - (4) Clonidine 0.08 mg,
 - (5) total volume to 100 mL.

In PACU one has the following:

- (1) postoperative check done by surgeon or assisting PA prior to leaving PACU,
- (2) assessing patients mental status and pain control to ensure proper PT training.

On the floor one has the following:

- (1) DVT and PE Prophylaxis:
 - (a) Coumadin referral for Goal INR of 1.5 to 2.5 for 6 weeks in hips and knees,
 - (b) selecting patients will get Aspirin 325 mg orally daily to start on day of surgery,

(2) All patients to be mobilized by the RN by getting them out of bed for meals (sitting up for dinner on the night of surgery),

(3) PT starting on POD#0:

- (a) PT is not to be held due to blood transfusion,
- (b) goal for 5 to 6 PT sessions by discharge,

(4) pain protocol:

(a) TKA:

- (i) Oxycodone 5 mg PO every 4 hours for 24 hours (6 doses),
- (ii) Zofran 5 mg IV every 4 hours with Oxycodone (6 doses), the prn,
- (iii) Norco 1 tab prn q6h for moderate pain,
- (iv) Norco 2 tabs prn q6h for severe pain,
- (v) Meloxicam 15 mg PO daily (held for GFR < 30 which is equal to CKD 4 or 5),
- (vi) Dilaudid 0.5 mg IV q2 hours prn breakthrough pain,

(b) THA:

- (i) Oxycodone 5 mg PO every 4 hours for 24 hours (6 doses),
- (ii) Zofran 5 mg IV every 4 hours with Oxycodone (6 doses), the prn,
- (iii) Norco 1 tab prn q6h for moderate pain,
- (iv) Norco 2 tabs prn q6h for severe pain,
- (v) Meloxicam 15 mg PO daily (held for GFR < 30 which is equal to CKD 4 or 5),
- (vi) Dilaudid 0.5 mg IV q2 hours prn breakthrough pain,

(5) GI Prophylaxis:

- (a) Omeprazole 20 mg po q12 hours while inpatient,

(6) bowel protocol to be started the morning POD#1 and *not prn*:

- (a) stool softener bid,
- (b) MOM at night on POD#1, if no BM by then and holding for diarrhea,
- (c) Dulcolax suppository on POD#2 morning, if no BM by then and holding for diarrhea,
- (d) Enema to be given evening of POD#2 afternoon if no BM,

(7) labs:

- (a) H/H drawn in AM of POD#1, 2, and 3:
 - (i) transfusion requirements:
 - (1) if Hb < 7, then transfuse 1 u PRBC,

(2) if Hb 7–9, then look for symptoms and fluid resuscitate, first:

- (a) tachycardia (HR > 100) at rest,
- (b) orthostatic symptoms,
- (c) if positive symptoms then transfuse 1 u PRBC,

(3) if Hb > 9, then give fluids only.

Discharge instructions and discharge medication are as follows:

- (1) discharge to be done by 4 pm on POD#1 on fast track patients and 9 am on POD#2 for all patients,
- (2) deep breath and cough 2 times per hour for the next 2 days,
 - (a) patients should go home with their incentive spirometer,
- (3) calling the office for persistent redness, increasing pain or fevers,
- (4) coming to the office during working hours for wound drainage,
- (5) home health referral for Home Health PT.

B. Demographic Data

See Table 1 and Figures 1 and 2.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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