International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 5 | Issue 4 | Oct-Dec - 2017
www.ijamscr.com

Research article Medical research

Assessment of intraoperative fluid administration practices in various surgical specialties: A population based study

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ABSTRACT

Objective

The main objective of the study is to assess the variation in different hospitals towards the intraoperative fluid management and their association during postoperative complications.

Background: Intraoperative fluid management (IOFM)

A substantial body of evidence is existing to support the use of intraoperative fluid management, which has resulted in the process forming one of the core components of Enhanced Recovery Programs. IOFM using a SV optimization (SVO) Algorithm is best method. Studies using the esophageal Doppler (ODM) for IOFM demonstrated a reduction in the incidence of postoperative complications (OR: 0.882; P<0.001). The Lacunae is due to the lack of institution-level studies of resuscitation practices and increasing interest in goal-directed, restricted-volume fluid administration for major surgery.

Methods

We have developed a computed intraoperative fluid balance accounting for patient morphometric, crystalloid, colloid, blood products, urine, blood loss, duration, compared patterns across disciplines and their associations with risk-adjusted postoperative length of stay (pLOS), and approach.Among 50 hospitals in the entire selected state-wide surgical collaborative, we profiled fluid administration practices during 6043 intestinal resections, 18,123 hysterectomies, and 951 abdominopelvic endovascular procedures.

Results

In our study we find that there is a lot of variation in fluid balance between hospitals (P < 0.001, all procedures), but significant within-hospital correlation across operations.

- Highest fluid balance hospitals had significantly longer adjusted pLOS than lowest balance hospitals for intestinal resection (5.4 vs 4.4 d, P < 0.001) and
- Hysterectomy (1.6 vs 1.3 d, P < 0.001), but not endovascular (1.8 vs 2.0 d, P = 0.78). Risk-adjusted complication rates were not associated with fluid balance rankings.

Conclusion

- The highest fluid balance hospitals have 11% to 13% longer risk-adjusted pLOS for visceral abdominal surgery

- Independent of patient complexity and complications. The findings were consistent with evidence that isovolemic resuscitation in enhanced recovery protocols accelerates recovery of bowel function.
- intraoperative fluid administration practice patterns are pervasive across disparate procedures

Keywords: Intraoperative Fluid Management, Health Care, Surgery

INTRODUCTION

Majority of Major surgery are considering being a physiologic insult that can be associated with significant morbidity and mortality. The manifestation of one or more postoperative complications adversely effects both short-term and long-term survival and increases healthcare costs [1]. The main aim of prevention of postoperative morbidity is a key factor in providing high-quality, high-value health care. The topic Perioperative fluid management practice remains a highly discussed and debatable topic. There scope is wide variability of practice, both between on individuals and institutions basis. Perioperative morbidity is linked to the amount of the intravenous fluid administered (fluid therapy) with both insufficient and, more commonly, excess fluid delivery leading to increased postoperative complications [2].

Currently taught and practiced methods of intraoperative volume management in which intravenous fluids are given based on a generalizable formula relying on body weight per unit time and modified by the perceived magnitude of surgical 'trauma' [3]. But these are not supported by known physiologic principles. Fluid therapy should be considered when patients are both in need of enhanced blood flow and are fluid responsive.

Different studies have shown that approaching fluid therapy management with the aim of hemodynamic stabilization can minimize the complications after major surgery [4]. More compelling are several meta-analyses and quantitative reviews demonstrating the strength of these beneficial effects across patient groups and surgical procedures [5]. The purpose of the study is to provide an overview of the components of an effective perioperative fluid administration assessment.

MATERIALS AND METHODS

1. We included all patients who underwent 1 of 3 categories of operations under general anesthesia between September 1, 2014 and August 30, 2016 selective basis.
2. This is a retrospective cohort study from the Hospital Surgical Quality Collaborative (SQC),
3. A voluntary network of 50 hospitals that collect data on surgical patients.
4. Each participating hospital employs at least 1 trained Surgical Clinical Quality Reviewer to prospectively collect data on general, gynecologic, and vascular surgery patients.
5. Patient selection uses an algorithm designed to minimize selection bias. SQC data collection is Institutional Review Board exempt, and the current study was performed with Institutional Review Board review, from a limited data set derived from the SQC database.
6. We included all patients who underwent 1 of 3 categories of operations under general anesthesia an elective basis..
7. We excluded urgent and emergency operations to minimize bias.

STATISTICAL ANALYSES

We evaluated the relationships between fluid balance and patient and procedural characteristics using Kruskal-Wallis analysis of variance on ranks. We constructed charts to display variation in scores across hospital for each individual operation, then compared hospital-level correlations in fluid balance across operations using Pearson rank correlation coefficients, and displayed the associations with fitted scatter plots.

To compare hospital characteristics and clinical outcomes according to fluid administration practices, we then ranked and grouped hospitals into 4 evenly-sized quartiles by average normalized fluid balance by operation. There were 50 hospitals eligible for analysis of intestinal resections, 50 hospitals for hysterectomy, and 36 hospitals for endovascular procedures. We compared hospital

characteristics and outcomes across quartiles using Kruskal-Wallis tests.

RESULTS

This manuscript is the result of 2 years of evidence-based, discussions, analysis, and synthesis of the currently known risks and benefits of individual fluids and the best methods suitable for administering them. The results of this paper provide an overview of the components of an effective perioperative fluid administration plan and address both the physiologic principles and outcomes of fluid administration. In our study we find that there is a lot of variation in fluid balance between hospitals ($P < 0.001$, all procedures), but significant within-hospital correlation across operations (Figure-1).

The study revealed evidence-based suggestions and individualized algorithms for a standardized approach to perioperative volume therapy for surgical patients. We identified 6043 intestinal resections, 18,123 hysterectomies, and 951 abdominal endovascular procedures eligible for analysis during the study period. Fluid balance was normalized, according to the method described above. The average fluid balance and standard deviation across all patients was 1758 ± 1654 for intestinal, 1059 ± 1331 for hysterectomy, and 848 ± 1338 for endovascular.

Average fluid balances according to the patient characteristics are projected in Table 1. The intestinal resections average normalized fluid balance was higher for patients who were younger, male, non-white, ASA 2 or 3, with less comorbidity. Tobacco or alcohol users and having surgery for inflammatory disease, rather than neoplasm. We observed the findings for hysterectomy were relatively similar except that operations for malignancy had significantly higher fluid balance than those for other indications (Table 2). Endovascular higher fluid balance was associated with age less than 75, fewer comorbidities, and tobacco use, but not with sex, race, body mass index, ASA class, or alcohol use (Table 3).

Table-1: Patient Characteristics with their Normalized Fluid Balance with respect to colorectal resections.

Colorectal Resections (N =6043)			
	N (%)	**Fluid Balance (Mean ± SD)**	***P***
Age group			<0.001
<50	1034 (17.1)	1898±1731	
50–64	2278 (37.7)	1862±1754	
65–74	1522(25.2)	1706±1297	
≥75	1209 (20.0)	1506±1761	
Sex			<0.001
Male	2756 (45.6)	1812±1540	
Female	3287 (54.4)	1712±1742	
Race			<0.001
White	5088 (84.2)	1728±1602	
Black	677 (11.2)	1803±1291	
Other	278(4.6)	2199±2868	
BMI			0.09
<18.5 or unknown	175 (2.9)	1630±1170	
18.5–24.9	1613 (26.7)	1705±1412	
25–29.9	2030 (33.6)	1745±1333	
30–34.9	1269 (21.0)	1825±2000	
≥35	961 (15.9)	1807±2140	
ASA classification			<0.001
ASA 1	85(1.4)	1617±1124	
ASA 2	2695(44.6)	1769±1398	
ASA 3	3009 (49.8)	1757±1777	

ASA 4 or 5	254 (4.2)	1689±2555	
Comorbidities			<0.001
0	1909 (31.6)	1774±1299	
1–2	3372 (55.8)	1792±1786	
3–4	677 (11.2)	1560±1673	
5+	78(1.3)	1622±2806	
Tobacco use			<0.001
No	4587 (75.9)	1735±1638	
Yes	1456 (24.1)	1828±1703	
Alcohol >2/d			<0.001
No	5850(96.8)	1749±1653	
Yes	193(3.2)	2019±1662	
Diagnosis			<0.001
Cancer	2248 (37.2)	1770±1931	
Diverticular disease	1565 (25.9)	1840±1387	
Inflammatory bowel disease	266 (4.4)	1929±1260	
Other	1903(31.5)	1649±1548	

Table-2: Patient Characteristics with their Normalized Fluid Balance with respect to hysterectomy

Hysterectomy (N = 18123)			
	N (%)	**Fluid Balance (Mean ± SD)**	***P***
Age group			<0.001
<50	11290 (62.3)	1003±1105	
50–64	4675 (25.8)	1170±1807	
65–74	1504(8.3)	1128±1110	
≥75	598(3.3)	1114±1323	
Race			<0.001
White	13719(75.7)	1072±1309	
Black	3189(17.6)	972±1427	
Other	1214(6.7)	1152±1302	
BMI			<0.001
<18.5 or unknown	217 (1.2)	1202±1087	
18.5–24.9	4005(22.1)	1140±1127	
25–29.9	5038(27.8)	1105±1309	
30–34.9	4023(22.2)	1022±1713	
≥35	4838(26.7)	973±1136	
ASA classification			0.01
ASA 1	1739(9.6)	1072±1241	
ASA 2	12233(67.5)	1050±1333	
ASA 3	4041 (22.3)	1090±1367	
ASA 4 or 5	108 (0.6)	809±1017	
Comorbidities			0.56
0	10819 (59.7)	1054±1406	
1–2	6760 (37.3)	1069±1229	
3–4	525 (2.9)	1061±970	
5+	36 (0.2)	1035±1084	
Tobacco use			0.25
No	13628 (75.2)	1060±1410	
Yes	4494 (24.8)	1058±1058	
Alcohol >2/d			0.51

No	17959 (99.1)	1060±1334	
Yes	163 (0.9)	991±920	
Diagnosis			<0.001
Malignant neoplasm	2012 (11.0)	1327±1286	
Benign neoplasm/carcinoma in situ	5636 (31.1)	1000±1286	
Other	10493 (57.9)	1041±1357	

Table-3: Patient Characteristics with their Normalized Fluid Balance with respect to endovascular

Endovascular (N =951)			
	N (%)	**Fluid Balance (Mean ± SD)**	***P***
Age group			0.02
<50	10 (1.1)	915±949	
50–64	184 (19.4)	939±2002	
65–74	359 (37.8)	945±1128	
≥75	396 (41.7)	716±1110	
Sex			0.61
Male	718 (75.5)	842±1374	
Female	233 (24.5)	867±1223	
Race			0.46
White	853 (89.7)	845±1327	
Black	65 (6.9)	859±1690	
Other	33 (3.5)	894±691	
BMI			0.39
<18.5 or unknown	24 (2.5)	547±1199	
18.5–24.9	246 (25.9)	819±1186	
25–29.9	376 (39.6)	862±1471	
30–34.9	193 (20.3)	979±1389	
≥35	112 (11.8)	701±1087	
ASA classification			0.15
ASA 2	47 (5.0)	846±1215	
ASA 3	693 (72.9)	861±1368	
ASA 4 or 5	210 (22.1)	805±1264	
Comorbidities			0.001
0	67 (7.1)	1114±885	
1–2	575 (60.5)	880±1435	
3–4	258 (27.2)	753±1192	
5+	49 (5.2)	608±1349	
Tobacco use			0.02
No	555 (58.4)	794±1400	
Yes	395 (41.6)	923±1242	
Alcohol > 2/d			0.80
No	899 (94.6)	848±1358	
Yes	51 (5.4)	843±936	

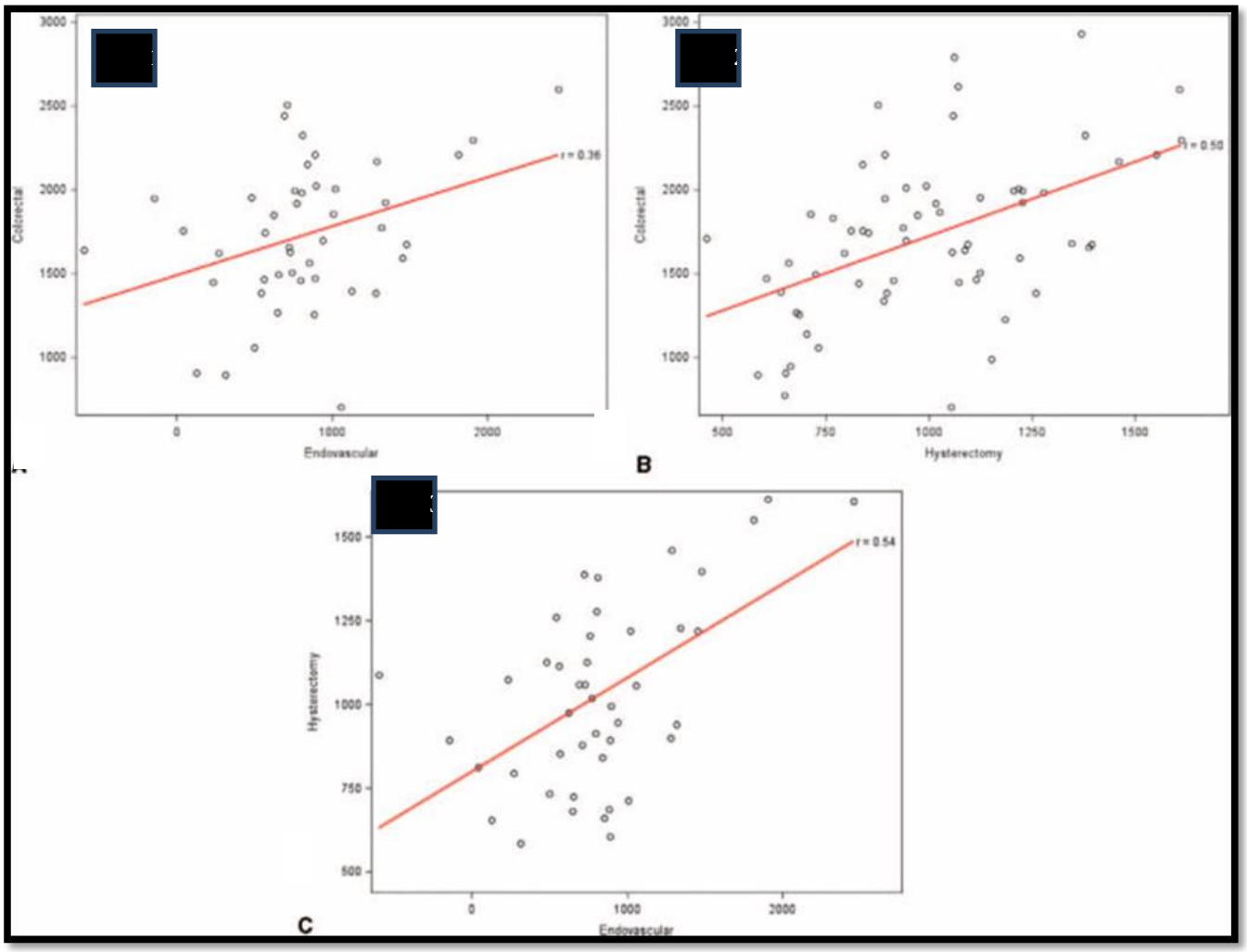

Figure-1:

- Scatter plots of hospitals' average normalized fluid balance in milliliters and
- Intrahospital correlations in average fluid balance across procedures.

Each dot represents a single hospital's average, the line represents linear best fit, and the Pearson correlation coefficient is displayed.

1. Intestinal resections and abdominal endovascular procedures;
2. Intestinal resections and hysterectomy;
3. Hysterectomy and endovascular procedures.

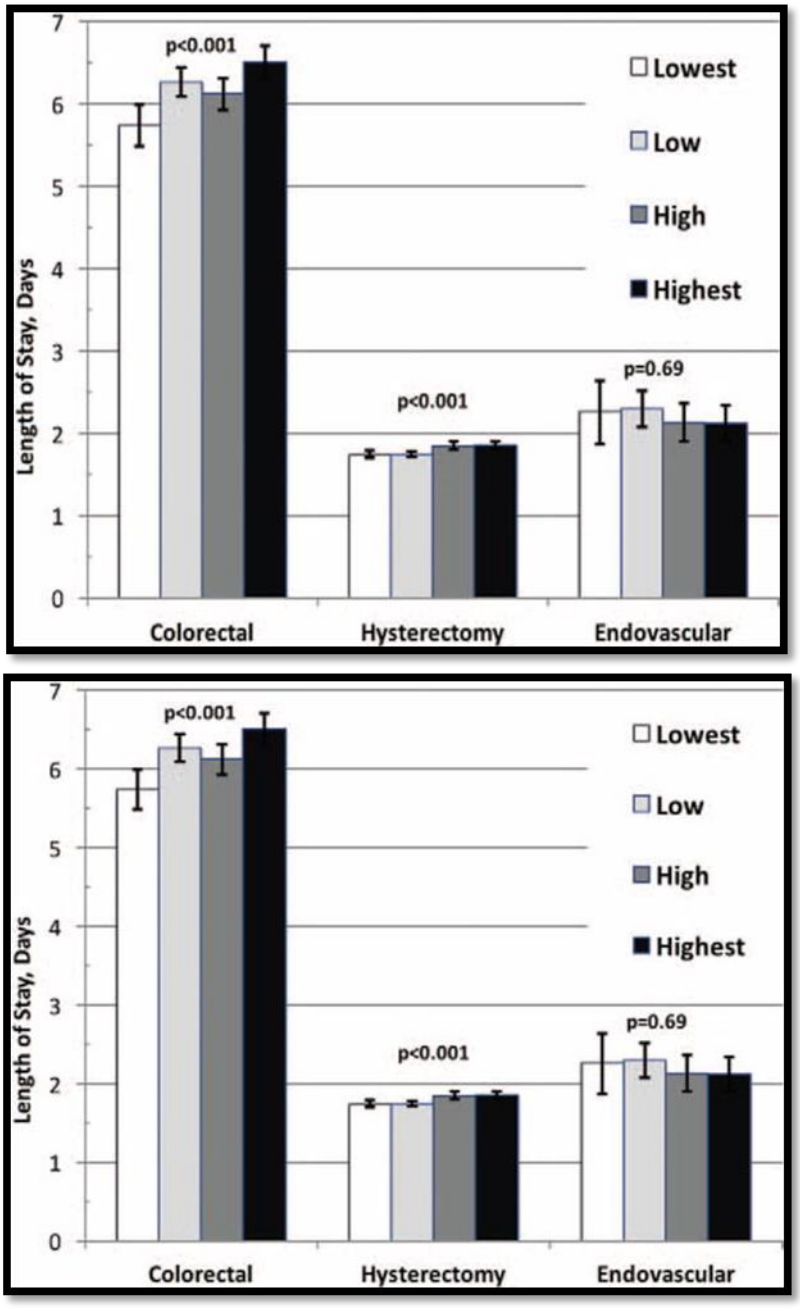

Figure-2:

Average postoperative length of stay, by fluid balance quartile, for intestinal resections, hysterectomy, and endovascular procedures.

DISCUSSION

It is observed that one of the most important drivers of length of stay in the absence of major postoperative complications is the occurrence of postop ileus [6-8.] Figure-2.This has been associated in turn with the volume of fluid administration during surgery. Thus, a common element of modern enhanced recovery protocols is the limitation of excessive intravenous fluid and a focus on maintenance of normovolemia [6, 9-11].

This study applied a novel metric to compare intraoperative fluid administration practices-normalized fluid balance. Most previous research has used total fluid administration or volume per hour as the exposure of interest. Even before considering the clinical outcomes, the wide variation between hospitals in average fluid balance is notable. There was some association between

higher fluid balance and patient-specific characteristics such as younger age, lesser comorbidity, specific indications for surgery (inflammatory bowel disease among the intestinal resections and malignancy among the hysterectomies), and operative duration. The observational studies on healthcare practices there are limitations to our analysis in our study. Although the SQC data are clinically rich, we lack several key clinical parameters in details during our analysis. We did not account for the time of day of the operation nor did the amount of time the patient remain without oral intake before surgery.

CONCLUSION

The study finds that hospitals may vary widely in their intraoperative fluid administration practices and their management is correlated across intestinal resections, hysterectomy and abdominal endovascular surgery procedures for which there is otherwise quiet little clinical care overlap. The association between fluid volume and time to recovery may be causally related as has been proposed in the enhanced recovery literature or it may reflect a confluence of care protocols in hospitals that have promoted both limitation of intraoperative fluids and fast-track postoperative care protocols. Either way, these findings reveal systematic clinical care variation that can be evaluated and restructured to optimize the perioperative care protocols for these operations. In future we will try to evaluate the specific care protocols monitoring and approaches to fluid administration in the hospitals with the best perioperative care practices and its outcomes.

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How to cite this article: Dr. Venkatesh,Dr. M..RamakrishnaDr. D.M.Ravichand. Assessment of intraoperative fluid administration practices in various surgical specialties: A population based study. Int J of Allied Med Sci and Clin Res 2017; 5(4): 920-927.

Source of Support: Nil.**Conflict of Interest:** None declared.