Kobe J. Med. Sci., Vol. 56, No. 1, pp. E18-E23, 2010

Limited Hydration May Reduce Intraoperative Blood Loss in Retropubic Radical Prostatectomy

KATSUMI SHIGEMURA[1, 2], TOMIHIKOYASUFUKU[2],
KUNITO YAMANAKA[1], MASUO YAMASHITA[1], TETSURO UEFUJI[3],
SOICHI ARAKAWA[2*], and MASATO FUJISAWA[2]

[1]*Department of Urology, Akashi Municipal Hospital*
[2]*Division of Urology, Department of Organ Therapeutics, Faculty of Medicine, Kobe University Graduate School of Medicine*
[3]*Department of Anesthesiology, Akashi Municipal Hospital*

Received 21 December 2009/ Accepted 12 January 2010

Key Words: Intraoperative blood loss; Retropubic radical prostatectomy; Limited hydration during operation

ABSTRACT

Retropubic radical prostatectomy (RRP) may involve major intraoperative blood loss. This study focuses on how limited intraoperative hydration, especially in the early part of the surgery, affects the total blood loss. Fifteen prostate cancer patients were enrolled in this study in which the RRPs were performed by a single surgeon with limited (no more than 1500 ml as a rule) intraoperative hydration in the first 2 hours of the surgery when ligation of intrapelvic lymph node, dorsal vein complex (DVC), neurovascular bundle (NVB) and cut of urethra are assumed to be finished, and were compared with the control group in which no intervention of hydration was undertaken. Intervention group (n=15) had significantly less intraoperative blood loss ($p<0.05$) compared with control group even though blood pressure at the first 2 hours was not significantly different. Limited hydration did not cause apparent adverse events resulted from dehydration. In conclusion, limited hydration especially in the first half of operation may reduce intraoperative blood loss without any side effects of dehydration. This study could help to establish detailed guidelines for hydration methods for less blood loss during RRP.

INTRODUCTION

Retropubic radical prostatectomy (RRP) ordinarily involves significant intraoperative blood loss (1-9). This is partly because the prostate is located deep in the pelvis and surrounded by many major vessels such as the dorsal vein complex (DVC) and neurovascular bundle (NVB) (8, 10). The average volume of blood loss during surgery is about 1000 ml even with skilled surgeons. Main intraoperative complication is hemorrhage and it may be caused from: 1) ligation of intrapelvic lymph node; 2) cut of endopelvic fascia; 3) ligation of DVC (10), and 1500ml of crystaloid until prostate is removed is necessary. Substantial bleeding may also occur unexpectedly (8, 10).

Many institutions perform autologus blood infusion (800-1200ml) (9, 12, 13). Morioka et al. reported that 4-unit preoperative donation of autologous blood (PDA) reduced the

Phone: 81-78-382-6155 Fax: 81-78-382-6169 E-mail: soichi@med.kobe-u.ac.jp

intraoperative need for homologous blood transfusion (14). We followed their methods and performed 800ml PDA as a rule to reduce the need for homologous blood transfusion. However, especially during the operation, blood transfusion is managed by anesthesiologists and how patients are hydrated can vary between anesthesiologists without any definite guidelines on how to and when to use PDA. Anesthesiologists may tend to increase the infusion volume to avoid intraoperative dehydration (5).

Previous reports showed the effects on intraoperative blood loss of limiting hydration during prostate mobilization, and that limiting intravenous fluids before completing dissection of the prostate is feasible without increasing morbidity in the hemodynamically stable patient (1). Davies et al. demonstrated that limiting intravenous hydration during prostate dissection could decrease intraoperative blood loss in US population (1). In a randomized prospective anesthesiologcal study, Boldt et al. reported that controlling hypotension during radical prostatectomy was more effective for reducing the performance of allogeneic blood transfusion than acute normovolemic hemodilusion performed before the operation (15).

In this study, we investigated how limited hydration in the first half part of RRP affects the volume of intraoperative total blood loss in order to offer a definite hydration method during RRP.

MATERIALS AND METHODS

Patients and methods of hydrations.

A total of 15 consecutive patients with localized prostate cancer underwent RRP by a single surgeon over 1-year period. All RRPs were conducted in general anesthesia with epidural anesthesia as a rule. Intraoperative hydration was limited to 1500 ml in the first 2 hours of surgery as a rule. They were compared with the control group (n= 22) who underwent RRP by the same surgeon and was not subject to definite methods of hydration. Intraoperative blood loss and hydration volume in total and in the first 2 hours were investigated and compared in these 2 groups. In addition, we compared hematocrit value of pre- and post operation (the day before and after RRP). All RRPs were performed by retrograde approach. The cases with some adverse events such as rectal injury were excluded from this study.

We limited hydration volume for the first 2 hours of operation in this study because this is an estimated time to finish the following procedure which may cause major blood loss: 1) ligation of intrapelvic lymph node; 2) cut of endopelvic fascia; 3) ligation and cut of DVC (10). We compared age, serum prostate specific antigen (PSA), specimen weight, body mass index (BMI), the performance of neoadjuvant hormonal therapy, Gleason score, the performance of blood transfusion, period since prostate biopsy, and total i.v. infusion volume between 2 groups. Nerve sparing procedure was not performed because patients did not request it. We recorded and state blood loss in this study as including urine volume after cut of the urethra unless otherwise stated.

Intraoperative i.v. hydration was managed by anesthesiologists. As a rule, a single anesthesiologist took part in each surgery. A total of 8 anesthesiologists were involved in this study.

Statistical analysis.

The data were analyzed statistically using the JSTAT - Java Virtual Machine Statistics Monitoring Tool (Sun Microsystems, Inc., Santa Clara, California, USA). Statistical analyses compared the two groups as mentioned above. P values ≤ 0.05 were considered as statistically significant.

RESULTS

Table I shows the patients' data. Blood loss (± standard deviation (S.D.)) was 1408.1 ± 585.22 g in intervention group and 2094.9 ± 1229.8 g in control group, and i.v. infusion volume in the first 2 hours of surgery was 1597.3 ± 237.98 ml in intervention group and 2059.8 ± 924.79 ml in control group. Total infusion volume was 3493.3 ± 1099.8 ml in intervention group and 5372.5 ± 3163.9 ml in control group (Table II). Pre- and post-operative hematocrit value was 39.8 ± 2.90 and 33.7 ± 2.84 % in intervention group and 38.0 ± 2.99 and 29.6 ± 5.14 % in control group, respectively.

Our statistical data showed that intervention group had significantly less intraoperative blood loss compared to control group ($p<0.05$). Blood pressure at 2 hours after the initiation of surgery were 104 ± 11 / 60 ± 8 mmHg in intervention group and 102 ± 14 / 60 ± 10 mmHg in control group, respectively. Importantly, there was no significant difference in blood loss and blood pressure at the point of 2 hours of surgical procedure in these 2 groups ($p>0.05$), suggesting that i.v. infusion volume during surgery, at least for the first 2 hours of surgery, was not determined by those factors. Regarding the comparison of pre- and post operative hematocrit, there was no significant difference between intervention group and control group ($p>0.05$).

Basically, PDA (800 ml) was taken from a patient before the operation to avoid homologous blood transfusion. Most patients received PDA regardless of whether they experienced anemia during the operation. One patient in control group could not undergo PDA before RRP because of iron-deficiency anemia and therefore received homologous blood transfusion at the time of surgery to compensate for a slight progression of anemia during surgery. Otherwise, no factors showed any significant differences between these two groups.

Table I. Patients' data

	Intervention group (n=15)	Control group (n=22)
Age (median)	51-75 (64)	55-79 (69.5)
PSA (ng/ml) (median)	5.15-46.62 (6.78)	0.03-23.70 (8.70)
specimen weight (g) (median)	14-51 (35)	15-65 (32.5)
BMI (median)	20.5-29.8 (23.1)	17.7-27.1 (23.85)
Neoadjuvant hormonal therapy Performed	5 cases (33.3 %)	10 cases (45.4 %)
Gleason score (median)	6-9 (7)	6-8 (6)
Period from PBx (months) (median)	2-4 (2.5)	2-19 (3)

PBx: Prostate biopsy

Table II. I.V. infusion, blood loss, and hematocrit

	Intervention group (n=15)	Control group (n=22)	
First 2 hours of operation			
Infusion volume (ml)	1597.3 ± 237.98	2059.8 ± 924.79	**(p=0.0343)**
Blood pressure (mmHg)	104 ± 10 / 60 ± 8	102 ± 14 / 60 ± 10	(N.S.)
Total			
Infusion volume (ml)	3493.3 ± 1099.8	5372.5 ± 3163.9	**(p<0.0001)**
Blood loss (g)	1408.1 ± 585.22	2094.9 ± 1229.8	**(p=0.0301)**
Hematocrit (%)			
Pre-operative (the day before RRP) (1)	39.8 ± 2.90	33.7 ± 2.84	
Post-operative (the day after RRP) (2)	38.0 ± 2.99	29.6 ± 5.14	
(1)- (2)	6.05 ± 3.16	8.43 ± 4.93	(N.S.)

N.S.: not significant

DISCUSSION

Generally, urologists and anesthesiologists recognized RRP as a major source of blood loss (5, 16). However, surgical techniques in RRP have been improved remarkably partly due to advances in anatomical understanding and partly from new developments in surgical instruments (8, 12, 17, 18). Laparoscopic surgery and robotic surgery give us a better visual field during surgery and have contributed to a better understanding of anatomy and surgical layers unrecognized in open surgery (7). Those improvements have resulted in less intraoperative blood loss, better margin status, and better potency after surgery than older methods (11, 18).

On the other hand, anesthesiologists may still believe RRP requires extra hydration or blood transfusion to maintain blood pressure despite the progression in surgical techniques (5, 15). Especially, younger and less experienced anesthesiologists tend to give a patient more hydration during RRP to prevent renal failure caused by dehydration besides keeping blood pressure normal (5). In this respect, it is important to note that our data demonstrated that blood pressure in the first half part of surgery were not statistically different between less hydrated (intervention) group (no more than 1500 ml infusion) and control group without any definite method about volume of infusion even though the total hydration volume was significantly different in these 2 groups ($p<0.05$). This finding suggests that hydration during the first half part of surgery was not guided by blood pressure at that point of operation.

Urologists may have the impression that it is easy to bleed and difficult to arrest bleeding when to see over-swelling of intrapevlic veins especially in DVC or around it mainly resulted from over-hydration and following higher venous blood pressure. This hypothesis is partly supported by the reports by Davies et al. (1) that central vein pressure (CVP) increased by over-hydration might be related to more blood loss and by Johnson et al. stating the strong relationship between intraoperative blood loss and inferior vena cava (IVC) pressure during liver resection surgery (19). It is necessary to discuss these findings and outcomes with anesthesiologists before surgeries so that unnecessary blood loss caused by over-hydration might be prevented (1). In addition, major blood loss regardless of the reason leads to a worse surgical field, making the sparing of the NVB, control of appropriate surgical margins and continence, and layer recognition, for instance between Denonvilliers' fascia and rectum, more difficult. From these points of view, less blood loss is important for better outcomes in terms of not only patients' cancer controls but patients' quality of life.

Our methods of limited hydration did not cause any adverse event such as low blood pressure and dehydrated symptoms. This was designed by Davis et al.'s reports but there is generally a difference in physique and shape of pelvis between United states' and Japanese men so that the methodologies of hydration should be different in a way. On the other hand, their number of RRP done by one surgeon in studied period (519 cases for 3 years and 4 months) was much more than in Japanese one because medical issue, the number of hospitals per definite population, educational system in surgeons including urologists are quite different in two countries so that it needs revisions to compare the data directly. Our data and hydration methods may be available in a variety of surgeons and hospitals where a variety of urologists and anesthesiologists as to skill and experience take part in RRP even though this major difference was considered, and therefore might be valued from the viewpoint of educational system of surgeons and anesthesiologists. Moreover, our all cases did not include the case in which the surgeon was changed in the middle of the surgical procedure in order to exclude the bias between surgeons strictly.

As risk factors for more blood loss, Dash et al. reported in their RRP cases that prostate size, use of general anesthesia, use of neoadjuvant hormonal therapy, and surgeon expertise were the independent factors associated with a need for perioperative homologous blood transfusion (20). In addition, BMI, an objective measure of obesity, was reported to relate to blood loss during radical cystectomy (8). Our data regarding risk factors that may affect blood loss showed no significant differences between intervention and control groups. Longer study periods or the use of several surgeons with a large number of cases would bring a strong supporting data by our future's project. In Summary, we demonstrated that limited hydration especially during the first half of RRP causes significantly less intraoperative blood loss without any adverse events resulted from dehydration. Further prospective studies with more number of cases and the establishment of guidelines for blood transfusion for anesthesiologists are necessary to offer a appropriate methods for less blood loss during RRP.

ACKOWLEGEMENTS

We thank Drs. Masaru Lee and Yoshihisa Kinoshita for patient care and Gary Mawyer, M.F.A., for English editing.

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