

Preoperative Warming Up Exercises Improves Laparoscopic Operative Times in an Experienced Laparoscopic Surgeon

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KEYWORDS

Pre-operative warm-up
Laparoscopic Surgery
Psychomotor Performance

ABBREVIATIONS

LRN = Laparoscopic Radical Nephrectomy
LPN = Laparoscopic Partial Nephrectomy
NWU = Non Warm-up
WU = Warm-up
PCA = patient controlled analgesia

Words: 1622 words, 13 references

Abstract:

Purpose: Performing warm-up exercises prior to athletic competition or stage performance is very common; however, most surgeons do not “warm-up” prior to performing complex surgery. We analyzed the intra-operative effects of warming up prior to surgery in an experienced laparoscopic surgeon.

Methods: A retrospective review of all laparoscopic partial (LPN) and radical nephrectomies (LRN) completed by an experienced laparoscopic surgeon (RVC) were analyzed according to whether or not warm-up exercises were performed prior to surgery. Routine warm-up consisted of 15-20 minutes of pelvic trainer suturing exercises (forehand and backhand sutures and knot tying), using both hands. Intra-operative and post-operative parameters were examined.

Results: LRN and LPN subjects were well matched among the warm-up group and non warm-up group. Patients in the LPN warm-up group did have significantly larger tumors (3.7cm vs. 2.4 cm, $p = 0.02$). Despite larger tumors, surgical time was significantly less in the warm-up group (227 minutes vs. 281 minutes, $p=0.04$) and total operative room time trended towards significance (320 minutes vs. 371 minutes, $p=0.0501$). Similarly, in the LRN group, operative times and total operating room time was significantly less in the pre-operative warm-up group ($p = 0.0068$ and $p=0.014$ respectively). Intra-operative and postoperative complications, estimated blood loss, positive margin rate, warm ischemic time, length of stay, changes in hemoglobin and creatinine from baseline were not significantly different between the two groups.

Conclusion: Performing warm-up exercises prior to complex laparoscopic surgery may improve operative times and performance in the operating room, especially for complex laparoscopic surgeries.

Introduction:

Warming up prior to a musical concert, athletic competition or other highly skilled tasks is very common and has been shown in a number of studies to improve overall performance ^{1,2}.

Many surgeons will routinely “mentally warm-up” by envisioning the type of surgery or surgical procedure they are about to perform. This exercise has been shown in a number of studies to improve surgical performance.³⁻⁵ Although surgery is a very highly skilled task, many surgeons do not routinely “physically warm-up” with surgery related tasks prior to an operation. This occurs despite a small but growing body of evidence that physically warming up prior to surgery can improve performance in the operating room.^{6,7}

As the demand for accountability and performance based initiatives are entering into the healthcare landscape, methods to improve surgical performance and outcomes should be examined. These methods, such as mentally or physically performing surgically related tasks prior to operating, could improve performance and outcomes in novice and advanced surgeons. We examine the effects of a simple pre-operative warm-up routine on patient outcomes and operative room parameters in an experienced laparoscopic surgeon.

Methods:

A retrospective review of all laparoscopic partial (LPN) and radical nephrectomies (LRN) completed by one experienced laparoscopic surgeon (RVC) were analyzed according to whether or not warm-up exercises were performed prior to surgery. All procedures were performed from June 2005-July 2009. Routine warm-up consisted of 15-20 minutes of pelvic trainer suturing exercises. This was performed using both hands, and included forehand and backhand sutures and knot tying. Prior to July 2007, the surgeon did not warm-up for planned LPN or LRN. Starting in July 2007, a planned warm-up was done prior to LPN or LRN. Cases of LPN (n = 13) and LRN (n = 29) without warm-up from June 2005 through July 2007, were compared to cases of LPN (n = 16) and LRN (n = 17) with warm-up from

July 2007 to July 2009. Only cases in which the major portion of the procedure was performed by the primary surgeon or first start cases were included in the analysis.

Intra-operative parameters, including total operative time, surgical time, estimated blood loss, warm ischemic time, complications and positive margin rates, and post-operative parameters, including, total length of stay, changes in post-operative hemoglobin and creatinine, were analyzed. Morphine equivalents were also calculated for patients after reviewing all narcotics administered after post-operative day 1 as well as determining the number of patients who required a PCA for pain control. A weighted average cost per minute of operating room time was calculated for fiscal year 2010 using departmental, anesthesia and costs of implants for LRN and LPN.

Data were analyzed using unpaired Student T tests, and Fischer Exact test where appropriate. All statistical analyses were performed using STATA software, version 9.0 (Stata Corp, College Station, TX).

Results:

The WU group and NWU group in the LRN cohort were well matched in terms of age at surgery, gender, tumor size, ASA classification and BMI. As summarized in Table 1, the WU group had a significantly shorter total operating room time by 53.9 minutes ($p = 0.0103$) and significantly shorter surgical time of 47.2 minutes ($p = 0.0208$). Changes in serum electrolyte and blood parameters were not significantly different between each group and the overall length of stay was also not significantly different. The percentage of patients who underwent concurrent adrenalectomy was not different between the groups (NWU = 71%

versus WU = 81%, $p = 0.283$), and there was no statistically significant increase in operative time when an adrenalectomy was included in the procedure.

The percentage of patients who required a PCA post operatively (NWU = 28% versus WU = 12%, $p = 0.119$) and narcotic used in morphine equivalents between the two groups was also not statistically significantly different, although there was a trend for less narcotic use in the WU group (14.5 + 15.2 mg vs 7.91 + 9.5 mg, $p = 0.266$).

The clinical parameters for the LPN group are summarized in Table 2. The LPN groups were also well matched in terms of age at surgery, gender, ASA and BMI. Tumors were significantly larger in the WU group by approximately 1.54 cm. (2.44 + 0.67 vs 3.99 + 2.04, $p = 0.015$). Again, surgical times were significantly shorter in the WU group compared to the NWU group (281.92 minutes vs. 227.13 minutes, $p = 0.0038$), and a decrease in the total operating room time trended toward significance ($p = 0.0501$). Warm ischemic time, estimated blood loss, changes in post-operative serum parameters and total length of stay were not statistically significantly different between the two groups. The percentage of patients who required a PCA for pain management and the morphine equivalents required after post-operative day 1 to discharge was also not statistically significantly different between the groups. (NWU = 33% vs WU = 20%, $p = 0.662$, and 9.58 + 9.41 mg vs 6.72 + 10.18 mg, $p = 0.534$ respectively)

Overall intra-operative complications (any event that deviated from the primary operation) rates in the LRN and LPN were low precluding any robust statistical analysis among the warm-up groups (LRN = 3 complications, LPN = 3 complications). When using a weighted

average for operating room costs per minute, the saving incurred by the decreased operating room times in the LRN would have amounted to on average approximately \$2230.92 and \$2201.53 in the LPN.

Discussion

The concept of warming up prior to a performance in sports, theater and other skill based activities is well established ^{8,9}. Only recently have researchers begun to examine the effects of preoperative warm-up directly on surgical performance and outcomes. This study is one of the first papers to report a direct improvement in measurable operating room efficiency after performing warming-up exercise prior to complex laparoscopic surgery.

There are very few studies that look directly at the impact of preoperative warm-up and surgical outcomes. One of the first includes Calatayud et al.⁶, who examined the impact of performing laparoscopic tasks on a virtual reality simulator immediately prior to performing a laparoscopic cholecystectomy. They found that surgeons who performed approximately 15 minutes of warm-up on a simulator just prior to surgery had significant improvement in OSATS global rating scores compared to those who did not warm-up. This study, however, did not examine the effects of warm-up on operative time or post-operative outcomes.

Kahol et al ⁷examined the effects of warming up in a virtual reality simulator on performance of surgically related tasks in the laboratory setting. Warming-up resulted in an improvement in surgical skill proficiency that was noted across all levels of surgical training. It even helped reduce errors related to post call fatigue. Finally, Do et al ¹⁰ demonstrated that 15

minutes of basic skill task warm-up exercises on a laparoscopic pelvic trainer significantly improved the subsequent time to perform the same tasks in Ob/Gyn residents and medical students.. These studies were limited to the laboratory and employed the same simulator for warm-up practice and evaluation of the surgical tasks.

This is the first study to look directly at the impact of pre-operative warm-up on patient outcomes. In our series, the 15-20 minutes of warm-up resulted in an average decline of just approximately 50 minutes of operating room time in the LPN and LRN groups. Although other measures of outcomes, such as length of stay, narcotic use, warm ischemic time, blood loss, and changes in serum parameters were not different between the groups, this study suggests that a warm-up period improves operating room efficiency even in an advanced laparoscopic surgeon, and thus may significantly impact both the cost of hospitalization and the patient safety/outcome with regard to amount of time under anesthesia. ¹¹⁻¹³ Using a weighted cost average for LRN and LPN at our institution, the decline in operating room times resulted in over \$2000 in cost savings per procedure for the hospital or over \$60,000 in the 2 years that warm-up was initiated. Finally, less surgical and anesthesia time has been shown to significantly reduce post-operative complications in a number of previous surgeries.

11-13

There are several limitations to this study. One is the retrospective nature of the data collection. This is also a single surgeon series. The impact of the various trainees who were involved in the procedure cannot be determined, as well as other factors that could have impacted operating room times (operating room staff, anesthesia staff, sleep deprivation in the surgeon or assistant, etc); however, at our hospital there is a dedicated urology laparoscopy team that would have participated in over 90% of the procedures which could

limit some of the external factors influencing times in the operating room. The study also does not identify the specific parts of the procedure where operative times improved in the warm-up group or if there was a reduction in the number of intra-operative errors. Warming up could help with some of the earlier less critical tasks, while the more complex portions of the surgery, such as dissecting the hilum or resecting the tumor, may not be affected by the warm-up period as the surgeon would have gone through the warm-up during the initial part of the procedure.

Despite the limitations, this singular study suggests that even in an advanced laparoscopic surgeon, warming up can have some benefits to surgical efficiency. It could potentially impact on the adverse effects of prolonged anesthesia for the patient. Finally, it could reduce operating room costs, by decreasing anesthesia time and total time spent in the operating room. Whether or not pre-operative warm-up can improve overall surgical outcomes and reduce intraoperative errors among experienced laparoscopic surgeons remains undetermined in this study.

Conclusion:

Pre-operative warm-up appears to improve procedural efficiency when performing complex laparoscopic procedures in an experienced laparoscopic surgeon.

References:

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Table 1: Clinical Characteristics in Patients Undergoing LRN

	Non Warm-up (n = 29)	Warm-up (n =17)	p value
AGE (SD)	66.1 (13.5)	57.4 (24.7)	0.132*
SEX			
Male	19 (65.5%)	10 (58.82%)	
Female	10 (34.5%)	7 (41.18%)	0.755 **
ASA			
1	0	1 (5.88%)	
2	9 (31.0%)	9 (52.94%)	
3	19 (65.5%)	6 (35.29%)	
4	1 (3.45%)	1 (5.88%)	0.109 **
BMI in kg/m2 (SD)	29.2 (7.10)	28.2 (7.17)	0.646*
SIDE			
Left	17 (58.6.0%)	8 (47.1%)	
Right	12 (41.2%)	9 (52.9%)	0.545 **
Tumor Size in cm (SD)	6.57 (2.81)	5.88 (2.32)	0.403 *
Total OR Time in minutes (SD)	388.3 (65.5)	334.4 (66.3)	0.0103 *
Surgical Time in minutes (SD)	290.4 (61.1)	243.2 (69.8)	0.0208 *
EBL in mL (SD)	130.9 (186.4)	74.4(41.90)	0.226 *
Change Creatinine in mg/dL (SD)	1.02 (2.1)	0.464 (0.342)	0.287 *
Change Hgb in g/dL (SD)	-2.11(1.25)	-2.12 (1.02)	0.957 *
Length of Stay in hours (SD)	65.6 (27.55)	65.6 (31.07)	0.995 *

SD = Standard Deviation, p values determined by * unpaired T-Test, ** Fischer Exact Test.

Length of stay (time admitted to hospital floor, until time discharge instructions printed)

Change in creatinine/hbg = change from baseline at time of discharge

Table 2: Clinical Characteristics in Patients Undergoing LPN

	Non Warm-up (n = 13)	Warm-up (n =16)	p value
AGE (SD)	57.15 (9.71)	51 (23.97)	0.394 *
SEX			
Male	11 (84.6%)	8(50%)	
Female	2(15.4%)	8(50%)	0.114 **
ASA			
1	0	1(6.25 %)	
2	8(61.5%)	12(75%)	
3	5(38.5%)	3(18.75%)	0.406 **
BMI in kg/m2 (SD)	27.2(5.42)	27.2 (5.26)	0.957 *
SIDE			
Left	6(45.15%)	6(37.5%)	
Right	7(53.85%)	10(62.5%)	0.716 **
Tumor Size in cm (SD)	2.44(0.67)	3.99(2.04)	0.015 *
Total OR Time in minutes (SD)	373.62(62.47)	320.43(74.55)	0.0501 *
Surgical Time in minutes (SD)	281.92 (59.73)	227.13(73.03)	0.0385 *
EBL in mL (SD)	101.2 (67.21)	102.5(74.95)	0.960 *
Ischemic Time in minutes (SD)	32.75 (11.27)	29.4(9.76)	0.533 *
Positive Margin Rate (SD)	0	3 (18.75%)	0.232 **
Change Creatinine in mg/dL (SD)	0.123 (0.153)	0.125 (0.220)	0.972 *
Change Hgb in g/dL (SD)	- 2.57 (1.62)	- 2.30(1.24)	0.616 *
Length of Stay in hours (SD)	66.4 (39.4)	58.8 (30.4)	0.562

SD = Standard Deviation, p values determined by * unpaired T-Test, ** Fischer Exact Test.

Length of stay (time admitted to hospital floor, until time discharge instructions printed)

Change in creatinine/hbg = change from baseline at time of discharge