Grygorenko V. M., Baydo S. V., Pryndiuk S. I., Deneka Y. R. Justification of endolifting in laparoscopic surgery on the kidney (experimental research). Journal of Education, Health and Sport. 2016;6(9):531-538. eISSN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.154739 http://ojs.ukw.edu.pl/index.php/johs/article/view/3875

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part B item 755 (23.12.2015).
755 Journal of Education, Health and Sport eISSN 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 05.08.2016. Revised 25.08.2016. Accepted: 21.09.2016.

JUSTIFICATION OF ENDOLIFTING IN LAPAROSCOPIC SURGERY ON THE KIDNEY (EXPERIMENTAL RESEARCH)

V. M. Grygorenko[2], S. V. Baydo[1] , S. I. Pryndiuk[1,2], Y. R. Deneka[1]

[1]LISOD – Israeli Oncological Hospital , Kyiv, Ukraine
[2]Public institution «Institute of Urology», Kyiv, Ukraine

In the experiment at 8 human corpses the effectiveness of the original model of spiral laparolift and traditional methods of carboxyperitoneum during laparoscopic surgeries for kidney and upper urinary tract have been compared. The offered model of laparolift creats satisfactory intra- and extracorporeal spatial relationships between laparolift, tools and object of surgery, practically does not restrict freedom of extracorporeal movements of handles of working tools and laparoscope.

The study showed that the availability of the surgery object, as working space in both the abdominal cavity and outside at the application of this laparolift are quite sufficient for laparoscopic surgery on the kidney. The positive results of the pilot study allowed successfully perform laparoscopic gas free surgeries on the kidneys (nephrectomy, resection) and upper urinary tract (pyeloplasty) in clinical practice, especially in patients with contraindications to surgeries in conditions of carboxyperitoneum

Keywords: laparolift, endolifting, intense carboxyperitoneum, gasless laparoscopy.

One of the characteristics of laparoscopic surgeries is a need for a carboxyperitoneum that provides intra-abdominal workspace and optimal visualization of anatomical structures [1;2]. Most of the changes of homeostasis caused by carboxyperitoneum are within the compensatory capacity of the organism. The combination of long-term increase in intra-abdominal pressure and the effects of the presence of carbon dioxide has a complex set of effects on the patient [3; 4]. We know that the most significant changes in the central hemodynamics and respiratory function in the presence of stress carboxyperitoneum primarily relate to patients with severe concomitant cardiovascular and

pulmonary disorders in which the presence of gas in the abdomen is additional aggression and becomes clinically significant [5; 6; 7].

In this regard, there has appeared an interest to gasless or low gas laparoscopy, in which intra-abdominal space in the abdominal cavity is created using endolifts (mechanical lifts of the abdominal wall) [1; 2; 8; 9; 10]. Despite the large number of different designs of endolifts, none of them fully satisfies surgeons [11-19]. The disadvantages of existing lifting systems are significant injury of abdominal wall, lack of visualization of the organs of the abdominal cavity (the space created resembles truncated pyramid), restrictions on freedom of manipulating instruments through bulky external structural elements of constructions of laparolifts, adequate exposure in patients with overweight is difficult [1; 8; 10; 20; 21; 22; 23].

The aim of this study was to investigate the extracorporeal relationship of endolift (which eliminates the drawbacks of known predecessors), laparoscopic instruments and objects of surgery using carboxyperitoneum and/or without it at laparoscopic interventions on the kidney and upper urinary tracts.

Methods

The accessibility of the surgery object and created workspace in the abdominal cavity for laparoscopic surgeries in kidneys and upper urinary tracts under conditions of carboxyperitoneum and the application of spiral laparolift were estimated. In addition, freedom of action with instruments both in the abdomen and beyond has been estimated. Also the trauma of the abdominal wall which is done at the application of laparolift has been taken into account.

Laparolift testing was conducted in conditions of postmortem unit in the dead of the category "person without a specific residence" just before corpse dissection. The bodies of the dead were retained in the refrigerator before dissection until the end of the third day after death. In our studies we were guided by Annex №20 to the Order of the Ministry of Health of Ukraine from May 12, 1992 r. №81. The study was conducted for 8 people dead. Of these people there were 5 men, 3 women. Age of the dead ranged from 42 to 74 years old. The corpses were of normostenic type, height from 150 to 178 cm, weight – from 60 to 80 kg.

Research methodology was as follows. The corpse is fixed on the table in lateroposition, after imposition of intense carboxyperitoneum the instruments needed to perform laparoscopic surgery on the kidney are inserted into the abdominal cavity. As a model surgery laparoscopic nephrectomy was used. Working trocar ports were installed as follows: 5 mm in mesogaster on the right, 12 mm on the right in ileac area, 12 mm in sub-xyphoid way. We used the laparoscopic instruments and equipment of “Karl Storz “, “Ethicon”, “Covidien”. After examination of the abdominal cavity and the exclusion of pathological changes the measurements. According to the below mentioned scheme, the accessibility of the surgery object and work space required for the surgery have been estimated. Using a long needle injected perpendicular to the operating table in

the projection of renal vascular leg, the distance from the surface of the parietal peritoneum up to internal organs (depth of workspace) has been measured.

Then on the same corpse after removal of carbon dioxide from the abdomen to the "minimum" carboxyperitoneum (8 mm Hg) under videoscopic control the working part of endolift (Patent № 69135, A61B 17/02. Device for gasless laparoscopy / Baydo S.V.et al.; № u201110315, 2012, Bull. N 8) was inserted into the abdominal cavity at a point of the navel on the midclavicular line with progressively-twisting movement and similar measurements have been performed. Laparolift has been fixed on elevating-fixing device with mount on the ceiling and de-suffusion was held. At that the rise of the lift was stopped on reaching the same depths of workspace that at the application of arboxyperitoneum. Spring dynamometer measured the force required to such a lift of the abdominal wall. The abdominal wall trauma inflicted with laparolift was estimated. With goniometer the degree of freedom of action of instruments outside the abdominal cavity was estimated, which characterizes the intra-abdominal freedom of manipulation with instruments.

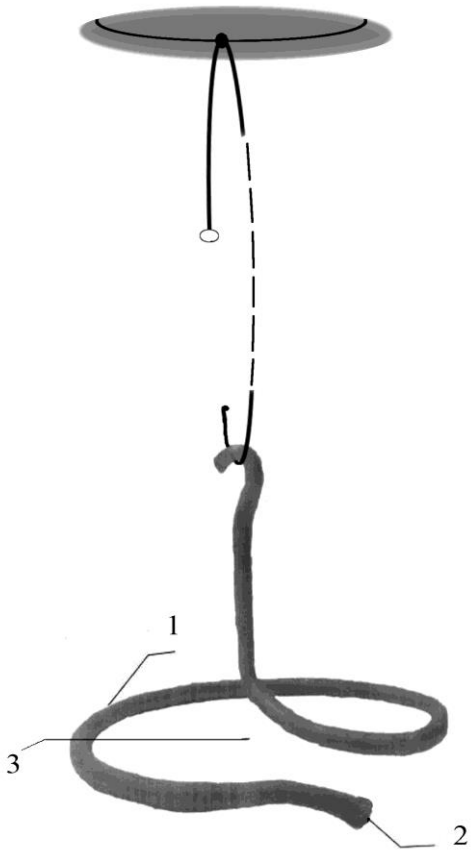

Fig. 1. A general view of the spiral laparolift to create a controlled amount of working space in the abdominal cavity, where:

1- marked spiral diameter equals to 5 mm;

2 - spherical bulge at the end of the spiral;

3 - spiral radius equals to 6.9 cm (the size is selected depending on the type of the patient);

To evaluate the accessibility of the surgery object and to characterize the workspace the following criteria were used: distance from the renal vascular leg to the parietal peritoneum at the site of laparoscope insertion, the distance from the renal vascular leg to the parietal peritoneum at the site of grasper insertion into mesogaster (side) from the side of the same name, the distance from the renal vascular leg to the parietal peritoneum at the site of grasper insertion in the ileac area from the side of the same name, the distance from the renal vascular leg to the parietal peritoneum at the site of grasper insertion in a subxyphoid way, angle between laparoscope and operating table, the angle between graspers. To assess the freedom of extracorporeal manipulations with instruments the following criteria have been applied: degree of freedom laparoscope, the degree of freedom of grasper in mesogaster, the degree of freedom of grasper in ileac area, the degree of freedom of grasper in a sub-xyphoid way (in degrees).

In the statistical analysis of obtained from the research data it was assumed that the measured values are distributed according to the normal law, are random and independent. Using the program Microsoft Excel 8.0 there were determined the arithmetic mean (M), the sum of squared central deviations (α), average squared deviation (σ), coming of which the average error of the arithmetic mean (m) and the total error of the difference of averages were calculated. Correlation of the difference of compared means to the total error of the difference (td) has been compared to the values t in the table of probability P of Student distribution.

Research results. These measurements are shown in Tables 1 and 2.

Table 1

Results of assessment of laparoscopic access to the kidney at usage of carboxyperitoneum and laparolift (N = 8)

Criteria of laparoscopic access assessment	Carboxyperito-neum 15 mm Hg	Spiral laparolift – motive force 7,9±0,5 kg	P
Distance (in cm) from kidney vascular pedicle up to parietal cavity in the place of laparoscope insertion	21,3±3,9	20,2±2,7	P>0,05
Distance (in cm) from kidney vascular pedicle up to parietal cavity in the place of collateral grasper insertion	14,5±3,5	13,6±3,4	P>0,05
Distance (in cm) from kidney vascular pedicle up to parietal cavity in the place of ileac grasper insertion	17,1±3,2	15,0±3,6	P>0,05
Distance (in cm) from kidney vascular pedicle up to parietal cavity in the place of subxyphoid grasper insertion	16,5±3,3	15,6±3,2	P>0,05
Angle between laparoscope and operational table, degrees	32,8±4,7	33,3±3,1	P>0,05
Angle between subxyphoid and ileac graspers, degrees	72,3±8,6	69,4±7,5	P>0,05

As can be seen from Table 1 comparison of intra-abdominal surgery spatial relationships of objects and tools at using carboxyperitoneum or laparolift found no statistically significant differences. These figures give an idea of the fact that the working space created with spiral laparolift around the kidney is quite comparable with that in carboxyperitoneum. The force applied to laparolift was relatively low and ranged from 6.4 to 13.1 kg.

Table 2

Assessment of extracorporeal degrees of tools freedom using different models of laparolift (N=8)

Criteria of laparoscopic access assessment	Carboxyperito-neum 15 мм Hg	Spiral laparolift – motive force 7,9±0,5 kg	P
Degree of laparoscope freedom, degrees	360,0±0,0	360,0±0,0	P>0,05
Degree of collateral grasper freedom, degrees	360,0±0,0	360,0±0,0	P>0,05
Degree of ileac grasper freedom, degrees	360,0±0,0	360,0±0,0	P>0,05
Degree of sub-xyphoid grasper freedom, degrees	360,0±0,0	360,0±0,0	P>0,05

The data in Table 2 illustrate that limits of extracorporeal freedom of manipulation with tools is not observed either during carboxyperitoneum or using spiral laparolift.

When viewed from the inside the abdominal wall ruptures or tears of tissue after application of endolift were not found. The integrity of the parietal peritoneum was not affected. Abdominal injury associated with direct insertion of laparolift into the abdominal cavity was minimal.

The positive results of the pilot study allowed to perform laparoscopic surgery on the kidney and upper urinary tract using spiral laparolift.

Discussion

The offered model of laparolift creats satisfactory intra- and extracorporeal spatial relationships between laparolift, tools and object of surgery. This model practically does not restrict freedom of extracorporeal movements of handles of working tools and laparoscope.

The study showed that the availability of the surgery object, as working space in both the abdominal cavity and outside at the application of this laparolift are quite sufficient for laparoscopic surgery on the kidney. Setting laparolift and traction of abdominal wall is accompanied by minimal injury of the latter and do not violate the principles of minimally invasive surgery.

The data obtained in the study allow to recommend the modification of spiral laparolift for clinical use. Refrain from using lifts should be applaid only for obese or athletic patients, i.e. people with massive or very muscular abdominal wall.

Conclusion

The new model of a spiral laparolift has satisfactory performance characteristics and can be recommended for clinical use in patients with contraindications to surgeries in conditions of carboxyperitoneum.

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