Egyptian Journal of Surgery Vol. (24), No. (1), Jan., 2005

A MODIFIED HOME-MADE ABDOMINAL WALL LIFT DEVICE FOR GASLESS LAPAROSCOPIC CHOLECYSTECTOMY

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Introduction: *The rationale of gasless laparoscopy using abdominal wall lifting (AWL) is to avoid the deleterious effects of carbon dioxide pneumo-peritoneum particularly in patients with cardiopulmonary diseases. Despite that, the AWL apparatus has not gained worldwide popularity, most probably due to its cost, complexity or unavailability. The aim of this work was to assess the feasibility of a simple modified gasless technique in laparoscopic cholecystectomy using a home-made set.*
Materials and Methods: *This prospective study included 20 cases with chronic calcular cholecystitis with a mean weight of 65.77 Kg (45 - 101). Conventional Foley's catheters (F16-F24) were used for AWL. Traction of these catheters was maintained manually or using the simple home-made mechanical retractor described in this study.*
Results: *Laparoscopic cholecystectomy was carried out successfully in 15 patients (75%) using this new technique. Failure was found in over weight patients and those with marked adhesions. No mortality but technique-related morbidity was minimal (early abdominal wall pain at the trocar site with late visible scars). No common bile duct or visceral injury was recorded.*
Conclusion: *This technique provided a simple, cheap, safe, and easily available home-made total AWL device particularly in non obese patients.*

Keywords: *Laparoscopic surgery, Laparoscopic cholecystectomy, modified gasless laparoscopic set, Home-made gasless laparoscopy.*

INTRODUCTION

Laparoscopic approach has become the standard technique for cholecystectomy in patients with symptomatic gall bladder stones.[1-3] In the classic laparoscopic cholecystectomy, the operation is performed by using special instruments after creation of a pneumo-peritoneum. The carbon dioxide (CO2) gas insufflation may restrict the indication of laparoscopic cholecystectomy particularly in patients with cardiopulmonary diseases. The adverse effects regarding the pneumo-peritoneum particularly the increase in the intra-abdominal pressure and its effect concerning the heamodynamic and ventilatory effects, liver function tests and the harmful and destructive effect on abdominal organs has been reported before by the authors.[4-7] Also, gas insufflations may carry a risk of fatal gas embolism, although this is quite rare.[3] Furthermore, it has been documented that pneumo-peritoneum may lead to complex metabolic, neurological and humoral effects.[8-10]

Gasless Laparoscopy using abdominal wall lift (AWL) has been developed in an attempt to avoid the above mentioned adverse effects of carbon dioxide pneumo-peritoneum that may occur in conventional laparoscopy.[1] Also, the introduction of AWL technique has largely minimized the restrictions for laparoscopic surgery.[1,2] Despite that, the AWL apparatus has not achieved worldwide popularity, due to its cost, complexity or its unavailability.[2]

The aim of this work was to assess the feasibility of using a simple modified gasless technique in laparoscopic surgery using the ordinary Foley's catheters for anterior abdominal wall lift.

PATIENTS AND METHODS

This study included 20 patients with symptomatic chronic calcular cholecystitis. The exclusion criteria included acute cases, bleeding tendency and the presence of associated surgical abdominal pathology which might need additional surgical procedures. Other cases of cardiopulmonary diseases and those with history of previous upper abdominal operations were excluded. All patients were subjected to thorough history taking, clinical examination and the usual biochemical and radiological investigations.

The operation set up excluding the CO2 insufflator was exactly the same as in conventional laparoscopic cholecystectomy. In this work, we used 2 L-shape screen support metal bars already available in the operating theatre as mechanical retractors in this home-made abdominal wall lift device (Figs. 1a,b). Both were fixed to the side of the operating table, one at the level of the xephoid process and the other at the level of the umbilicus.

The umbilical port was inserted using an open technique. A sub umbilical curved skin incision 1½ cm in length is deepened until reaching the peritoneal cavity. A10 mm port with its blunt trocar was inserted safely for few centimetres into the abdominal cavity. Through the same umbilical incision, a 18 F size Foley's catheter was inserted guided with a long metal blunt needle (stylet) and its balloon was inflated (Fig. 1c). Lifting of the anterior abdominal wall is achieved by manual traction of the catheter using the assistant's hands as shown in (Figs. 2a,b,c). In the next cases, traction was maintained mechanically using the L-shape metal bar. To maintain traction of the abdominal wall lift to L-shape metal bars two different techniques were performed; either using a non traumatic clamp the blades of which were padded with plastic tubes to avoid catheter tear, or having the catheter tied to the bar with gauze strip. The degree of traction was adjusted by changing the site of the catheter grasp, and its direction by changing the position of the metal bar and the site of connection of the clamp / gauze strip to it. The laparoscopic camera was inserted into the abdominal cavity to the required length.

The epigastric port was inserted using the same technique similarly under vision (camera), through 1½ cm transverse skin incision. An 18 F size Foley's catheter was introduced through this incision and retracted in the same manner as in the umbilical port. Using the same technique, both the third and fourth ports (5 mm) and their Foley's catheters were inserted through a 1 cm transverse skin incision each under vision (camera) in the anterior axillary line and in the mid-clavicular line respectively. Both catheters were inflated and traction was maintained as above (Figs. 3a,b).

Through the four ports, the working instruments were used exactly as in classic laparoscopic cholecystectomy. Additional ports/catheters could be added if required to provide more exposure of the surgical field and exploration was made using a high power light source. The gall bladder was extracted and the abdominal wounds were closed with or without sub-hepatic tube drain if needed. All cases had local anaesthesia (Marcain 0.5%) injected at the port sites at the end of the procedures.

RESULTS

Out of the 20 cases included in this study 16 (80 %) were females. Their ages ranged from 22 to 55 years with a mean of 39 $\pm$ 15. 2 yrs. The weight varied from 45 to 101 Kg with a mean of 65.667 $\pm$ 10.978 Kg. Laparoscopic cholecystectomy using the modified gasless technique described in this study could be carried out successfully in 15 (75%) cases Table 1. The remaining 5 (25%) cases were converted to open surgery and 2 out of them (40%) were males. The conversion was due to AWL device failure in 3 cases and marked adhesions in the remaining 2 cases. This failure occurred in patients having high body weight Table 2. In the 15 successful cases, catheter traction was maintained by the assistant hands in the first 5 cases. In the next 10 cases. The simple idea of mechanical retraction described in this work was used.

Rubber Foley's catheters were used in the initial 3 cases that were replaced by silicon ones in the remaining cases. Silicon catheters proved to sustain traction more than the rubber catheters, which are more liable to tear and rupture of their balloons.

In the former 12 cases, only the laparoscopic instruments were used. The conventional open surgery instruments were tried successfully with the laparoscopic instruments in some steps in the later 3 cases. They were introduced directly into the abdomen through port incisions without the need of laparoscopic port (but with avoiding the diathermy burn).

The operating time ranged from 245 minutes in the first case, to 125 minutes in the last one with an average of 177.667 ± 30.026 minutes. There was no operative mortality in this study. Also, no billiary or visceral injury was reported and there was no shoulder pain. There was no abdominal wall haematoma or obvious wound infection. The early 3 cases experienced mild to moderate wound pain at the port site that responded well to non steroidal anti-inflammatory drugs.

There were late visible scars in all patients due to the wider incision at port sites and manipulation.

Table 1. The successful gasless laparoscopic cholecystectomy cases.

No	sex	Wt (kg)	Catheter			Type of instruments	Technical problems	Op. Time (minutes)
			Type	No	Traction			
1	F	45	Rubber	3	Hand	Laparoscopic	Assist fatigue & Catheter tear	245
2	F	50	Rubber	3	Hand	Laparoscopic	Assist fatigue, & Catheter tear	235
4	F	52	Rubber	4	Hand	Laparoscopic	Assist fatigue, & Catheter tear	210
7	F	55	Silicon	4	Hand	Laparoscopic	Assist fatigue	190
9	F	61	Silicon	3	Hand	Laparoscopic	Assist fatigue	195
10	F	80	Silicon	4	Mechanical	Laparoscopic	Balloon Rupture	180
11	F	64	Silicon	3	Mechanical	Laparoscopic	No	200
12	F	69	Silicon	4	Mechanical	Laparoscopic	No	180
14	F	70	Silicon	4	Mechanical	Laparoscopic	No	190
15	F	71	Silicon	4	Mechanical	Laparoscopic	No	170
16	F	69	Silicon	4	Mechanical	Laparoscopic	No	150
17	F	79	Silicon	4	Mechanical	Laparoscopic	No	120
18	F	68	Silicon	4	Mechanical	Lap & Conventional	No	130
19	M	79	Silicon	5	Mechanical	Lap & Conventional	No	145
20	M	73	Silicon	5	Mechanical	Lap & Conventional	No	125

Table 2. The failed cases that were converted to open surgery.

No	Sex	Wt (Kg)	Catheters			Cause of conversion	Op. Time (minutes)
			Type	No	Traction		
3	M	92	Rubber	5	Hand	Catheter tear & Assist fatigue	210
5	M	98	Rubber	5	Hand	Catheter tear & Assist fatigue	210
6	F	65	Rubber	3	Hand	Marked Adhesions	190
8	F	91	Silicon	3	Hand	Marked Adhesions	220

13	F	101	Silicon	5	Mechanical	Inadequate operative field	250

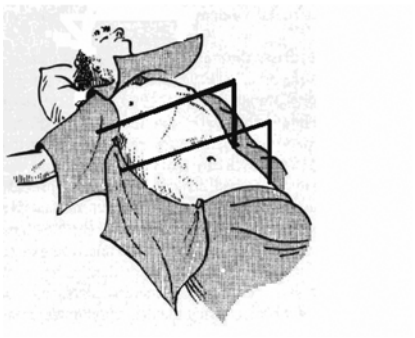

Fig 1a

Fig 1b

Fig 1c

Fig 1a,b,c. The home-made AWL system

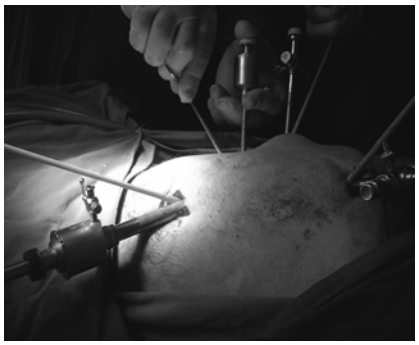

Fig 2a

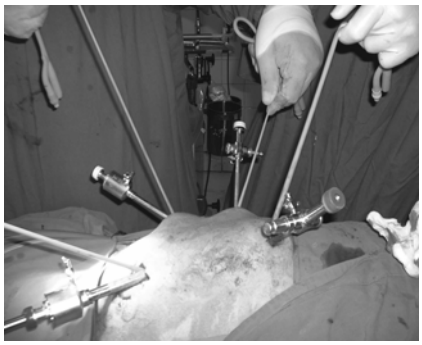

Fig 2b

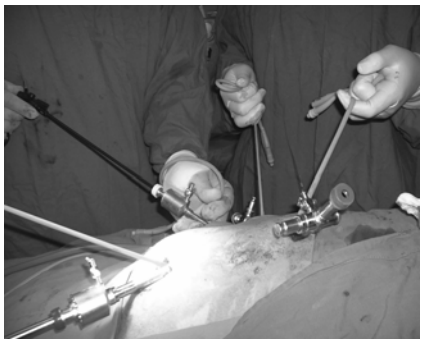

Fig 2c

Fig 2a,b,c. the home-made gasless AWL system using manual traction of the assistant's hands

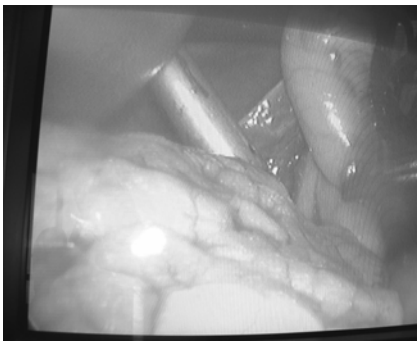

Fig 3a

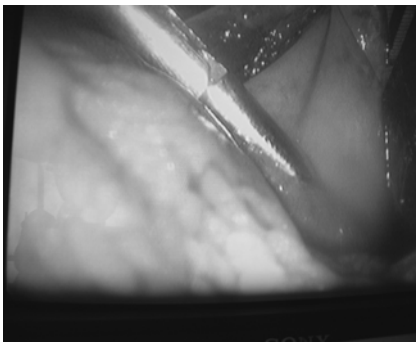

Fig 3b

Fig 3a,b. The operative field created by the home-made gasless AWL system

DISCUSSION

The idea of abdominal wall Lift (AWL) for laparoscopic surgery has been reported since 1992.[11] Several forms of devices to elevate the abdominal wall and create an intra abdominal room for surgery have been developed. The available AWL systems could be divided into two main

types regarding the concerned layers of the abdominal wall. These comprise; total abdominal wall lift and subcutaneous wall lift.[1,2] The total abdominal wall systems elevate the whole thickness as seen in the U-shaped[11] and laparo-fan retractors,[12] while the other devices lift only the skin and subcutaneous layers of the anterior abdominal wall. These include the wiring[13] and the fish–rod[14] types. The subcutaneous wring placed in the anterior abdominal wall then pulled up.[13] The fish–rod type retractor is introduced from the lateral side pushing up the abdominal wall.[14] Despite these interesting studies and considerable innovations, the technique of gasless laparoscopy has not gained world wide popularity. Until now, the AWL is not used routinely in laparoscopic surgery and is still discussed only from the viewpoint of technical feasibility.[1,2]

In this work, the technical feasibility of using a homemade total AWL device for gasless laparoscopic cholecystectomy has been tried successfully. Although there was no gas insufflation or increase intra abdominal pressure, patients with cardiopulmonary dysfunction were excluded from the study. This was because of the prolonged operating time expected, at least for the early few cases.

In the early cases, the conventional rubber Foley's catheter has been chosen due to its availability, low price, and its non traumatic nature. But it was found to be easily teared and yield on traction. It was replaced in the next cases by silicon Foley's catheter which provides better durability and more resistance to traction.

In the meantime, catheter traction was maintained manually by the assistant hands. They felt severe fatigue and needed to have a break several times, during which the camera and instruments were withdrawn. This situation prolonged the operating time. In the next cases, traction was maintained mechanically using the simple homemade retractors described in this work.

Previous studies proved that gasless laparoscopic cholecystectomy is more time consuming than conventional laparoscopic cholecystectomy.[12,15,16] In our study, it was noted that the mean operating time was obviously longer than that reported in other gasless laparoscopic cholecystectomy.[15,16] But we found that the operating time got shorter in the last cases that may reflect the more familiarity with the technique. Moreover, other investigators who have more experience with the gasless technique demonstrated that the technique is not time consuming compared to the conventional laparoscopic cholecystectomy.[17] The field of operation was limited to some extent. By using more catheters that were retracted alternatively according to the field required a better view was achieved.

In the current study, failure cases of gasless technique were converted to open surgery while other investigators reported that these cases could be completed by conversion to CO2 pneumo-peritoneum.[1] The conversion rate to open surgery was 25%, quite higher than that reported in other literatures that reported conversion rates to CO2 pneumo-peritoneum varying from 0% to 21%.[1] The failure of AWL using our system occurred in obese patients with thick abdominal wall that resist traction. Also, the same situation was found in male patients with muscular abdominal wall in this study, but this problem could be solved by the anaesthetist. The conversion was found in the early cases, but there was no failure in the last 7 cases Table1. However, previous works revealed that obese and muscular patients make a considerable limitation to use other gasless devices.[11-14,18] The improvement in both the operating time and conversion to open surgery in the last cases of this series might be due to the modification in the technique and the progress of the learning curve.

The results of this study displayed some potential advantages over the previously used systems. The non traumatic nature of the Foley's catheter makes the abdominal wall and viscera at much less risk of retractor trauma. Although other studies reported no visceral injury,[15,19,20] some studies reported omental injury[21] or postoperative abdominal wall wound pain and haematoma.[22] The alternating traction of the Foley's catheter provides a reasonable operative field, as the limited field is one of the reported disadvantages of other AWL systems.[1,2,16,20]

The encouraging results of this work regarding the use of home made AWL device could lead to manufacture a modified Foly’s catheter that may be more suitable for traction. The proposed catheter will be with a single track for the inflation of its balloon. The omitting of the unneeded Foly’s catheter urine lumen will make it more solid and resists traction. Also, the traction on this single track catheter makes the abdominal cavity an air tight room that can adapt low pressure pneumo-peritoneum if required for better exposure to avoid conversion to open surgery. Further more this catheter and its balloon could be made of a more tough and durable plastic material that will add to its resistance to traction. Actually, the above modification will render it as an atraumatic inflatable plastic retractor rather than a catheter.

Gasless laparoscopic cholecystectomy using the Foley's catheters for total abdominal wall lift (AWL) is a feasible technique. It provides a simple, cheap, safe and easily available home-made total AWL device. It may be applicable in laparoscopic surgery when insufflation machine is not available or there is restriction of pneumo-peritoneum creation particularly in non-obese patients with cardiopulmonary dysfunction. The proposed

technique seemed to be a reasonable alternative to the other more sophisticated, less available and more expensive total AWL systems.

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