A Modified Suction Device for Applying Precise Aspiration during Surgery: Suction Tube with Air Channel

Cerrahide Tam Aspirasyon Sağlayan Modifiye Bir Aspirator Cihazı: Hava Kanallı Aspirator Ucu

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Abstract

Purpose: Aspiration of intra abdominal fluid and debris is usually needed during different stages of the operation. This is necessary in order to protect the intra abdominal space from contamination and/or to remove blood or tissue fluids that may occur during the operation. It is also essential for obtaining a clean surgical area. Aspiration of intra abdominal fluid collecting in Douglas Pouch is difficult, even with the use of lower abdominal incisions such as phannensteal. Aspiration of intra abdominal fluid collecting in the Douglas Pouch becomes more difficult when an upper abdominal incision is used because of the difficulty of access to the Douglas Pouch and suctioning the omentum and intestine with the aspirator.
Materials and Methods: In this study, a modified suction device (Suction Tube with Air Channel =STAC) has been reported which allows the surgeon easier suctioning intra abdominal fluid.
Results: STAC has an additional air channel which prevents the device from suctioning intra abdominal organs such as the intestine and omentum. We tested the efficacy of STAC in a simulated intraabdominal space such as a large transparent plastic bag with fresh sheep intestine-omentum and with 2000 cc of physiologic saline solution. While the suctioning of all the fluid was difficult (13-21 training) and time consuming (240-360 sec) when the conventional suction unit was used, all of the saline solution was easily and quickly suctioned when STAC was used (1 training and 30-60 sec, respectively).
Conclusion: In conclusion STAC provides a safe, fast and complete fluid extraction.

Key Words: **Equipment and Supplies; Suctions; Surgery; Surgical Instruments.**

Özet

Amaç: Ameliyatların çeşitli basamaklarında batın içi mayi ve partiküllerin aspire edilmesi gerekir. Aspirasyonun amacı batın boşluğunu kontaminasyondan korumak; kan ve doku sıvılarını uzaklaştırmaktır. Bu temiz bir cerrahi saha için gereklidir. Batın içindeki mayinin aspirasyonu Phannensteal gibi alt abdominal inzsizyonlar kullanılsa bile zordur. Bu işlem özellikle üst batın insizyonlarında douglas boşluğuna ulaşmadaki zorluklar ve omentumla barsak anslarının aspiratöre yapışmasıyla daha da zorlaşır. Çalışmada, cerraha batın içi mayii aspire etmede kolaylık sağlayan modifiye bir aspiratör ucu (Suction Tube with Air Channel=STAC) sunulmuştur.
Gereç ve Yöntemler: STAC batın içi orgqanların aspiratöre yapışmasını engelleyen ilave bir hava kanalına sahiptir.STAC'ın effektivitesi yeni kesilmiş koyun barsağı ve omentumu doldurulmuş şeffaf bir poşete 2000 cc mayi doldurularak oluşturulan modelde test ettik.
Bulgular: Klasik aspiratör kullanırken tüm mayinin aspire edilmesi zor (13-21 deneme)ve zaman alıcıydı (240-360 saniye),ancak STAC'da mayi kolayca (1 deneme) ve kısa sürede (30-50 saniye) aspire edildi.
Sonuç:STAC güvenli, hızlı ve tam mayi aspirasyonu sağlamaktadır.

Anahtar Kelimeler: **Cerrahi; Cerrahi Cihazlar; Cihaz ve Gereçler;Emme.**

Introduction

Intra abdominal cleansing and aspiration of the fluid is commonly carried out during the course of an abdominal operation. This procedure is usually performed in order to prevent the intra-abdominal space from contamination and to get rid of blood and necrotic material which may be present (1, 2).

The primary difficulty during aspiration of intra abdominal fluid is the possibility of the intestine and omentum sticking to the tip of the suction tube which then blocks the suction. This situation prevents the surgeon from being able to completely remove fluid, blood, infectious material and necrotic debris. Suction of intra abdominal material may become more difficult even when a small subcostal and upper median incision are used and particularly when the targeted space is the Douglas Pouch. Difficult aspiration results in a prolonged operation and ineffective aspiration of intra abdominal fluid and debris.

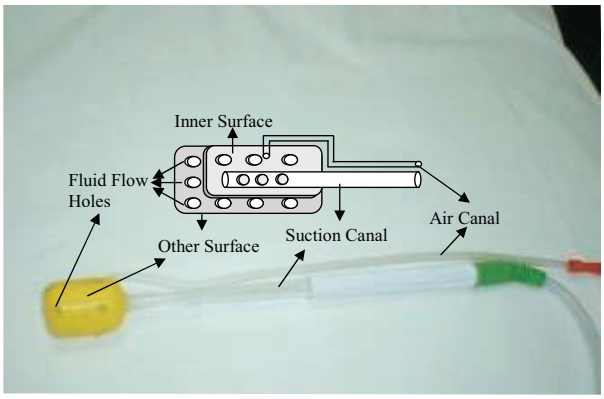
Therefore, a device providing safe and fast suction capability is needed for effective, complete and easy removal of intra abdominal fluid. For this purpose we created a suction tube with an air channel (STAC) which can aspirate nearly all intra abdominal fluid in one attempt without adhering to the intestine and omentum.

Material and Method

The study was performed in the department of General Surgery at Gulhane Military Medicine Academy Ankara TURKEY on March, 2007.

Definition of the newly introduced suction device (STAC). The STAC has three main parts: (1) A multi-orifice spherical protective tip which prevents the tissues from sticking to the suction device; (2) An air canal preventing negative air pressure inside the spherical tip and allowing air flow from outside of the body into the spherical tip and (3) A suction tube which has negative pressure in it (Picture 1).

Intra-abdominal fluids and debris needing to be removed from the body flow inside of the multi-orifice spherical tip of the STAC and are taken out of the body by the negative pressured canal. However, peripheral tissue does not stick to the suction device because air suctioned into the spherical tip of the STAC from outside of the body via the air canal prevents this environment from negative pressure which causes suction of the peripheral tissue.



Picture 1. Picture and diagram of STAC

Comparison procedure of classical suction device and STAC. A plastic bag containing fresh scarified sheep intestine and omentum and 2000 cc isotonic saline solution were used in order to test both suction devices (Picture 2). The deepest part of the plastic bag was assigned as the Douglas Pouch. Each suction device was applied to this place. Effective suction volume was tested using two procedures:

Procedure 1. Fluid was suctioned without attempting to protect the suction device tip from sticking or adhering to the intestinal tissue. The suction procedure was terminated once the suction device tip became obstructed by the intestinal tissue. Amount of fluid suctioned during this period of time was noted and this procedure was repeated six times.

Procedure 2. Suction was carried out by covering the tip with a hand in order not to obstruct intestinal tissue with the tip of the suction device. Suction procedure was continued till all the fluid was completely removed from the bag. The suction attempts and total suction time to remove all fluid from the bag and remnant volume of fluid was noted for each device. This procedure was repeated six times as well.

Statistical analysis. SPSS 10.0 statistical software package (Chicago, Ill, USA) was used for statistical analysis. All values were given as median (min-max). The differences between the groups regarding all variables were tested using Mann Whitney U test. A p value 0.05 was considered statistically significant for each analysis.

Picture 2. Experimental Environment

Results

Procedure 1. The classical suction device aspirated 30-150 cc (median 88 cc) fluid with a single suction attempt and nearly 1850-1970 cc fluid was retained in the bag. As for STAC, 1750-1900 cc (median 1834 cc) fluid was suctioned with each suction attempt and 100-250 cc fluid was retained (Table I). STAC suctioned significantly more fluid compared to the classical suction device in terms of the single suction attempt. (p=0.004)

Table I. Single suction fluid volume (cc) using classical suction device and STAC.

	Classical Suction Device (cc)	STAC (cc)	p:
1	30	1810	
2	80	1750	
3	150	1900	
4	70	1830	
5	110	1880	
6	85	1835	
Median	88	1834	0.004
(min-max)	(30-150)	(1750-1900)	

Procedure 2. 13-21 (median 17) suction attempts were performed to aspirate maximum fluid volume from the bag, 350-550 cc (mean 465 cc) fluid was retained in the bag and the suction procedure took 240-360 seconds for the classical suction device.

As for STAC, only one suction attempt was needed in order to remove nearly all of the fluid and no obstruction occurred. Every suction procedure required less than one minute (30-50 seconds, median 40 seconds) (Table II). Statistically, lesser retained volumes were measured when the STAC was used (p=0.004) and less suction attempts were required compared to the classical suction device (p=0.002). Suction times were also statistically lower when the STAC was used (p=0.004).

Table 2: Suction Attempt, Retained Volume And Total Suction Time

		Classical Suction Device	STAC	
1	SA	15	1	
	RV	510	150	
	TST	310	35	
2	SA	18	1	
	RV	550	120	
	TST	240	30	
3	SA	21	1	
	RV	350	100	
	TST	315	50	
4	SA	17	1	
	RV	420	180	
	TST	360	45	
5	SA	17	1	
	RV	460	135	
	TST	300	40	
6	SA	13	1	
	RV	470	130	
	TST	270	40	
				P Value
Median (min-max)	SA	17 (13-21)	1(1-1)	0.002
	RV	465 (350-550)	132.5(100-180)	0.004
	TST	305 (240-360)	40 (30-50)	0.004

SA : Suction Attempt; RV : Retained Volume; TST: Total Suction Time (Seconds)

Discussion

Every surgeon agrees on the need for removal of intra abdominal debris, hematoma, washing fluids and infected materials. Doing so helps prevent postoperative complications and reduces the risk of tumor implantation via elimination of the free intra abdominal tumor cells which are usually present during oncologic surgery (1, 2, 3). In addition, the removal of intra abdominal blood and necrotic material reduces the risk of postoperative peritoneal adhesion (3, 4, 5, 6).

Important factors for intra abdominal cleaning include fast and gentle suction and maximum removal of all intra abdominal debris. In particular, the small upper abdominal incisions usually become problematic while suctioning either the perioperative area or the pouch of the Douglas. Many surgeons may have difficulty with suctioning if they use conventional suctioning tubes. Decreasing the suction pressure seems to solve the problem but this usually results in ineffective and prolonged suction. As an alternative, STAC provides fast and nearly complete suction of unwanted intra abdominal fluids and debris. Data collected from this study showed that STAC suctions statistically significantly faster, obtaining more fluid when compared with classical suctioning tubes.

Today's common procedures usually require drainage of the residual intra abdominal fluids and debris by drains placed at strategic locations in the intra abdominal space just before the operation is done. These drains are usually removed when fluid discharge reaches certain levels. The time for this varies between 1 and 3 days. Prolonged drainage may cause ascending bacterial contamination of intra abdominal space and have a negative effect on a patient's daily activity and comfort (3). Therefore, a complete and effective intra abdominal cleaning and suctioning using STAC will also prevent patients from prolonged and unnecessary abdominal drain usage and decrease the need for same.

In conclusion, in an experimental environment, STAC provided fast, safe, continuous and nearly complete cleaning of fluid without the suctioning of peripheral tissue. Though we do not have any data concerning usage of this new suctioning device in the human body, it appears to be very useful in the suctioning and cleansing of intra abdominal unwanted materials such as washing fluids and inflammatory and hemorrhagic debris. This is particularly the case when small and upper abdominal incisions are performed. Further studies are needed concerning the usage of STAC in the human body.

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