

Neovascularization of Small Intestine with Pediculated Omental Flap: An Experimental Study on Functional Capacity of Omentoenteropexy

PEDİKÜLLÜ OMENTUM FLEBİ İLE İNCE BARSAK NEOVASKÜLERİZASYONU: OMENTOENTEROPEKSİNİN FONKSİYONEL KAPASİTESİNE YÖNELİK DENEYSEL BİR ÇALIŞMA

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Summary

Objective: An insufficient mucosal surface area or a short mucosal contact time may separately or both together cause short bowel syndrome (SBS). Nonsurgical treatment of SBS is expensive, long lasting and mostly associated with high morbidity and mortality so that the interest for investigation on surgical treatment of SBS has been increasing. Basing on the determination of the glucose absorption of an isolated bowel segment established by omentoenteropexy in rats, the effectiveness of the omental flap as a vascular pedicle in bowel elongation procedure was evaluated.

Materials and Methods: A staged operation on rats was performed to obtain an isolated intestinal segment with omentoenteropexy, which was applied on the antimesenteric site. Omentoenteropexy was made as a first stage, following an interval of four weeks, the isolated intestinal segment was longitudinally divided to get two separate intestinal segments, one with a blood supply from mesentery and the other from the omental flap; and one side of the isolated segments was exteriorized. The rats were divided into two groups and the glucose absorption capacity of those two isolated segments with intraluminal perfusion of 20% dextrose solution was determined for 24 hours.

Results: In both groups arranged according to the vascular pedicle pattern, blood glucose level has increased during the intraluminal perfusion. The level showed a time correlated linear increasing pattern. There was no statistical difference between the groups ($p > 0.05$).

Conclusion: Macroscopic findings and ability of glucose absorption of isolated bowel segment with omentoenteropexy have shown the success of the neovascularization. Although it needs to be supported by more comprehensive experimental studies, it was concluded that the technique could be used as an alternative surgical procedure in SBS.

Key Words: Short bowel syndrome, Intestine, Absorption, Omentoenteropexy

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Ozet

Amaç: Yetersiz mukoza yüzey alanı veya mukoza temas zamanı, tek tek veya birlikte kısa barsak sendromuna (KBS) neden olurlar. KBS'nun cerrahi olmayan tedavisi pahalı, uzun süreli ve yüksek morbidite ve mortalite ile seyrederek. Bu nedenle KBS'da cerrahi tedavi arayışına yönelik ilgi artmıştır. Bu çalışmada sıçanlarda, omentoenteropeksi ile oluşturulmuş izole barsak segmentinde, glukoz absorpsiyon düzeyi tespiti ile; barsak uzatma işlemlerinde, vasküler pedikül olarak omental flap kullanmanın etkinliği araştırıldı.

Materyel ve Metod: İzole barsak segmentinin antimezenterik tarafına omentoenteropeksi uygulamak için sıçanlarda evreli cerrahi girişim yapıldı. İlk evrede omentoenteropeksi uygulandı, dört haftalık bir aradan sonra, izole barsak segmenti, uzunlamasına biri omental flapten diğeri mezenteriden beslenen iki ayrı parça olara hazırlandı. İzole segmentlerin bir ucu batın duvarına ağızlaştırıldı. Lümen içi %20 dekstroza perfüzyonu ile her iki barsak segmentindeki glukoz absorpsiyon kapasitesi 24 saat için, denekler iki farklı gruba ayrılarak ölçüldü.

Bulgular: Vasküler pedikül çeşidine göre bölünen iki grupta da, kan glukoz düzeyleri lümen içi perfüzyon sırasında arttı. Bu düzeyde zamanla paralel, doğrusal bir artış gözlemlendi. Gruplar arasında istatistiksel olarak anlamlı bir farklılık saptanmadı ($p > 0.05$).

Sonuç: Omentoenteropeksi ile elde edilen izole barsak segmentinin neovaskülarize olduğu, makroskopik bulgu ve glukoz absorpsiyon yeteneği ile gösterilmiştir. Daha kapsamlı deneysel çalışmalar ile desteklenmesi gerekmektedir, KBS'da bu tekniğin alternatif bir cerrahi girişim olarak kullanılabilceği düşünülmüştür.

Anahtar Kelimeler: Kısa barsak sendromu, Barsak, Absorpsiyon, Omentoenteropeksi

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The short bowel syndrome (SBS) is a disease featuring an overall bowel surface deficit that prevents a standard caloric intake by the patient. It is mostly due to a deficit of the small bowel (1).

Several medical and surgical treatment modalities have been tried in SBS to provide a better functioning intestine. For obtaining the maximum performance from the remained intestine, the drugs such as cimetidine, somatostatin and colestamine and to provide the time needed for intestinal adaptation to the new situation, elemental diet, total or partial parenteral nutrition have been proposed (1-3). In experimental and clinical studies, several surgical methods including tapering and lengthening of intestine, forming a valve mechanism or an antiperistaltic segment have been directed toward slowing intestinal transit or increasing the absorptive surface area of the bowel (4-6). Recently, materials such as biodegradable polymers and acellular matrix have been used to increase the intestinal surface (7).

The purpose of this study is to evaluate the possibility of using omentum as vascular pedicle in bowel elongation by investigating whether the intestinal segment neovascularized by an omental flap without mesenteric blood supply could survive or not and if it could, what would happen to the function of absorption.

Materials and Methods

Sprague-Dawley rats (n:15) weighing 240-270 g were used in this experiment. They were allowed to have a standart solid chow and to drink water ad libitum. The rats were fasted 6 hours before the operation and anesthetized by the intraperitoneal administration of chloral hydrate (50 mg/kg).

As a first stage, following the laparotomy by a midline incision, at the distal ileum, which is 5 cm from the ileocecal valve, a longitudinal incision (12 cm long) was made down to the seromuscular layer of the ileal segment on antimesenteric site and the seromuscular layer was detached from the mucosa with a 150° angle from the both sides of the incision. Omental flap was prepared and sutured with a 7/0 nylon suture material to the seromuscular incision border. The abdomen was closed.

At the end of the postoperative fourth week, as a second stage, a relaparotomy was performed, and macroscopic inspection revealed the achievement of neovascularization in all the rats. The ileal segment with omentoenteropexy was resected and

ileoileostomy was performed. The segment with omentoenteropexy was longitudinally divided to get two separate mesenteric and pedunculated omental flap segments. Both were tubularized with 7/0 polyglyactin and the distal sides were closed. Proximal ends were exteriorized as an ileostomy. Three rats died at the postoperative third to fourth days and were all excluded from the study. The postmortem exploration showed the mechanical intestinal obstruction caused by intraperitoneal adhesion.

One week later from the ileostomy, the glucose absorption capacity of these two segments was evaluated. The rats were divided into two different groups. In group I (n: 6) the absorption capacity of the ileal segment supplied by mesentery was investigated, and in group II (n: 6) the glucose absorption of the ileal segment supplied by omentum was evaluated.

Rats were immobilized with a special cage. Following a 24 hours fasting, 20% Dextrose at a rate of 5 ml/h was continuously infused from the stomal orifice by a catheter for 24 hours. Filling the same amount of fluid was achieved for each animal. Blood glucose levels were measured before the infusion and at 1, 3, 6, 12 and 24 hours of infusion. This measurement was repeated three times for both groups.

Results

Blood glucose levels are demonstrated in figure 1. In both groups 1 and 2, glucose levels showed a gradually increasing pattern. This linear increase was evaluated by student-t test. There was no statistical difference in groups (t: -1,78; SDm: 0,7; SDo: 1,41; p>0.05).

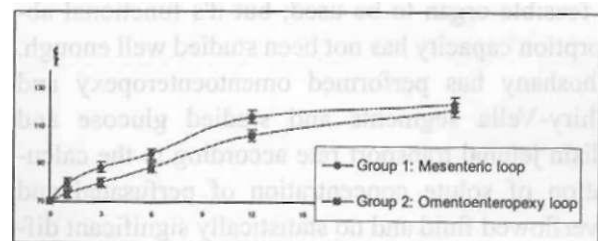


Figure 1. Blood glucose levels. In both groups, glucose level showed a gradually increasing pattern.

Discussion

In SBS, while intestine gradually adapts to the new situation, intravenous support is needed for survival and growth (2,7). Morbidity and mortality are directly correlated with the length of intestine and the duration of total parenteral nutrition. In SBS, the traditional treatment has a long lasting, expensive and complicated trace so that the surgical approaches for SBS have been getting an increasing interest. Although many clinical and experimental works have been made on the issue, it is still an unsolved clinical problem (3,5,8,9).

Before the surgical procedures have been developed, elemental diets and total parenteral nutrition have been used to support the patients. For mucosal adaptation neurotensin, insulin like growth factor (IGF) and interleukin like substance have been tried in clinical and experimental works (10,11). For severe cases, several surgical methods have been developed to increase intestinal mucosal surface area and contact time, but very limited number of those methods were adapted and performed in clinical cases (12). Bianchi has declared that adaptation of remained gut and increasing absorptive mucosal surface area by neomucosal growth could be achieved by autolog gastrointestinal reconstruction. It's only alternative could be the intestinal transplantation with serious immunosuppressive complications (13).

The main questionable and difficult points of surgical techniques described for SBS are the anatomical difficulties and blood supply of elongated segments. Kimura and Soper experimentally have tried to use liver and abdominal wall for the blood supply (14). Several histopathologic and angiographic studies on newly formed intestinal segment with omental blood supply have demonstrated that omentum due to it's anatomical properties is a feasible organ to be used; but it's functional absorption capacity has not been studied well enough. Shoshany has performed omentoenteropexy and Thiry-Vella segments and studied glucose and glisin jejunal transport rate according to the calculation of solute concentration of perfused and overflowed fluid and no statistically significant difference was observed in groups (15). In our study, glucose absorption of ileal segment supplied by

omental flap demonstrated a time related linear increase in blood glucose level.

Uncertainty is still present in the therapeutic approach of SBS. In our experiment, we worked on a model which was performed to test the absorption capacity of an isolated intestinal loop vascularized by omentum and would be a base for our future experimental studies on the issue. Our study"showed that following the longitudinal division of ileal segment by omentoenteropexy from antimesenteric site; two tubes could be formed from the part supplied by omental flap and the part supplied by mesentery and since the segment with omental flap has absorption capacity, it could be used in an alternative surgical procedure as a functioning intestinal segment in SBS.

The aim in the surgery for SBS is to lengthen the bowel to increase the absorptive surface area. Although the experimental studies done on omentoenteropexy are not enough to make a definite conclusion yet, among the several surgical techniques suggested, the autolog gastrointestinal elongation supported by an omental flap seems to be one of the reasonable alternatives. The results of this study provide only a part of the information needed for this procedure, the technique is a promising one and more comprehensive experimental studies have to be performed to develop the anatomic and surgical approach of the procedure and the functional capacity of the intestinal segment neovascularized by omental flap.

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