

Effect of omentum graft on esophageal anastomosis in dogs

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Abstract

This aim of this study was to evaluate the complications and final function outcome of wrapping nonvascularized omentum graft around the suture line of esophageal anastomosis. Twelve adult local breed dogs were used in this study. The animals were divided into two equal groups (control and treated), all animal induced into general anesthesia by injection of atropen sulphate in a dose 0.04 mg/kg B.W, intramuscularly then after 15 minute given mixture of ketamine hydrochloride and xylazine hydrochloride in doses 15 mg/kg and 5 mg/kg B.W intramuscularly respectively. An oblique resection of about 1cm of the esophageal length and anastomosis by double layer of simple interrupted pattern by 2.0 cat gut suture (control group), same procedure was done in treated group except the wrapping the anastomosis site with patch of omentum tissue after lapratomy operation in the left flank region procedure. The clinical signs of treated animal revealed signs of dysphagia and regurgitation in treated group while this signs disappear in the control group. Radiological and histopathological examination of the anastomosis site performed at 15 and 30 days post operation. Radiological study recorded high degree of stenosis in the anastomosis site in treated group at 15 and 30 days post operation in compared with animals in control group that record mean degree of stenosis in treated group at 15 day (57.61 ± 0.2) and at 30 day (55.78 ± 0.2) while it recorded in control group at 15 day (39.34 ± 1.04) and at 30 day (36.06 ± 0.9), histopathological results recorded enhanced healing of anastomosis site in treated animals more than control animals. In conclusion we found that non vascularized omental graft prevent leak when used around the anastomosis line in esophageal and enhanced healing of anastomosis line but it increase the stenosis, fibrosis and adhesion of anastomosis site with surrounding muscle and this interferes with the swallowing as well as dysphagia and regurgitation.

Keywords: Anastomosis; Esophagus; Omentum; Stenosis.

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تأثير طعم الثرب في تفهم المرئ في الكلاب

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فرع الجراحة والتوليد، كلية الطب البيطري، جامعة بغداد، بغداد، العراق

الخلاصة

ان الهدف من هذه الدراسة هو تقييم المضاعفات التي يحدثها استخدام طعم الثرب حول تفهم المرئ. تم استخدام ١٢ كلبا بالغاً من السلالات المحلية، حيث قسمت هذه الحيوانات الى مجموعتين متساويتين وهما مجموعة السيطرة ومجموعة المعاملة. خدرت الحيوانات باستخدام اتروبين سلفيت بجرعة ٠,٠٤ ملغم/كغم من وزن الجسم وبعد ١٥ دقيقة استخدم مزيج من الزايلزين ٥ ملغم/كغم من وزن الجسم والكيتامين ١٥ ملغم/كغم من وزن الجسم كعلاج تمهيدي بالعضلة. في مجموعة السيطرة تم استئصال ١ سم من المرئ بشكل مائل وخيط بصفين من الخياطة البسيطة المتقطعة بخيوط كات كات حجم ٢,٠ اما في مجموعة المعاملة فاتبعت نفس الخطوات كما في مجموعة السيطرة ماعدا استخدام قطعة من الثرب حول منطقة التفهم أخذت من الحيوان بعد عملية فتح البطن. تمثلت العلامات السريرية بعدم القدرة على البلع وفي بعض الحالات ارجاعه في حيوانات مجموعة المعاملة مقارنة مع مجموعة السيطرة، اما الدراسة الشعاعية بعد ١٥ و ٣٠ يوم بعد العملية اظهرت مجموعة المعاملة تضيقا واضحا مقارنة مع مجموعة السيطرة، اما الدراسة النسجية المرضية فقد اظهرت التئام منطقة التفهم في مجموعة المعاملة بعد ١٥ يوما من العملية تمثلت بالنسيج الليفي المنتظم مقارنة مع النسيج الليفي غير المنتظم لمجموعة السيطرة اما بعد ٣٠ يوما فقد اظهرت مجموعة المعاملة التئام جيد لمنطقة التفهم مقارنة مع مجموعة السيطرة التي لم يكتمل

الإلتئام فيها، نستنتج من الدراسة ان لف طعم الثرب حول منطقة تقم المرئ يمنع النضح ويعمل على تسريع الألتئام لكن في نفس الوقت يسبب تضيق منطقة التقم اضافة الى زيادة التصاقها مع العضلات المجاورة مما يؤدي الى عدم القدرة على البلع و ارجاع الطعام.

Introduction

Esophagectomy is an approach to remove an entire section of the esophagus, it was performed for a wide spectrum of conditions but mostly for carcinoma (1). The goal of esophageal resection is to restore both swallowing and barrier to the gastro esophageal reflex with minimal mortality and morbidity (2,3). In esophageal surgery, there is higher risk of complications than in any other portion of alimentary tract (1,4). This is believed to be the result of its lacks of a serosa cover which helps to limit leakage by exuding fibrin, lacks an omentum to help localize and seal a leak (5), segmental blood supply, constant motion and poor suture holding as compared to other part of the (1,6). Different approaches used for the excision of esophageal cancer varying from transthoracic to transhiatal and in some cases only abdominal approach have been recommended, each approach has its pros and cons (7). The conventional method of birding anatomic defects of the upper digestive tract in the neck is by tissue transfer –either gastric or colon pull through, free jejunal graft, or full –thickness skin flap (8), pedicle diaphragm and omentum flap (9). Anastomosis leak was defined as extravasations of water soluble contrast medium and/or clinical symptom of leakage. Anastomotic stricture was defined as an anastomotic narrowing that did not allow a standard fiber endoscope with a diameter of 9mm to pass with out resistance, and this indication for dilatation (10).

Any studies showed the omentum has a rich vascular, lymphatic tissue and it enhances anastomotic healing when added as an adjuvant for reconstruction procedures (11), that its pedicle transposition for reinforcing the anastomotic line significantly reduce the leakage after esophagectomy for carcinoma of esophagus (12). Anastomosis can be handmade, stapled or semi mechanical. As the hand –sewn anastomosis, many technical details, e.g. running versus interrupted sutures, absorbable or non absorbable, one-or two-layer sutures, knots within or outside the lumen, have been debated (1). However a greater number of stapled anastomosis resulted in strictures and there were less dangerous of anastomosis site leakage and continues necrosis (13). The goal of this study was to evaluate the effect of wrapping nonvascularized omental graft in the healing of anastomosis site in oblique esophageal partial resection in dogs.

Materials and methods

Twelve adult dogs (2-4 years), local breed, apparently healthy weighting 15-20 kg were used in this study.

Animals were divided randomly into two equal groups (control and treated). Prophylactic antibiotic penicillin – streptomycin in a dose 10,000 I.U and 20 mg/kg B.W intramuscularly, respectively was administered one hour before operation. Experimental animals were anesthetized by injection with atropine sulfate in a dose 0.04 mg/kg B.W as a premedication followed 15 minutes later by a mixture of ketamine hydrochloride in a dose 15 mg/kg B.W and xylazine hydrochloride in a dose 5 mg/kg B.W, intramuscularly. In animals of control group the surgical area of the ventral cervical region was prepared for aseptic surgery, the animal positioned on dorsal recumbency, ventral cervical midline incision through the skin and subcutaneous tissue. The sternohyoideus muscle were separated on their midline and retracted laterally for exposing the trachea, care must be take to avoid injury to the adjacent carotid sheath and left recurrent laryngeal nerve, curved artery forceps placed under the esophagus and stay sutures were placed proximally and distally to the site of cutting to facilitate the manipulation of the esophagus and prevent leakage of the intraluminal content, oblique incision is made in the middle third of esophagus by scalpel and about 1 cm of its length excised then anatomists with hand sewn suturing accomplished in two layer, the strongest layer in esophagus is the mucosa and sub mucosa are closed by placing simple interrupted suture by 2.0 chromic cat gut with the knot was tied inside the lumen, the second interrupted pattern placed in the muscular layer and adventitia the knot was tide on the outer aspect of the esophagus wall. In animals of treated group the same operation was made to expose the esophagus and excision part of it, then laporatomy was performed on the left flank region to obtain the patch of omentum tissue then fixed around the anatomises site by several stitches with 2.0 chromic cat gut, then suturing the laporatomy incision by routine technique. Antibiotic injection as mentioned previously for four days and intravenous fluid therapy of dextrose 5% in a dose 20 ml /kg B.W was given for three days after operation then soft food (milk with water) was given for 5 days later and the animals reintroduce gradually to solid food. Segment of esophagus was taken after euthanasia the animal in the period 15 and 30 days after operation an esophagogram was taken by clamping one end of esophagus by artery forceps and filled with water soluble material (barium sulphate solution) to evaluate the leak and the degree of stenosis at anastomosis site by using this formula {stenosis index % = 100(1-2A/B+C)} A: diameter in centimeter at anastomosis site, B and C : diameter in centimeter at two centimeter proximal and distal the anastomotic site (14), next the esophagus opened

longitudinally and the biopsy taken from anastomosis site fixed in neutral buffer formalin solution 10% for histopathological study.

Results

Clinical signs of all experimental animals post operation period were recorded, and there was soft swelling in the neck at the site of operation, persisted for 2-3 days, then disappeared after retaining the animals to feeding on semi solid food. The animals of control group eat normally, but suffered from moderate signs of dysphagia and regurgitation that disappear after several days but this sign continued for long period in treated animals and the animal was able to eat the food but needed long time. After euthanizing the animals, to obtain the specimens, severe adhesions were seen between the anastomotic site and the muscle which surrounded it in treated animals less than seen in control group (Fig. 1 A and B).

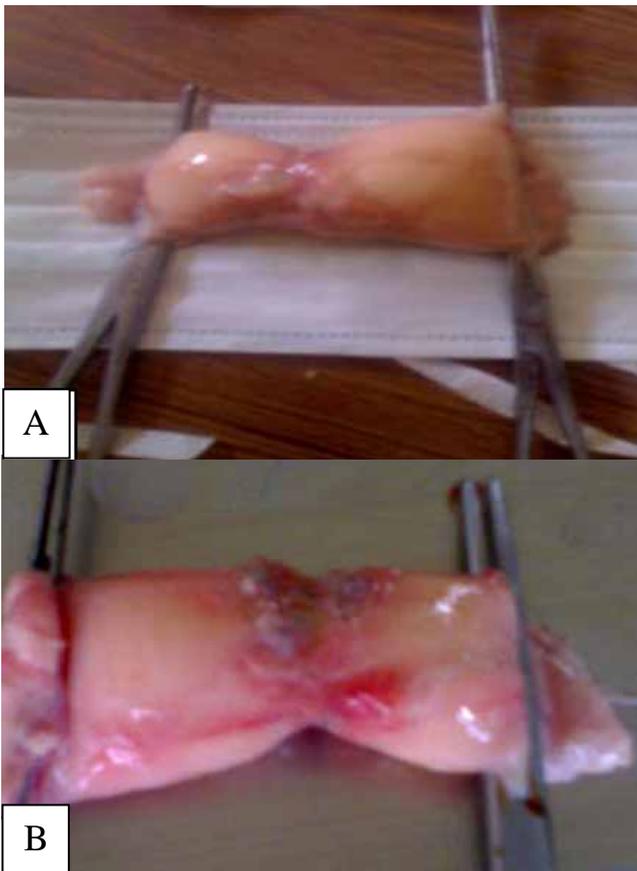


Fig. 1: Adhesion of the anastomosis site with its surrounding tissue after filling with barium sulphate on two animals in treated group after 15 days (A) and 30 days (B) post operation.

Radiographic examination of the two groups revealed the presence of difference in the degree of stenosis at anastomosis site 15 and 30 days after the operation (Fig. 2 A and B) and (Fig. 3).

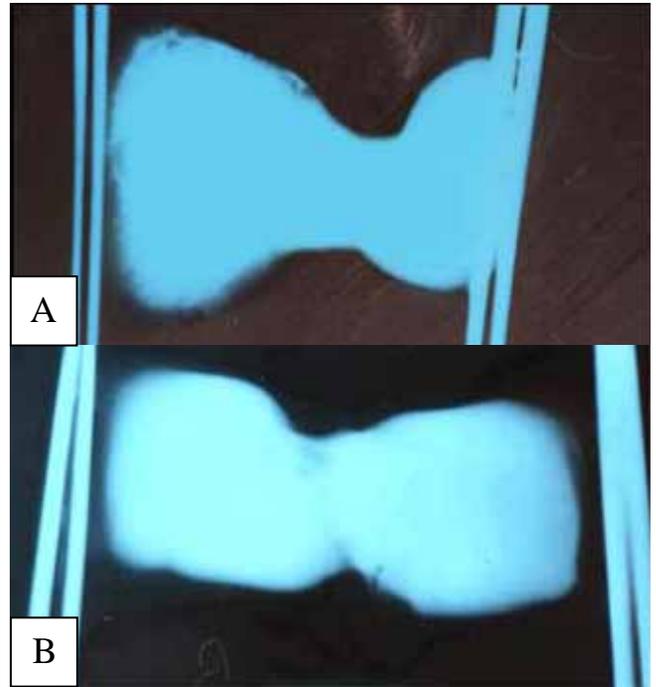


Fig. 2: Radiography of the anastomosis site after 15 days (A) and 30 days (B) in two animals of the control group.

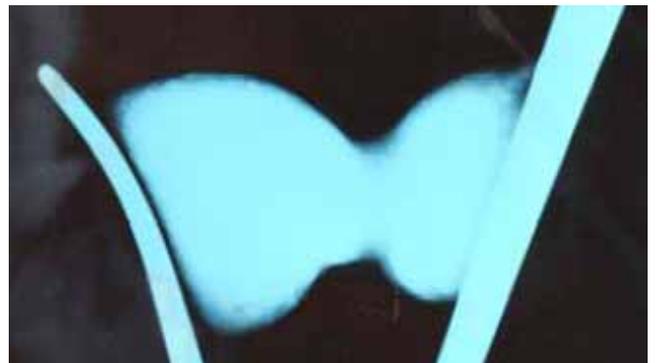


Fig. 3: Radiography of the anastomosis site after 30 days in one animal of the treated group.

Statistical analysis revealed low degree of stenosis in the control group (36.06 ± 0.9) after 30 days and high degree of stenosis after 15 days in the treated group (57.61 ± 0.2) (Table 1).

Table 1: mean degree of stenosis at the anastomosis site in the two groups.

Group	Mean degree of stenosis at 15 day	Mean degree of stenosis at 30 day
control group	39.34±1.04	36.06±0.9
treated group	57.61±0.2	55.78±0.2

Histopathological examination on postoperative day 15 in the control group showed fibrous connective tissue infiltrated by inflammatory cells (Fig. 4) with moderate thickness of epithelial layer covering the irregular direction fibrous connective tissue. On postoperative day 30 there was proliferation of stratified squamous epithelial layer which extended as papillary projection into sub epithelial layer with more thickness comparative to that seen on day 15 covering the fibrous connective tissue (Fig. 5). Hyperplasia of mucus gland surrounded by fibrous connective tissue were also seen, and in the area incomplete stratified epithelial layer.

On postoperative day 15 in the treated group, the histopathological section showed formation of fibrous connective tissue in the adipose tissue of omentum and infiltrated by inflammatory cells (Fig. 6). The suture material was surrounded by fibrous connective tissue and proliferation of the epithelial layer with regular mature fibrous connective tissue, this layer was thicker that seen in the control group on this day.

On day 30, there was severe fibrous connective tissue surrounded the suture material (Fig. 7). Mature regular fibrous connective tissue was infiltrated by inflammatory cells and complete thickness of epithelial layer.

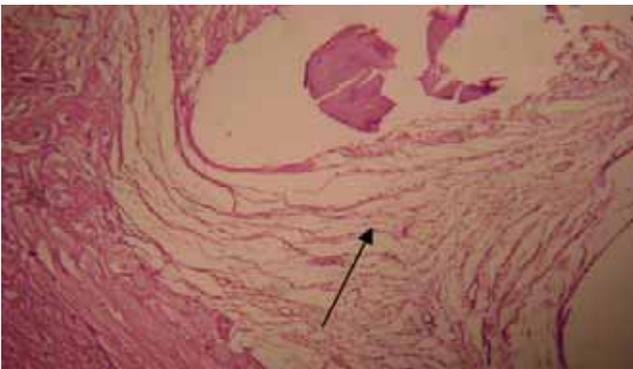


Fig. 4: Histopathologic section in the esophagus of control group on day 15 after the operation showing irregular direction of fibrous connective tissue (→) with inflammatory cells infiltration. (H&E). 40×.

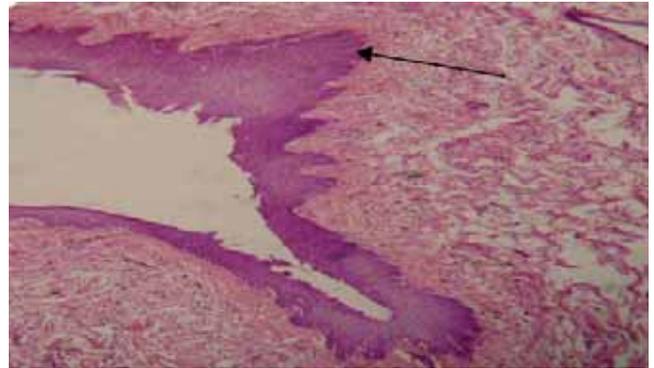


Fig. 5: Histopathological section in the esophagus of control group on day 30 after operation showing proliferation of stratified squamous epithelium layer which extend as papillary projection (→) in sub epithelium layer. (H&E). 40×.

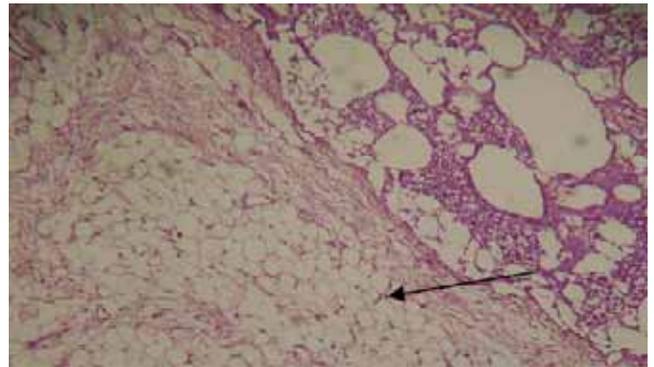


Fig. 6: Histopathological section in the esophagus of treated group on day 15 after the operation showing formation of fibrous connective tissue (→) in adipose tissue of omentum which was infiltrated by inflammatory cells. (H&E). 40×.

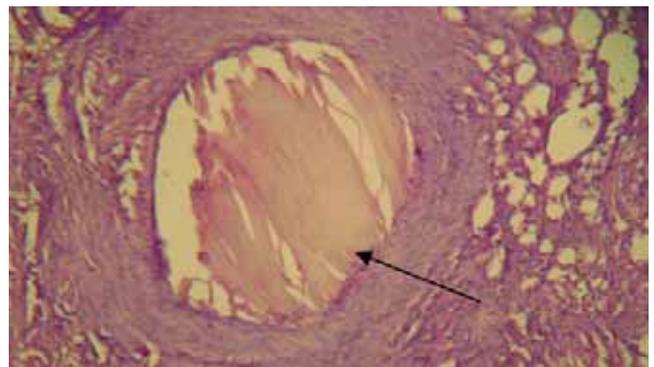


Fig. 7: Histopathological section in the esophagus of treated group on day 30 after the operation showed fibrous connective tissue (→) surrounding the suture material (H&E). 40×.

Discussion

Leakage one of serious complication seen in surgery of esophagus (7), for these reason some surgeon decided to use the pedicle omentum transposition for reinforcing the anastomotic suture line to reduce significantly the incidence of leak after esophagectomy and to decrease the morbidity and mortality of the procedure (12). Well vascularized flap of omentum provides of oxygen and nutrient for improve healing, moreover, the omentum delivers vascular endothelial growth factor and potent angiogenic growth factor(15), this substance gives ability to accelerate neovascularization cross anastomosis line (16). from observation of experimental animals in post operation period for 30 days, all animal did not exhibit any signs of anastomosis leak and when euthanized the animals to take the specimen it showed that's all anastomotic site was normally healed with out any dehiscence and this exactly appear radiographically in this study that's no any leak of contrast media with present of stricture in the two groups was observed but it differ in its degree, this agree with previous study reported that in hand - sewn anastomosis there is a higher tendency for stricture formation after two-layer anastomosis than after single -layer anastomosis and disagree with (9) that refer not happen stricture in his study when used omentoplasty with diaphragmatic muscle in esophageal reconstraction, in addition to that the adhesion which appeared in two groups of this study disagree with (17) who showed no any adhesion or stenosis at the site of anastomosis that used omental pedicle but it record increase in the thickness of esophagus at the anastomosis site and it related with the presence of omental pedicle, and the present study also disagree with other study (18) said stenosis of esophagus not appear at less than 30 day, and agree with (19) that demonstrated one layer suturing in esophageal anastomosis in the neck must be considered superior to the two layer procedure because of the lower incidence of non malignant stricture formation.

The clinical sings of the treated animal recorded the present of dysphagia and regurgitation when in feeding solid food and need long time for eating and with the time the severity of the signs was decreased. When compared with control animals, that suffering from moderate signs of dysphagia and regurgitation that will disappear after several days and this appeared radiographically by higher degree of stenosis in treated group at 15 and 30 days post operation when compared with control group at the same period. This may be related with the role of omentum that's enhance fibrosis and adhesion of anastomosis site with the surrounding muscle and this may be interfere with the freely movement of esophagus throw swallowing of food and lead to dysphagia and regurgitation, this agree with other study demonstrated that omentum contain in its histological structure fibroblast, fibrous cells and fibroblast

growth factor that enhance fibrosis and formation of fibrous connective tissue to the site it move to it (20). Also this study agree with the histopathological result showed formation of fibrous connective tissue in adipose tissue of omentum which infiltrated by inflammatory cells at 15 days post operation in treated group. The role of omentum is in believed enhances esophageal anastomosis healing from its ability to produce fibroblast growth factor. This compared with the histopathological result by the formation of mature regular fibrous tissue in treated group at 15 day while in control group the fibrous connective tissue is irregular, this factor may enhance fibrosis and adhesion at the site of anastomosis and later lead to increase of stenosis and this compared with the radiographical results referred that's mean degree of stenosis in treated group at 15 and 30 day post operation is higher than control group at the same period.

The conclusion of this study revealed that non vascularized omental graft prevent leak when use around the anastomosis line in esophageal resection and at the same time enhanced healing of anastomosis line but it increase the stenosis at anstomosis site and increase the fibrosis and adhesion of anastomosis site with surrounding muscle and so interfere with the swallowing of patient by dysphagia and regurgitation.

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