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EXPERIMENTAL TENDON SPLITTING IN DONKEYS ANGIOGRAPHIC AND HISTOLOGIC STUDY

(With 6 Figures)

By

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دراسة تجريبية على شـــق الأوتـار في الحمـــــير
التغيرات في نسـق الأوعيـة الدمويـة وفـي الأنســـــجة

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كان الهدف دائما في علاج التهابات الأوتار المزمنة في الفصيلة الخيلية هو العمل على تنشـــيط الدورة الدموية للوتر المصاب ، ويرجع ذلك لطبيعة تركيب نسيج الوتر ونسق دورته الدمويـــة الفقير نسبيا. وبالاضافة للطرق التقليدية لتنشيط الدورة الدموية ظاهريا عن طريق الكيّ أو الحراقة ، فلقد استحدثت في السنوات الأخيرة طريقة شق الوتر ـ كتنشيط داخلي لعلاج مثل هذه الحـــالات ـ وبهدف دراسة التغيرات التي تحدث في نسق الأوعية الدموية وفي أنسجة الأوتار بعد عملية شق الوتـر. أجريت ١٦ عملية تجريبية على تسعة حمير، تم اعدامها على فترات مختلفة، وقد تم عمل صور شعاعيـة ملونة لشرايين المنطقة قبل العملية كذلك عند نهاية الفترة المحددة، كما أخذت عينات من الأوتـــار للفحص الميكروسكوبي. وقد أثبتت النتائج أن شق الوتر يؤدى الى تنشيط واضح في الدورة الدمويـــة الرئيسية والجانبية للأوتار، مما يؤدى الى تنشيط النسيج نفسه ويساعد على عملية الالتئام .

SUMMARY

Sixteen experimental tendon splitting of the superficial and deep flexor tendons were done on 9 apparently healthy donkeys. The animals were euthanasied at different intervals post-operatively. Contrast arteriograms were performed before the splitting and before euthanasia. Samples from the operated tendons were examined histologicaly. The results proved an active reparative vascular and tissue reactions in and around the area of splites as well as the paratenon.

INTRODUCTION

As most of the equine population in Egypt is still mainly used as draught animals, chronic tendon affections constitute one of the most common problems in the field of equine surgery.

Firing and/or blistering are still the common methods used by the Egyptian practitioners for treatment of chronic tendinitis with variable degrees of improvement.

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The repair of tendon injuiries is usually a slow process due to the specific structure of the tendinous tissue (LEONARD, 1961 and HICKMANN, 1964), which is mainly attributed to the insufficient vascularization (STROMBERG & TUFVESSON, 1969 and ASHEIM & KNUDSEN, 1976).

To improve tendon vascularization, splitting of the tendons in equines has been practicised by many authors (FROSSEL,1931; ASHEIM,1964; NILSSON and BJORCK, 1969; STROMBERG et al., 1974 and others).

The present experiment is designed to study the changes in the vascular pattern in case of tendon splitting during the process of healing.

MATERIAL and METHODS

Experimental animals: consist of nine donkeys (Equus asinus), 8 males and one female, between 6 and 10 years old. Animals were fed on a maintenance ration, subjected to light excercise during the time of experiment.

Anaesthesia: used for performing both angiograms and tendon splitting operations was sedation with Combelen* 0.2 mg/kg b.w. intramuscularly, followed by Chloral hydrate (5G/50 kg b.w.) i.v., augmented by 5 mg/kg b.w. Nesdonal**.

Operation: A total of 16 percutaneous tendon splitting were performed according to the modified technique of ASHEIM and KNUDSEN (1976). The operation was done by passing a special tendon knife in the midmetacarpal area through the skin on the medial side of the superficial and deep flexor tendons. The blade was held parallel to the longitudinal axis of the tendons. Three fan shape splites at intervals of 1.5 cm were made along the mid-metacarpal area. Firm bandage was applied on the operated area.

Arteriograms: were done directly before the operation (control) and directly before euthanasia of the animals at different intervals (7, 14, 30 and 60 days). Angiograph of the median artery was done after SCOTT et al. (1976) using warm Urografin***. Mediolateral radiographs were taken using an exposure potentials: 52 KVP, 48 MA. at 0.5 second with 60 cm focal distance.

Tissue samples: from the flexors of the operated fore limbs at the extrasynovial region were collected directly after euthanasia for histological examination using phospate buffered formalin as afixtive and specimens were processed by routine methods. Sections of 5-10 microns were stained using H.&E., Van Gieson, PAS. and Gomori's reteculin stains.

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* : Bayer-Leverkusen, W. Germany.

** : Thiopental-sodium, specia.

*** : Urografin 76%, schering, W. germany.

RESULTS and DISCUSSION

Comparing the pre-and post-operative arteriograms, a remarkable vascular reaction of different degrees was evident in all animals. This reaction reached its maximum 14 days post-operatively, after which began to regress gradually after 30 and 60 days. The changes were mainly in the collateral circulation in the form of refunctioning of some pre-existing non-functioning blood vessels with formation of conglomerates and vascular plexus (Fig. 1&2). However, the changes in the main blood supply (common digital artery) were constant in all animals as a marked increase in the caliber with high degree of filling during the whole time of experiment. These results coincide generally with the microangiographic findings of ASHEIM (1964), NORBERG et al. (1967), RAKER (1968) and STROMBERG et al. (1974). The latter authors found such changes even 360 days after experimental tendon splitting in the horse.

The fact that, the collateral circulation was more activated than the common digital artery, can be explained as a reaction to the direct trauma at the site of splite, whereas the changes at the common digital artery as a compansatory reaction.

The tissue reaction reached its maximum 14 days post traumatically, by which the granulation tissue was more vascular than cellular (Fig. 3). This granulation tissue is characterised by remarkable dilatation of the intratendinous cappillaries, presence of young fibroblasts with great number of cappillary buds, poor collagen and more reticular fibers.

30-60 days postoperatively the granulation tissue appeared to be more cellular less vascular, rich in collagen and reticular fibers taking a wavey pattern together with the fibroblasts (Fig. 4). These findings coincide with those mentioned by NORBERG et al. (1967), RAKER (1968) and STROMBERG et al. (1974) in experimental horses.

The adjacent area to the site of splite showed a pronounced vascular and cellular activity at 14 and 30 days post-operatively which subsided gradually. This vascular reaction together with the leucocytic infiltration in and around the area of spliting promote the reparative process in the tendinous tissue. This coincides with the findings of ASHEIM (1964) NORBERG et al. (1967), STROMBERG et al. (1974) and ASHEIM & KNUDSEN (1976).

The tenocytes in the area adjacent to the splite were characterised by a large hyperchromatic darkly stained nuclei with high mitotic activity 7 and 14 days post operatively. Thirty days post operatively, the nuclei appeared darkly basophilic and well distinct specially toward the splitted (Fig. 5). This active cytological reaction denotes that the fibroblasts in and around the splitted area are mainly derived from the tenocytes of the edges of the splite. These findings agrees with GARLOCK (1927), LINDSAY & THOMSON (1960), LUNDBORG (1976), MAHFOUZ (1976) and WILLIAMS et al. (1980) and disagree with SKOOG and PERSSON (1954) and POTENZA (1962), who mentioned that fibroblasts are derived only from paratenon or tendon sheath.

60 days postoperatively, areas of hyalinization were noticed invaded with proliferated fibroblasts and blood cappillaries together with collagen fibrils (Fig. 6). This process of revitalisation can be considered as an active process against irreversable pathological lesions (NORBERG et al., 1967; RAKER, 1968 and STROMBERG et al., 1974).

The vascular and cellular reactions at the paratendinous tissues in the from of excessive connective tissue proliferation around the blood vessels with perivascular aggregation of leucocytes, fibroblasts and collagen fibrils are also observed experimentally by STROMBERG et al. (1974).

In conclusion, it can be said that, the rate of tendon healing is relatively a slow process due to the specific structure of the tendinous tissue itself. However, after percutaneous tendon splitting, the vascular reaction inside (splitted and adjacent areas) as well as outside the tendon (Paratenon) is markedly activated for a long period, motivating hand in hand with the cellular reaction the process of healing. However, it should be taken in consideration that, this experiment has been applied on apparently healthy tendons and that the results should be critically transfered on the diseased one.

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LEUGEN OF FIGURES

Fig. (1): Vascular reaction with conglomerate formation (Arteriogram, Pre and 14 days p. op.).

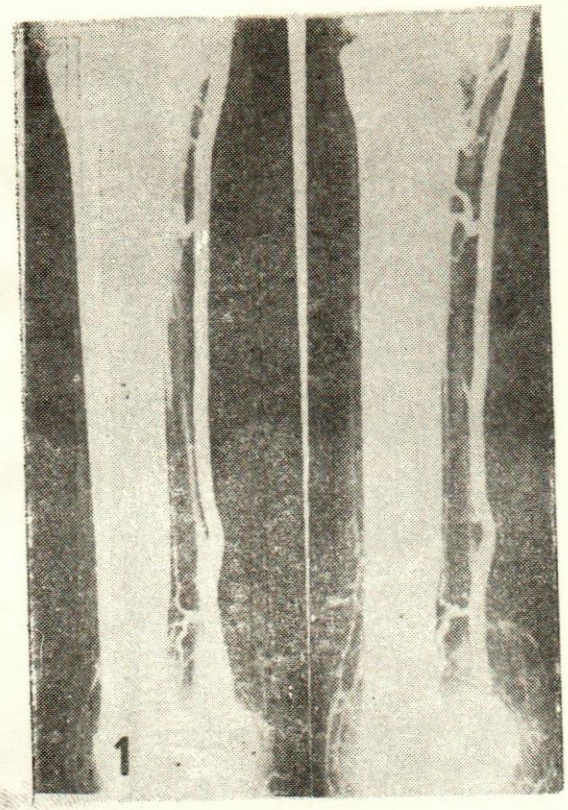
Fig. (2): Schematic diagram for arteriogram of Fig. 1.

Fig. (3): Splitted area filled with granulation tissue, adjacent area showing dilatation of the blood cappillaries-arrow. (14 days p.op.).

Fig. (4): Wavy pattern of collagen and reticular fibres (14 days p. op.).

Fig. (5): Activity of nuclei of tenocytes in the adjacent area towards the splite (30 days p. op.).

Fig. (6): Hyalinized tendinous tissue invaded with proliferated fibroblasts and collagen (60 days p. op.).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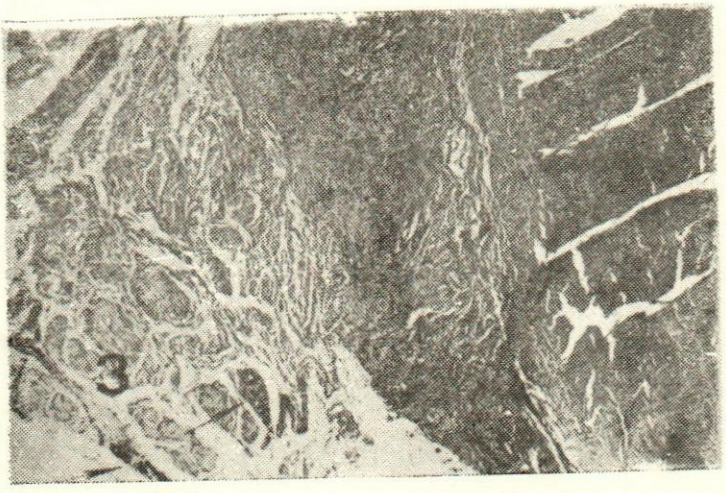
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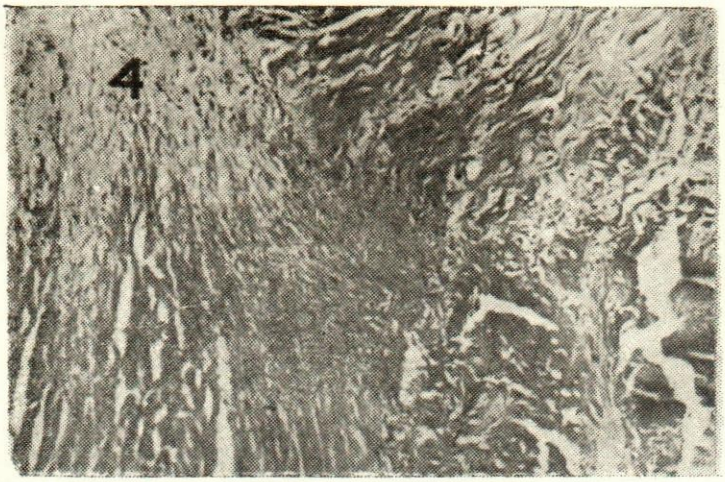
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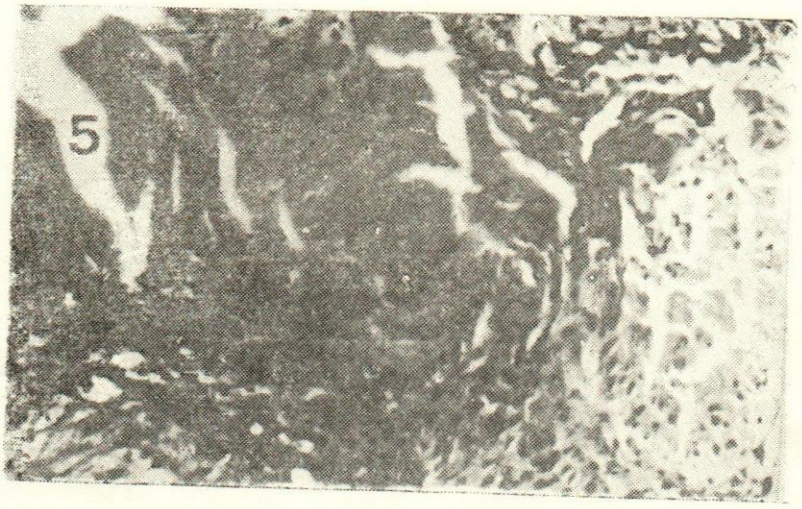
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