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ANATOMICAL VARIATIONS OF AXILLARY ARTERY WITH CLINICAL IMPLICATIONS

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Summary

Axillary artery is frequently injured due to the trauma of the shoulder region. Nevertheless the management of such injury is often controversial and several techniques have been developed in vascular surgery in the last years. The variations of the axillary artery can

present a complication during multiple surgical and non-surgical procedures. The review of axillary artery variations with clinical implications in surgery is presented in this article.

Rezumat

Variații anatomice ale arterei axilare cu implicații clinice

Artera axilară este frecvent rănită din cauza unei traume în zona umerilor. Cu toate acestea, managementul a astfel de prejudiciu este adesea controversate și mai multe tehnici au fost dezvoltate în chirurgia vasculară, în ultimii ani. Variațiile de artera axilară poate prezenta o complicație în mai multe proceduri chirurgicale și non-chirurgicale. Articolul prezintă revizuire a variații arterei axilare cu implicații clinice în chirurgie.

Introduction

The axillary artery has the second highest rate of injury after the popliteal artery. Thus it is important to know of such variations for surgeons, cardiologists and different vascular system specialists. The anatomical variations are crucial in ligation of the artery during emergency operations after trauma, artery and muscle flaps in plastic surgery.

The variation of the upper limb arterial supply can be described by a model in which it develops in 5 stages. The first part is the development of the axial system such as axillary, brachial and anterior interosseus arteries. The abnormal patterns of different arteries are explained by the anomalies of the division during these stages. Local hemodynamic factors are also involved in the patterning of blood vessels [1, 2].

Another important subject is the vascular anastomosis around scapula that plays a great role in preventing ischemia of the upper limb. Though there is almost no detailed information about this anastomoses it has a large clinical value in different areas of surgery such as vascular and trauma surgery.

The arteries involved in the formation of scapular anastomosis are the suprascapular artery, the descending branch of the transverse cervical artery from the subclavian artery and the circumflex scapular artery, a branch of the subscapular artery from axillary artery. So, the arterial circle is formed by the arteries of the first part of the subclavian artery and third part of the axillary artery. The ligation of the artery distal to the subclavian artery will result in severe reduction of blood flow to the upper extremity and to necrosis later on [3, 4].

Material and methods

We performed a review of current data regarding the axillary artery variation, anomalies and possible clinical implications. A cadaveric study has been performed on 4 specimens to describe the anatomy of the axillary area. In addition we have described and analyzed a case of the axillary artery trauma and a case of brachial gun shot wound.

Anatomical variations and abnormalities

The arteries present an anatomical structure with a high rate of variations. The subclavian, axillary arteries and their branches are not an exception.

Thorek, 1951 reported the detachment of the subscapular artery from the 3rd part of the axillary artery in 80% of cases, of which in 58% it was a separate branch, in 18% a common branch with the posterior circumflex humeral artery, in 2% from profound brachial artery. In the other 20% cases it was arising from the 1st part of the axillary artery. In 6% of cases it was a separate branch, in 6% - branch of the lateral thoracic, in 4% a branch of the posterior circumflex humeral artery while in 4% it was absent.

P. L. Williams et al., 2005 indicates the absence of this artery in 1.7% and Patnaik et al., 2000 in 8.3% of cases. A. A. Khaki et al., 2011 described a direct detachment of the circumflex scapular artery from the 3rd part of the artery where it gave off a short branch to the latissimus dorsi muscle [32, 14].

S. Koirala et al., 2012 during a dissection of 102 upper extremities described a common trunk arising from the second part of the axillary artery and dividing into lateral thoracic, subscapular and posterior circumflex arteries in 18.7% of cases. In 0.9% subscapular artery branched from the second part of axillary artery [4].

V. Saralaya et al., 2008 described a case report in which the axillary artery had only two branches in its first part and no branches at all in the second and third parts. The branches were superior thoracic and an unusual branch which were divided into circumflex scapular, thoracodorsal, posterior circumflex humeral, thoraco-acromial and lateral thoracic arteries. The authors named it as common subscapular trunk [25].

T. M. Farhan et al., 2010 described the usual pattern of the subscapular artery where it is divided into the circumflex scapular and thoracodorsal arteries in 77%. The subscapular artery originated from the lateral thoracic in 7%. The lateral thoracic artery is originated from the subscapular in 5% of cases. In 2.5% of cases the circumflex scapular artery along with thoracodorsal arteries branched from the lateral thoracic artery [8].

A case of anomalous origin of the subscapular and suprascapular arteries by a separate arterial trunk which coursed obliquely between the musculocutaneous and median nerves was described. The total length was 4.2 cm and the trunk branched into three subbranches: ventral and dorsal branches to subscapularis muscle and the suprascapular branch [5].

N. K. Mahato, 2010 reports a bilateral suprascapular artery originating from the third part of the axillary artery. The arteries ascended between the lateral and posterior cords of the brachial plexus. At the level of the inferior belly of omohyoid they joined the suprascapular nerves and then were passing together under the transverse scapular ligament. The arteries made up 8 cm [17].

A few authors describe the origin of this artery from the first part of the axillary artery. An anomalous origin of the suprascapular artery is less frequent than its abnormal course [19, 28, 2].

A group of authors describe the presence of a common trunk originating from the third part of the axillary artery. It gave rise to the anterior and posterior circumflex humeral and subscapular arteries and then descended into the arm where it branched into a radial collateral and middle collateral arteries and continued as the superior ulnar collateral artery. The profound brachial artery was absent in this case [23].

S. Jayakumari, G. Rath and J. Arora, 2006 described a rare variation of two axillary arteries. The artery was divided at the level of the pectoralis minor muscle. The first axillary artery branched into superior thoracic, clavicular, deltoid, pectoral and acromial arteries. The second axillary artery branched into anterior and posterior circumflex humeral arteries at the inferior border of subscapularis. Then both arteries then continued into two separate brachial arteries [13].

E. Lopotenko, 2010 describes similar anatomical variation. The lateral trunk in this case was named brachial artery. It was anterior to the median nerve and terminated with radial and ulnar arteries giving of branches to biceps brachii muscle and inferior collateral ulnar artery. The medial trunk was named a. axillaris propria because it branched into anterior and posterior circumflex humeral arteries and subscapular artery which was a common trunk for the circumflex scapular, thoracodorsal and lateral thoracic arteries [16].

Anastomosis of the shoulder region

As we mentioned above the scapular anastomosis is formed by three major arteries. But there is a possibility of additional arterial contribution from other vessels making the anastomosis a much larger system than we can presume at first.

A group of authors found that anterior circumflex humeral artery had the anastomosis with posterior circumflex humeral artery, thoracoacromial and suprascapular arteries. The posterior circumflex humeral artery additionally gave small but consistent branches to the

circumflex scapular artery and subscapular artery in all specimens. This anastomosis protects the proximal part of the humerus from ischemia [19].

D. E. Cooper et al., 1992 described that the labral and capsular blood supply originates from the suprascapular, circumflex scapular, and posterior circumflex arteries [6].

J. L. Andary and S.A. Petersen, 2002 confirm a consistent anastomosis between the suprascapular and circumflex scapular arteries, indicating that there might be a watershed region in the capsule. The capsule also receives a part of its vasculature from the arteries of the rotator cuff muscles which are attached to the humerus [1, 3].

Some other authors found a seventh branch of the axillary artery in 50-86% of cases. It originated proximal to the subscapular artery and distal to the lateral thoracic artery, then passed to the coracoid process and supplies the subscapularis muscle sending additional branches to the shoulder capsule [3].

The lateral and inferior part of the scapula region is also supplied by medial branches from thoracodorsal artery. There are usually 1 to 3 branches with the diameter of 0,5-1,0 mm. They also supply the anterior serratus and teres major muscles. Besides that the thoracodorsal artery is eventually divided into three arteries (60%), two arteries (30%) and has multiple small branches (10%) all supplying the inferior part of the scapula [35, 36].

The information is clinically relevant because it shows that the scapular arterial circle may not consist of only from the three usual arteries which contribute to its formation.

Clinical anatomy

Traumatic lesions of the axillary artery present 15 to 20% of the arterial injuries of the upper limb. About 94% are penetrating wounds and 6% are blunt force traumas usually due to the shoulder fractures or dislocations [1].

About 50% of the cases of acute arterial insufficiency of the upper extremity are due to embolization. The remaining 25% are due to arterial thrombosis and 25% have an iatrogenic origin [34].

J. M. Hayes and G.N. Van Winkle, 1983 report that 89% of injuries usually occur with the third segment. In this case M. Yagubyan and J. Panneton, 2004 report an abnormal pulse in 89% of cases, 75% had no distal pulse and 14% had a weak distal pulse [12, 21].

Q. Zhang et al., 2013 report that not all of the patients develop ischemia of the limb when the artery is injured or blocked. It is explained by the fact that the axillary artery has 5 main branches which create a strong collateral circulation, thus preventing ischemia and necrosis in some patients [34].

The major problem is that about 46% of patients presented with neurological deficits, and 68% with acute ischemia, which makes this type of trauma hard to diagnose [33].

C. S. Modi et al., 2008 indicate that limb salvage rate is 94%, and 70% of patients can regain good neurological function if the treatment is not late. Generally the damage of the upper extremity is associated in 75% with nerve, bone, or venous damage [20, 33].

H. Gill, W. Jenkins et al., 2011 analyzes the data of 68 patients with the axillary artery injury. Primary repair was possible in 60.3% of patients. 7.4% injuries were ligated. The limb salvage rate was 100% and the main cause of morbidity was a brachial plexus injury.

Another case where the knowledge of the axillary artery branches is useful is the scapula fractures. These fractures account for 3-5% of all the fractures of the shoulder girdle. A surgeon who operates in this area must always remember of the possibilities of a neurovascular damage. This can happen in the case of muscular flap elevation or if the artery and nerve pass in an unusual area. Two arteries are at critical risk during a posterior surgical approach. These are the suprascapular artery and circumflex scapular artery. The circumflex scapular artery can be damaged due to the use of the retractor during the surgery. It is also helpful to ligate the artery in the case of heavy bleeding [30, 31].

R. M. Tikhilov, S. P. Lushnikov, A. U. Kocsis, 2009 suggest that a part of the scapula can be used in case of bone autotransplant along with its vascular pedicle. This was clinically proved to be helpful in the treatment of upper 1/3 of the humerus [36].

Surgery of the axillary artery

Textbooks usually propose anterior approach (along the apex and base of the axillary space), subclavicular horizontal approach (parallel to the inferior border of the clavicle), deltopectoral approach (along the deltopectoral groove) or combined approach which can be deltopectoral-subclavicular, transpectoral one (from the middle of the clavicle to the anterior axillary line), subpectoral-axillary approach (along the inferior border of the pectoralis muscle). A few of the main approaches can be seen on fig. 1 [7]. The anatomical area is quite difficult and is shown on fig 2.

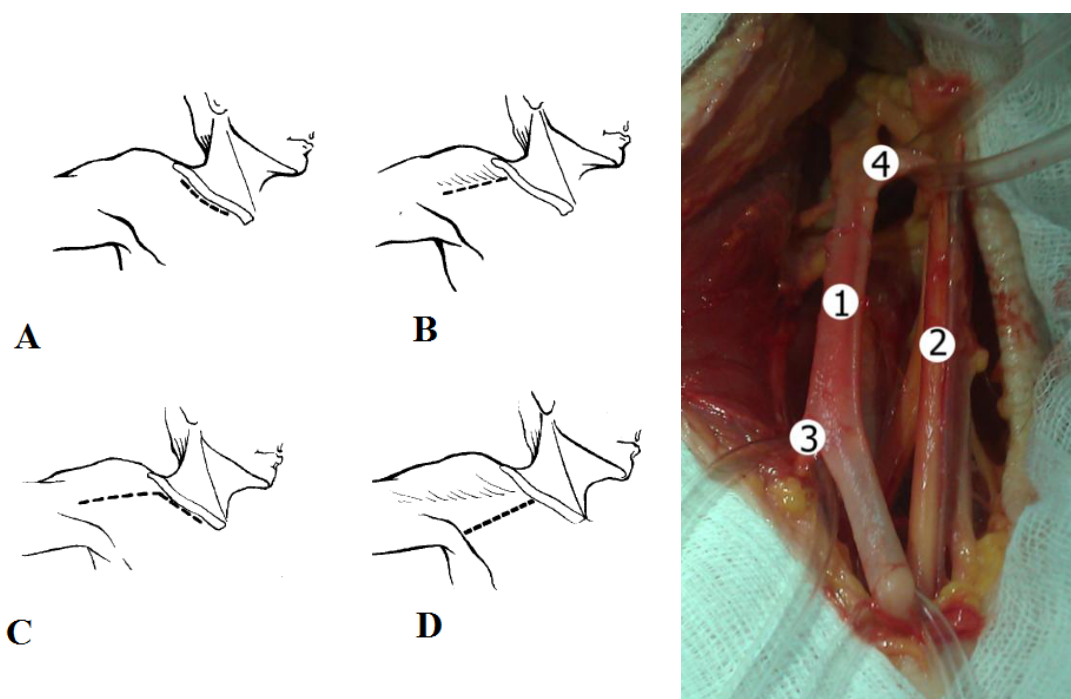


Fig. 1. The scheme of the main lines of the approach to the axillary artery.

A – subclavian approach; B – deltopectoral approach; C – deltopectoral-subclavicular approach; D – transpectoral approach. (Enrico Ascher. Haimovici's vascular surgery 5th ed. p. 326-329, 2003, modified)

Fig. 2. Anatomy of the axillary artery region.

1 – axillary vein; 2 – axillary artery; 3 – anterior circumflex humeral artery; 4 – subscapular artery.

We present a case of the axillary artery trauma with transpectoral approach. A 67 years old male, was admitted to the hospital after a fall on the left brachial area. The primary diagnosis was humeral collum fracture. But during the abduction of the arm the axillary area had a significant enlargement. A puncture was performed which showed the presence of blood in the area. The final diagnosis was rupture of axillary aneurism due to the trauma. The artery was ligated and after that successfully repaired as shown on fig. 3 [4].

The axillary artery aneurisms are considered to be rare. Usually they occur due to blunt or penetrating trauma. Seldom they can have iatrogenic or post obstructive etiology. Infection, atherosclerosis and genetic disorders such as Marfan's syndrome are also risk factors. The axillary artery aneurism can cause temporary or permanent neurological deficit and thromboembolic complications. Endovascular methods have been successfully used in case of axillary artery, but still the open surgery is considered to be the best choice for such condition.

Polytetra-fluoroethylene and saphenous vein grafts are used after aneurysmectomy [9, 10, 18, 29].

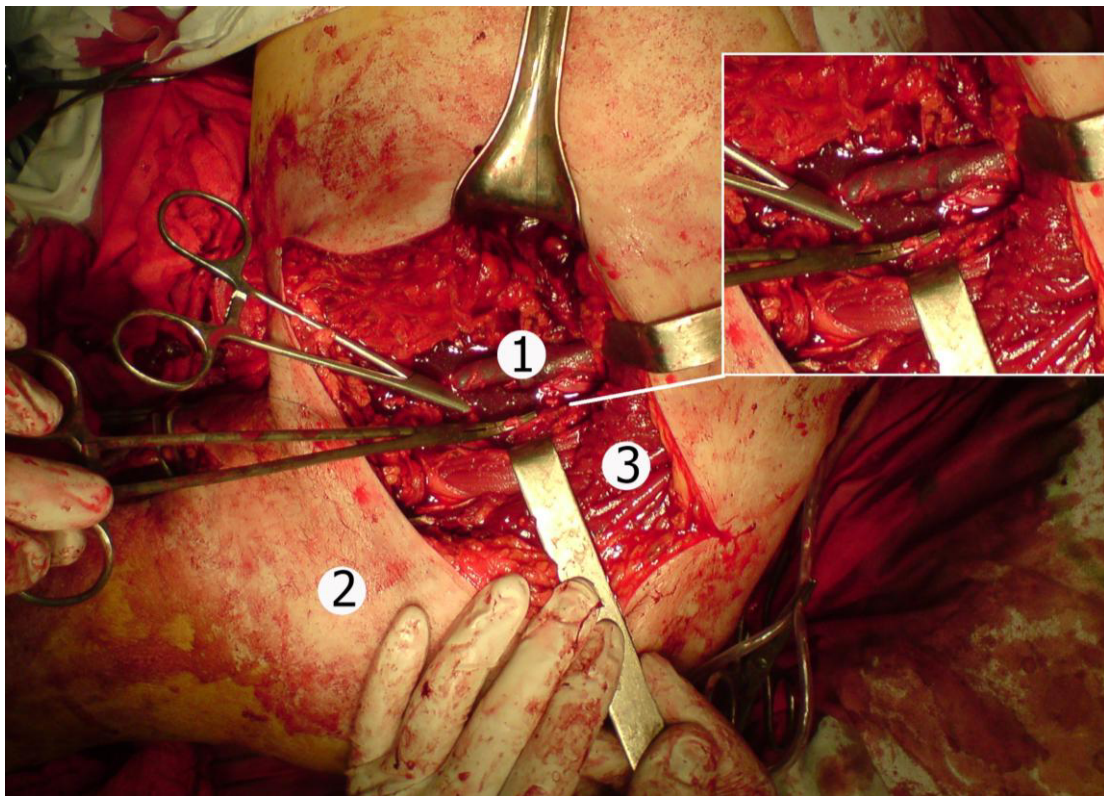


Fig. 3. The axillary artery trauma with transpectoral approach.
1 – axillary vein, 2 - deltoid region, 3 - pectoralis major muscle (Amiably given by of Serghei Suman MD – Associate Professor Department of topographic anatomy and operative surgery).

The second case involved a 28 years old patient with close range gunshot wound of the right brachial artery (fig. 4). On admission the pulse was 110 beats/minute, pressure 90/60 mm Hg, ischemia of the palmar region with no pulse distal to the axillary artery. Autovein graft was used with drainage of the area of the trauma (fig. 5). 4 hours after surgery the patient was transferred to the department of vascular surgery for second surgery due to thrombosis of the graft (fig. 6). Internal saphenous vein was used for the second graft (fig. 7). On day 6 after surgery erosive hemorrhage has developed which was stopped by suturing of the defect. After 24 hours the patient developed a second hemorrhage. Ligation of the subclavian artery with amputation was performed to stop the bleeding. Several necrotomies were performed after the last surgery. The patient was discharged on day 22 in a relatively stable state.

Such trauma is difficult not only because of the blood loss and wide area of the trauma but due to other possible complications. Such complications involve embolism and arteriovenous fistula [24].

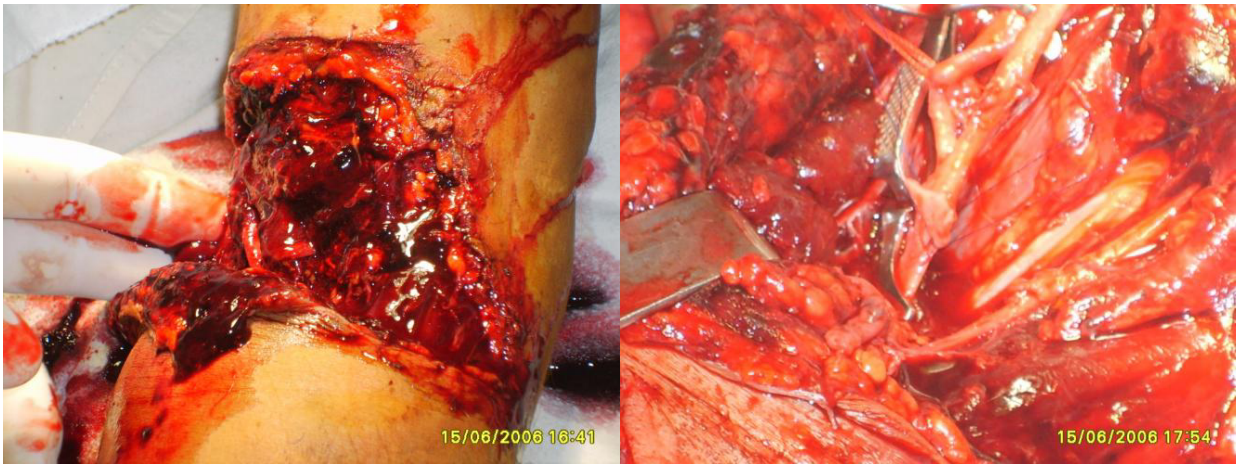


Fig. 4. The brachial artery trauma before revascularization.

Fig. 5. The distal anastomosis with brachial artery bifurcation.

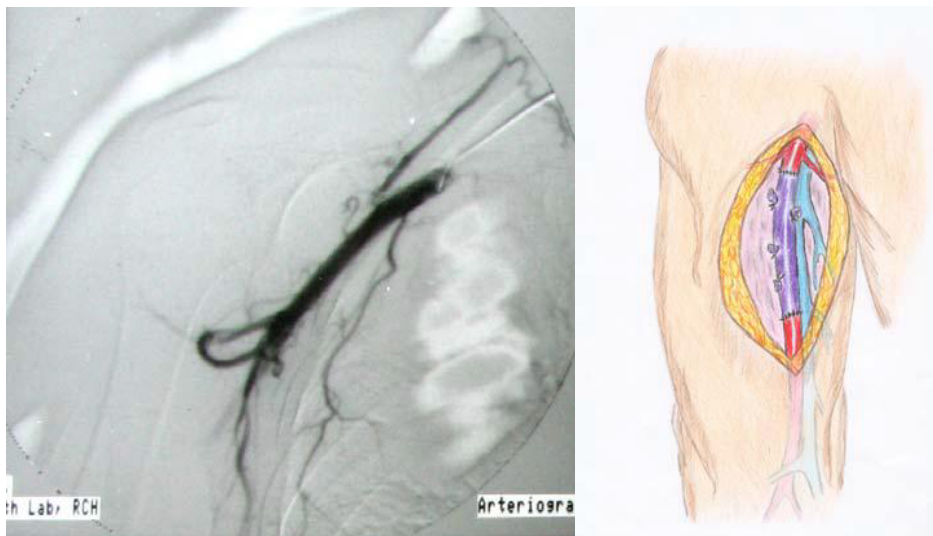


Fig. 6. Angiography of right graft and brachial artery thrombosis.

Fig. 7. The scheme of right brachial artery graft using saphenous vein.

Conclusion

The axillary artery variations and anomalies have a great clinical implication in surgical and non-surgical specialties. The trauma of the upper extremity is frequent. The treatment of the axillary artery trauma can be controversial due to the multiple surgical approaches. Besides the axillary artery gives off multiple branches which create a powerful anastomosis in the scapular and shoulder regions. This is why such a trauma can have no symptoms at all until it is too late and there is permanent damage of the upper extremity. It is also important to resolve the problem quickly before there is a damage of the brachial plexus. The dignostical and surgical procedures should be precise in order to facilitate recovery and minimize the negative outcomes in patients.

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ASIMETRIA VENTRICULELOR LATERALI LA PACIENȚII CU MIGRENĂ

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Summary

The lateral ventricleis asymetry in patients with migrena

The purpose of this study is to associate ALV with migrena. Migrena is a chronic disorder characterized by recurrent from moderate to severe headaches. It is one of the most common medical complaints presented by patients. Migraine is known for more than 3000 years. In ancient Egyptian papyrus were found the description of the disease and the therapeutic recommendations. But many aspects in the pathogenesis of this disease still remain unclear.

Actualitatea

Termenul de migrenă, provine din utilizarea de către Galien a cuvîntului hemicranice pentru a descrie o afecțiune periodică caracterizată prin dureri de cap, vărsături și fotofobie survenind la intervale regulate și atenuate de somn și obscuritate.(2,8) Migrena este o maladie frecventă, cu un prognostic variabil. Un studiu recent a estimat că aproximativ 25% din pacienții cu migrenă episodică evoluează progresiv spre migrena cronică în cursul unui an. Durerea de cap este una din cele mai frecvente plîngeri prezentate medicului de către pacienți. Circa 85% din numărul populației Europei și 90% din cel al SUA suferă periodic de cefalee. În marea majoritate a cazurilor cefaleele sunt primare, fără modificări organice și doar în 8-10% cauza durerilor de cap este o maladie severă a creierului provocată de tumoare, traumatism craniocerebral, ictus cerebral, neuroinfecții etc. În 1988, Societatea Internațională de Cefalee a publicat clasificarea cefaleelor și algiilor faciale. Conform acestei clasificări migrena este o cefalee primară. Ea este cunoscută mai bine de 3000 de ani. În papyrusurile egiptene din