the bactericidal activity of the quinine solution *in vitro*, but appears to prevent precipitation of the alkaloid caused by the strongly alkaline discharge present in some profusely suppurating wounds.*

5. There has been no report of any injurious effects from the application of any of the methods described above.

6. There has been reported no unfavourable systemic reaction from the absorption of the solution, while a few cases have shown a desirable decline in temperature associated with the substitution of quinine dressings for others.

The cost of the solution should not prevent its fairly general use. The 1 per cent. solution amounts to about 8d. per litre—rather more expensive than some of the other solutions in general use—but as it has seemed considerably to shorten the course of convalescence, it is not regarded as an expensive solution. It is further believed, from observations on *in vitro* experiments, that a solution of $\frac{1}{2}$ per cent. would be effective on the wounds if the acidity of the solution were increased by the addition of $\frac{1}{10}$ per cent. of hydrochloric acid. This latter solution has not been used clinically except on a few cases, each of which has run a satisfactory course.

It is a pleasure to acknowledge the laboratory's financial assistance from Mr. Robert Walton Goelet; the co-operation of Dr. Joseph A. Blake, in whose wards much of the work has been conducted; and the aid of Dr. Bertram H. Buxton, who has made the bacteriological examination of the wounds.

REFERENCE.

* The Use of Quinine in the Treatment of Experimental Gaseous Gangrene, *Lancet*, September 4th, 1915, p. 538.

NOTES ON TRAUMATIC AND ARTERIO-VEINUS ANEURYSM.

By CAPTAIN F. L. A. GREAVES, R.A.M.C.

THE following notes of one case of traumatic aneurysm and four of arterio-venous aneurysms will afford an opportunity for discussing some of the symptoms and treatment of this condition.

CASE I.—Traumatic Aneurysm of Right Popliteal Artery.

Multiple shrapnel wounds sustained July 25th; admitted three days later. Severe compound comminuted fracture of left tibia and fibula badly infected by *B. perfringens*. There were smaller wounds at the back of both popliteal spaces, which were much cleaner, and no operation was done on them, but the left leg was carefully cleaned up and wide drainage established. Continuous irrigation with isotonic saline was employed and the leg speedily became healthy.

About three weeks after admission a swelling was noticed in the right popliteal space, lying just internal to the biceps tendon. The skin was hotter over it than normal, the swelling was soft and fluctuated, but there was marked expansile pulsation. No thrill was present, palpation elicited slight pain; movement of flexion of the right knee-joint was limited. A definite systolic bruit was heard with the stethoscope over the swelling; this was conducted upwards to the external iliac artery and downwards to the posterior tibial at the ankle and also to the dorsalis pedis. Neither of these vessels was palpable. The foot was quite warm and no swelling or pain was present in the leg.

For two days the swelling increased slightly and was softer and more superficial; after this it became gradually and progressively harder, more defined, and more circumscribed. The skin became cooler and the pulses eventually returned in the posterior tibial and dorsalis pedis arteries. At the time of receipt of injury there was no haemorrhage from this right popliteal wound. An x-ray plate showed the presence of a bit of metal.

The patient was evacuated for England on September 25th (nine weeks after injury) with a small, firm aneurysm of the right popliteal artery still contracting, a united left tibia and fibula, and all wounds healed.

Treatment of the aneurysm was simple rest, obtained by pillows and sandbags, with the limb in position of slight flexion and elevation.

CASE II.—Arterio-venous Aneurysm of Third Part of Subclavian Vessels.

Single wound from bomb explosion, August 27th, 1915, on the right side of the neck, with severe haemorrhage, which was arrested by a private soldier compressing the wound with his

* It was reported from one hospital that this solution showed the formation of a precipitate on standing, but it was found that the water used came from a very highly alkaline spring. No difficulty was experienced after the addition of a few drops of hydrochloric acid to the litre.

thumb. Admitted next day, very pale and faint, rapid respiration, rapid and feeble pulse; perspiring slightly about forehead and nostrils. There was a wound horizontally placed above the junction of the inner third and outer two-thirds of the right clavicle, and swelling of supraclavicular triangle, and upper pectoral region. Marked pulsation was felt above and below the clavicle and very marked thrill, like the purr of a cat. On auscultation with a stethoscope a loud continuous bruit was heard like the whirr of machinery; the point of maximum intensity of thrill and bruit was just below the mid-point of the clavicle. The bruit was well heard all over the right pectoral region and conducted to the axillary and radial arteries. No radial pulse could be detected, and only a possible brachial pulse. The right hand and arm were cold. He had pain in his hand and arm, which was quite paralysed and anaesthetic up to a point 2½ in. above the elbow. Presumably, therefore, a severe injury to the brachial plexus had occurred.

Treatment.—Isotonic solution to the wound, rest and elevation and warmth to hand and arm; he was kept very quiet in semirecumbent posture. The after-history was that of a gradual general improvement; respiration soon became normal, the pulse-rate dropped very slowly, the pain in hand and arm diminished in intensity, but never quite disappeared. No power of motion or improved sensation occurred, and where he picked at the skin of two fingers he developed very indolent little sores. There was never any pulmonary complication. He was evacuated to England on September 5th, 1915, in good general condition with the signs of arterio-venous aneurysm much localized, but with a completely useless right arm. X rays showed a bit of metal lying vertically below the mid-clavicle anterior to the upper part of the scapula, below and internal to the coracoid process.

CASE III.—Arterio-venous Aneurysm of Second Part of Right Subclavian Artery.

Single wound on right side of neck from piece of shrapnel from a "whizz-bang," sustained on September 5th, 1915. Not much immediate bleeding. When admitted, three days later, he was pale, with rapid pulse and respiration; he had not coughed up any blood; general appearance that of internal haemorrhage. Small entrance wound, moderately septic on the right side of the neck close to the inner end of the clavicle. There was a small amount of swelling and ecchymosis over the clavicle and upper pectoral region, and well marked thrill and bruit very like the former case, and conducted in a similar way. The brachial plexus was damaged; he could flex his fingers and use his biceps group. Other muscle groups of arm and hand were paralysed. There was dullness, loss of vocal fremitus, and resonance at the right base (? right haemothorax). The bruit was heard with a stethoscope all over the right chest and conducted to the radial artery at the wrist. The radial pulse was present, but feeble; no swelling of hand or arm.

The general condition improved with treatment similar to that in Case II; circulation in radial pulse also soon improved. The thrill and bruit became more localized to a point internal to the mid-clavicular line. He was evacuated to England on October 6th, 1915. The fluid in the chest had cleared up, and his general condition was excellent; there was no improvement in sensation or muscular power in the right arm. X rays showed a bit of metal posterior to the fifth rib 1½ in. from the front of the chest.

In neither of these two cases could the patient hear his own bruit.

CASE IV.—Arterio-venous Aneurysm of Axillary Vessels.

Sustained a circular wound over the upper part of the right deltoid region from a high explosive shell on September 6th, 1915. Some smart haemorrhage was stopped by dressing. When admitted, two days later, the wound was moderately septic; there was general swelling of right shoulder and slight ecchymosis, and a diffuse swelling extending from the axilla a short distance down the arm on the inner side. Expansile pulsation was seen and felt. A very marked thrill was present. A loud continuous murmur was heard with a stethoscope over the swelling and conducted to the root of the neck and down to the radial at the wrist. The distal circulation was good; the radial artery was easily felt. There was an area of anaesthesia of the hand and forearm corresponding to the ulnar distribution. No loss of motion. In addition to the swelling mentioned, a tumour (? foreign body) could be felt high up on the inner wall of the axilla. No pulmonary complications were present.

The swelling gradually contracted and became harder and more defined; the point of maximum intensity of thrill and bruit also became more localized, the ulnar anaesthesia gradually passed off, and he was evacuated to England on October 6th. X rays showed a metal fragment on the outer side of the chest wall, high up in the axilla, with eight other tiny fragments lying along the track of the larger piece.

CASE V.—Arterio-venous Aneurysm (Femoral).

Struck by shrapnel bullet on outer side of the left thigh on September 6th, 1915; not much haemorrhage at the time. Admitted two days later with nearly clean entrance wound just in front of the left great trochanter. The general condition was good, but he complained of pain down the front of the left thigh and leg—distribution of long saphenous nerve. A probe introduced into the wound failed to reach the bullet. An x-ray photograph showed a shrapnel bullet in the adductor region. An anaesthetic was given and, the dressing being moved,

Captain Addinsell noticed that there was diffuse pulsation, with a thrill over the base of Scarpa's triangle. No operation was attempted.

When I saw the case, two days after admission, there was slight swelling over the base of Scarpa's triangle, a very marked thrill, and a bruit so loud that it could be heard by approaching the ear to the thigh without touching it. The murmur was conducted to the tibial vessels and upwards to the abdominal aorta. The whole leg was slightly oedematous. Although rest by sandbags and elevation of the limb were used, the leg and thigh became progressively more oedematous, and the pain persisted. After ten days this gradually passed away and the posterior tibial and dorsalis pedis arteries became palpable. The point of maximum intensity of thrill and murmur became more localized to a point just below Poupart's ligament. He was evacuated to England on October 8th, 1915, with his leg normal in size, less pain, and in good general condition.

Having briefly related the symptoms and history of these cases, I should like to compare some points with the description given in Keen's *Surgery* (edition 1914).

1. *Time of Appearance.*—The textbook statement gives from four hours up to many weeks after injury. Three of my cases were noticed on admission—that is, twenty-four hours to three days. The femoral case was not noticed until two days after admission—that is, four days after injury. It is possible that this case was overlooked, but I do not think it likely, as the medical officer in charge had examined it carefully and probed the wound. Possibly the communication between artery and vein took place in consequence of this probing. The popliteal aneurysm I know, from my own observation, had no swelling in the popliteal space until at least a fortnight after admission. That it appeared suddenly was borne out by the fact, for two days after its appearance it became larger and softer and the skin became hot. If one had not been on the look-out for pulsation, it was very like an abscess arising from a foreign body coming up to the surface, and might have been incised with disastrous results.

2. *Primary haemorrhage* is said rarely to be severe, and this was so in all my cases, except possibly in Case II—the arterio-venous aneurysm of subclavian—where the haemorrhage was stopped by a private soldier.

3. *Local swelling* is stated to be diffuse, at first enlarging for a few days and then contracting. This was so in all cases.

4. *Ecchymosis* of skin is stated to be seen when the vessels are superficial. This was only noticed in one case, and was never a marked symptom.

5. *Thrill*, a very marked and striking symptom, quite absent in ordinary traumatic aneurysm where the vein is not involved. This was well marked in all cases.

6. *Murmur* is described as like the whirr of machinery, or a fly in a paper bag. This describes the condition in all the arterio-venous aneurysms, and is quite different from the blowing systolic bruit heard in the traumatic aneurysm. The pitch of the murmur varies in different cases and also from time to time. In one of the subclavian aneurysms Sir George Makins pointed out the slamming character of the murmur, possibly due to vibration of a tag in the vessel. The murmur is stated to be heard by the patient if in the subclavian or carotid regions. Neither of my subclavian cases could hear his own murmur.

7. *Changes of Pulse.*—The pulse is said to be fuller than normal proximal to the aneurysm, and absent or feeble distal to it. This was so in all cases.

8. *Superficial veins* above or below the aneurysm are said to be (a) dilated—very slight dilatation of veins was seen in one subclavian case, none whatever in the others; or (b) tortuous—not seen in any case; or (c) pulsating with systole—not seen in any case.

9. *Peripheral temperature* is stated to be lowered at first, but soon compensated. Cold extremities were noticed in four out of five of my cases, but it is important to note the coincident damage to important nerves in those of my cases in which this coldness was noticed.

10. *General Effects.*—Faintness and rapid pulse until the system has learnt to tolerate the altered arrangement of the circulation. This is a very difficult thing to say much about. It is quite true that in both subclavian cases it was noted, but the coincident injury was severe. In the case of the femoral arterio-venous aneurysm, which apparently was formed whilst in our hospital, it was absent. As a whole, my cases all had rather rapid pulses, and they were still rapid—about 100 to 110—on evacuation.

I can say nothing about the secondary result of these

lesions, and I much regretted having to part with the cases before I could observe the effect subsequent to their moving about.

The question of after-treatment also does not come into the scope of this very imperfect note.

ARTERIO-VENOUS ANEURYSM: ANASTOMOSIS OF VEIN, AND SUTURE OF ARTERY.

By H. J. GODWIN, F.R.C.S.E.,

SENIOR SURGEON TO THE ROYAL HAMPSHIRE COUNTY HOSPITAL, WINCHESTER.

In the following case arterio-venous aneurysm of the popliteal vessels, caused by gunshot wound, was successfully treated by end-to-end anastomosis of the vein and suture of the artery.

Private H. was wounded on November 2nd, 1914, in France, the bullet passing through the lower third of the right thigh; it was a clean wound and healed up quickly, but an arterio-venous aneurysm developed.

On November 19th he was operated on in France; the surgeon exposed the femoral vessels, did not find the communication, ligatured the anastomotica magna, and closed the wound.

The patient, after being in various hospitals in England, returned to his dépôt at Winchester for light duty, but, owing to pain and swelling in his leg after exercise, was admitted to the military hospital, and from there transferred, on April 9th, 1915, to the Royal Hampshire County Hospital for operation. He complained of pain in his right leg, especially after exercise, and said that sometimes his right foot would go white and cold and become very swollen. There was some swelling and oedema of the leg, and on palpation a very distinct thrill was perceptible over the whole of the inner side of the right thigh and popliteal space, and a very loud, harsh, roaring bruit was heard all over the femoral and popliteal vessels. The patient was kept at rest for two weeks, but as the pain returned after allowing him up, it was decided to operate.

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

A, Artery. B, Vein. C, Communication between artery and vein. D, Hole in artery after dissecting out communication and refreshing edges. E, The two ends of the vein ready for end-to-end anastomosis, the dilated portion having been cut away in order to get healthy vein tissues for anastomosis. F, Artery sutured laterally with fine silk sutures. G, Vein sutured, end-to-end anastomosis. H, Graft from internal saphenous vein surrounding the sutured artery, and sutured on opposite side to sutured artery at I.

Operation.

An elongated incision was made in the line of the adductor magnus tendon, giving enough room to have control of the lower end of the femoral and popliteal vessels. It was found that the communication between the artery and vein was just below the opening in the adductor magnus tendon, and that there was quite a small sac between the artery and vein (Fig. 1). A careful dissection of the vessels was made, and Crile's clamps applied to the vessels about and below the aneurysm. On removing the small sac it was seen that the hole in the artery was smaller than that in the vein (Fig. 2). After removing the dilated portion of the vein and excising it as far as healthy tissue, it was found possible to do an end-to-end anastomosis of the vein without producing any tension on the vessel. It was not possible to do an end-to-end anastomosis of the artery because the diameter of the artery on the distal side of the hole was a good deal smaller than that on the proximal side, and because it was found that there would have been too much tension. The edges of the hole in the artery were refreshed, and