of each case. Such a comparison is urgently required and should be undertaken in centres where there is an established routine for treating neonatal asphyxia, and where enough cases of this variable condition occur, so that treated cases and controls can be studied.

Summary

An instrument is described which is capable of performing artificial resuscitation when electrodes are applied to the neck over the site of the phrenic nerve. Experiments on the treatment of asphyxia neonatorum are described together with appropriate case histories taken from 29 subjects. Results are given which show the method to be promising and the line for further experiments is suggested.

This work has been possible only because of the kind co-operation of many people, as our appointments carry no clinical responsibilities. Post-mortem examinations of most of the cases at the Rotunda Hospital were made by Dr. J. H. D. Widdes and the pathological material was examined by Professor W. D. Newcomb and Dr. D. M. Pryce, to all of whom we are very grateful. We would also like to thank the Medical Committees of the English hospitals, the Masters and staff of the Rotunda and Coombe Hospitals, and the many clinicians who have co-operated with us. Our thanks are particularly due to the Medical Research Council for a grant to one of us (K. W. C.) which made possible the clinical work at Dublin, and to Mr. K. F. Tindall for help in constructing the instruments.

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The pioneer health centre of the Union of South Africa was set up at Polela, Natal, in 1940, and up to date 39 have been opened. They aim primarily to prevent disease and to promote health, but curative medical treatment is also given. On the whole patients are encouraged to go to private practitioners in case of illness, so no encroachment is made on private practice; on the contrary, routine medical examinations and home visits result in more patients attending the doctors' surgeries. All persons in the area covered by a centre, whether they are ill or not, are encouraged to attend the centre for routine medical examination, and the assessment of health and ill-health is based on environmental and social as well as individual pathology. Preventive services such as immunization against infectious diseases, antenatal examinations, and so on are provided by the centres. Each centre is left as much freedom as possible to carry out experiments and adapt itself to local needs; in short, each is a research centre. They are still embryonic; the training scheme being developed in Durban plans to give each medical officer a minimum of six months' training, and to appoint at least two to every centre, preferably one man and one woman. The health-centre movement has had to cope with both official prejudices and the opposition of herbalists and witch-doctors. One of their biggest advantages is the scope they give for the employment of the African on health work among his own people. They cater mainly for Africans, but also for non-Europeans and in certain cases Europeans; one result of their work is the increasing confidence the people are showing in hospital treatment (see *S. Afr. med. J.*, 1946, **20**, 326). The centres are also educating in sanitation, diet, and hygiene.

BRUCELLA ABORTUS ENDOCARDITIS

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Infections due to *Brucella abortus* are not uncommon in this country. They remain long undiagnosed and for many months blood-stream infection persists. Until recently, no therapy was effective. It is therefore surprising that no fully proved case of endocarditis due to this organism has so far been recorded in British journals, although in 1936 Rennie and Young described a case which was not proved bacteriologically at necropsy. To date, only three reported cases can be said to satisfy all the required criteria in life and at necropsy (Rothman, 1935; Spink and Nelson, 1939; Spink, Titrud, and Kabler, 1942).

Chemotherapy and antibiotics have yet to be proved effectual in *Brucella* endocarditis. Spink *et al.* (1948) reported a case in which streptomycin and sulphadiazine appear to have inhibited the growing powers of the organism but did not save the patient.

Now that aureomycin and chloramphenicol have both been given with satisfactory results in uncomplicated *Br. abortus* infections, the following case is worth reporting, as courses of "aureomycin," chloramphenicol, penicillin, and streptomycin did nothing to alter the progress of the disease. Admittedly chloramphenicol was given too late to have any effect, but with none of the drugs mentioned was the fever lowered; in fact a Jarisch-Herxheimer reaction appeared to be caused by aureomycin. Dihydrostreptomycin together with aureomycin as used by Heilman (1949) and Herrell and Barber (1949) was contemplated, but was withheld until too late.

Case History

The patient, a male labourer aged 48, was first noticed to have a "bad heart" at the age of 7. In 1917 he was rejected for military service on this account. As he had suffered from dyspepsia for the past five years he had been drawing extra unpasteurized milk from the estate on which he worked in order to supplement his gastric diet.

He was first seen in the out-patient department on July 26, 1949, complaining of palpitations of six months' duration, malaise and fatigue for one year, and shivering attacks with night sweats for three weeks. The heart was found clinically to be enlarged to the left. Loud harsh systolic and faint soft diastolic murmurs were heard at the aortic area, and a systolic thrill was palpable at the same site. The E.C.G. was normal; haemoglobin 92% (Haldane); screening and radiographs of the heart showed some prominence of the ascending aorta, rounding of the cardiac apex with slight enlargement of the left ventricle, and calcification of the aortic valves. Clinically and radiologically the picture was that of aortic stenosis, compatible with the diagnosis of a long-standing rheumatic condition.

He returned on August 17, 1949, with fever, and was admitted as a case of subacute bacterial endocarditis superimposed on a long-standing rheumatic aortic stenosis. His temperature was ranging between 100 and 104° F. (37.8 and 40° C.). His B.P. was 120/85. Slight clubbing of the

FIG. 1.—Electrocardiogram showing complete heart-block.

fingers was present. Three successive blood cultures yielded a pure growth of *Br. abortus*, and the serum agglutinated the organism to a titre of 1/5,000.

In spite of his high fever he did not complain, and he looked far from being a very sick man. He was treated with penicillin, 2,000,000 units daily, for 11 days without improvement.

On August 30 aureomycin was started, 500 mg. by mouth, four times daily. On this drug the temperature, pulse, and respiration rates became higher and more swinging in type, and after 48 hours' treatment the patient complained of acute pain in the left side of the abdomen and left testis. These symptoms developed rapidly in a symptom-free patient and disappeared a few days later. After 14 days the dose of aureomycin was increased to 750 mg. four times a day, and two days later to 1 g. four times a day. The drug was stopped on September 23 after 25 days' administration (total, 60 g.) without apparent effect.

Streptomycin was given from October 10 to 18, 1 g. daily (total 8.5 g.), without appreciable effect. On October 28 penicillin, 250,000 units twice daily, was given for boils in the neck, pus from which yielded a pure growth of *Staph. pyogenes*. Under treatment the boils rapidly subsided. About this time the fever abated and he was allowed up.

Throughout his stay in hospital the patient had felt well and his physical signs had remained virtually unchanged. At no time was the spleen palpable, and only on admission were a few doubtful petechiae noted. He was transferred to the hospital convalescent home on November 11, still slightly febrile—temperature 98–100° F. (36.7–37.8° C.). Blood culture had been negative since August 30, and, judging by his temperature-pulse-respiration chart, he had apparently made a slow

and gradual improvement during his three months in hospital.

At the third week of his convalescence he began to feel ill, his temperature rose to 102.5° F. (39.15° C.), and he developed severe pains in his joints, especially his knees and the interphalangeal joints of his hands. His pulse rate lay between 60 and 85. On December 1, the day before he returned to hospital, he experienced his first "blackout," which consisted of a peculiar faint sensation without loss of consciousness. Subsequently these sensations occurred two or three times a day. No physical signs were found during such bouts, and his pulse remained regular.

On December 2 he re-entered hospital, a sick-looking, pale, sallow man—an entirely different picture from that of three weeks previously. The soft diastolic murmur at the aortic area was now marked. His pulse became slow the day after admission, rose subsequently to normal, and then dropped to 50, with a pyrexia of 99–102° F. (37.2–38.9° C.). Auricular sounds could be heard occurring in diastole, and a diagnosis of complete heart-block was made; this was confirmed by E.C.G. (Fig. 1), which showed also

a right bundle-branch block. Two days later a second E.C.G. showed a complete A-V block persisting. Most of the ventricular complexes were now normal; only a single short run showed right bundle-branch block.

Chloramphenicol therapy was started, 250 mg. two-hourly, on December 7, but two days later nocturnal coughing and dyspnoea rapidly developed, with considerable restlessness and great apprehension. Oxygen afforded some relief. Further attacks occurred, and at 4.40 p.m. on December 9, almost five months after his first attendance, he died with marked pulmonary oedema. His pulse rate before death was 40–50 a minute.

FIG. 2.—Photograph of heart showing vegetations on aortic valve.

Radiographs taken with a portable apparatus on the last day of life showed the picture of left ventricular failure with right-sided hydrothorax.

Necropsy Report

At necropsy, 64 hours after death, the body was well nourished, and there was no evidence of oedema. The pericardial sac contained 3 oz. (85 ml.) of straw-coloured fluid, and around the base of the heart were a few stringy fibrous adhesions. The heart was enlarged (525 g.), mainly owing to hypertrophy of the left ventricle. The aortic valve showed bacterial endocarditis superimposed on an old rheumatic lesion (Fig. 2). The valvular orifice was obstructed by a mass of vegetations, 25 mm. thick, attached to the margin of all the cusps, creamy yellow in colour and of rubbery consistence. The underlying valve cusps showed fibrous thickening and calcification, both clearly of long standing, with fusion of the two posterior cusps. The partition between the fused cusps had undergone recent perforation, so that only its upper border remained, forming a fibrous bridge between the valve margin and the posterior wall of the aorta, thus allowing free communication between the respective sinuses of Valsalva, into which the ulcerative process had extended. Each of these posterior sinuses contained vegetations, and each had undergone distinct aneurysmal dilatation. That on the left had caused a bulging into the medial wall of the left auricle (Fig. 3),

FIG. 3.—Photograph of heart showing left auricle laid open to expose a swelling in the anterior part of the interauricular septum.

25 mm. broad, and involving the anterior part of the auricular septum. On incising this, haemorrhagic fluid escaped from a chronic abscess, 8 mm. in depth, lying just below the septal endocardium and communicating deeply with the vegetations in the sinus of Valsalva.

The aneurysm of the right sinus of Valsalva had caused a similar bulging into the right ventricle in the region of the infundibulum. The infective process in its recesses had also spread through the upper part of the interventricular septum to involve the medial cusp of the tricuspid valve, which was tacked down to the septum at this point. Ulceration had spread through the substance of the cusp, and from its free margin a polypoid vegetation, 3 cm. long and 1 cm. broad at its bulbous tip, was projecting into the right ventricular cavity (Fig. 4).

The left ventricle was dilated and hypertrophied; its average thickness being 18 mm. The mitral valve ring admitted three fingers, but showed no evidence of old or recent endocarditis. The left auricle was dilated, and in its auricular appendage was a small pale adherent thrombus. The right ventricle was dilated but not hypertrophied. The tricuspid valve ring admitted five fingers. The right auricle showed terminal dilatation only. The coronary vessels were patent throughout.

FIG. 4.—Diagram of transverse section of heart at the level of the aortic valve, to show the spread of infection to the interauricular septum and to the medial cusp of the tricuspid valve.

There were moderate passive congestion of the lungs, subacute congestion of the liver, enlargement of the spleen (227 g.), which contained a yellow resolving infarct, and a healed infarct in the right kidney. In other respects the kidneys looked normal.

Microscopical Examination

Heart.—The aortic vegetations were composed of dense masses of fibrin containing numerous clumps, morphologically *Brucella*. The aortic cusps were thickened by old hyaline fibrosis, with some calcification. The haemorrhagic abscess bulging into the left auricle had a wall composed of necrotic myocardial fibres, infiltrated with polymorphs and occasional monocytes. Round its periphery were deposits of calcium, presumably an old lesion. Sections from the right and left ventricles failed to show evidence of focal inflammation.

Lungs.—Recent ante-mortem thrombosis of the pulmonary veins was observed, probably due to slowing of the circulation by extreme aortic stenosis.

Liver, Spleen.—Passive congestion only.

Kidneys.—These showed an inconspicuous degree of focal embolic nephritis, with scattered foci of interstitial leucocytic infiltration, mostly round cells. Some of the older lesions showed tubular atrophy and interstitial fibrosis.

Adrenals, Lymph Nodes, Bone Marrow, Meninges.—Nothing of note.

Summary of Findings.—Bacterial endocarditis, supervening on chronic rheumatic endocarditis (aortic stenosis and incompetence); mycotic aneurysms of sinuses of Valsalva involving cardiac septa and causing heart-block; infarcts in spleen and right kidney; focal embolic nephritis.

Bacteriological Findings During Life

Isolation of Organism.—Blood cultures on August 18, 19, 23, and 30 in liver broth, liver agar, and glucose broth grew *Br. abortus* within four days. On August 30 there were seven colonies per ml. of blood. Blood cultures of September 23 and November 1 remained sterile during 28 days' incubation.

Identification of Organism.—The organism from the blood culture of August 23 proved to be a Gram-negative non-motile cocco-bacillus, forming colonies 0.5 mm. in diameter after 48 hours' incubation on liver agar in the presence of CO₂. There was no visible growth without CO₂. No acid or gas was produced in lactose, sucrose, dulcitol, maltose, mannitol, glucose, salicin, raffinose, trehalose, arabinose, and xylose. Hydrogen sulphide production on liver-agar slopes was detectable with lead acetate papers for five days. Flood plate cultures of liver agar incubated in the presence of CO₂ showed, on an average of eight tests, a 4-mm. wide zone of inhibition around a paper disk soaked in saturated

aqueous thionine (vital, G. T. Gurr), and no inhibition around a disk soaked in saturated aqueous basic fuchsin. A saline suspension was agglutinated to titre by *Br. abortus* serum (Standards Laboratory, Colindale) and to half-titre by *Br. melitensis* serum. Flood plate cultures on liver agar incubated in the presence of CO₂ showed, on an average of eight tests, a 5-mm. zone of inhibition around a disk soaked in 0.1% aqueous aureomycin, a 12-mm. zone around 0.1% chloramphenicol, and a 4.5-mm. zone around streptomycin 1,000 units per ml.

Thus the organism was a normal strain of *Br. abortus* with normal drug sensitivity.

Serology.—On August 24 the serum of August 23 agglutinated standard *Br. abortus* suspension (Standards Laboratory, Colindale) to a titre of 1/5,000, after 24 hours at 37° C. On May 30, 1950, the serum of September 1, 1949, showed the following agglutinin titres: *Br. abortus* N.C.T.C. No. 5059, non-standard suspension, 1/320; *Br. abortus* homologous strain, non-standard suspension, 1/320; *Br. melitensis* N.C.T.C. No. 5060, non-standard suspension, 1/160 (partial).

Bacteriological Findings After Death

Vegetation.—A portion of the aortic vegetation fixed in formol saline showed very large numbers of Gram-negative cocco-bacilli. The organisms were well demonstrated by over-staining with methyl violet and partial decolorization with aniline water. No intracellular organisms could be seen. A portion of the aortic vegetation, well washed several times in saline and coarsely ground with powdered glass in a mortar, grew a profusion of *Br. abortus* on liver-agar plates during 48 hours' incubation in the presence of CO₂.

Bone Marrow and Spleen.—Cultures taken with precaution to avoid contamination grew *Br. abortus* only.

Blood.—Cultures grew only scanty coliforms and staphylococci.

Drug Sensitivity of Organism.—A comparison of the sensitivities and other characteristics of the strains isolated before and after death with those of N.C.T.C. strains of *Br. abortus* and *Br. melitensis* is set out in Table I. It

TABLE I

Organism:	<i>Br. abortus</i>			<i>Br. melitensis</i>
	Blood Culture (Patient)	Vegetation (Patient, P.M.)	N.C.T.C. 5059	N.C.T.C. 5060
Growth on liver agar:				
With CO ₂ :				
24 hours ..	±	±	±	±
48 ..	+++	+++	+++	+++
Without CO ₂ :				
24 hours ..	0	0	±	±
48 ..	0	0	+	+++
H ₂ S production:				
Day 1 ..	+	+	+	0
" 2 ..	+	+	+	0
" 3 ..	+	+	+	0
" 4 ..	+	+	+	0
" 5 ..	±	±	0	0
Zone of inhibition:				
Thionine (satd.) ..	3.0 mm.	3.0 mm.	3.0 mm.	0.0 mm.
Fuchsin (satd.) ..	0.0 "	0.0 "	0.0 "	0.0 "
Aureomycin (0.1%) ..	5.0 "	1.0 "	5.0 "	2.5 "
Chloramphenicol (0.1%) ..	11.0 "	4.0 "	21.0 "	2.5 "
Streptomycin (1,000 u./ml.) ..	4.5 "	4.5 "	2.5 "	2.0 "

will be seen that *in vitro* the strain isolated at necropsy was considerably more resistant to both aureomycin and chloramphenicol than that isolated from the blood before treatment.

Comment on Case

There were several unusual features in this case, the most striking perhaps being the well-being of the patient until arthralgia and heart-block occurred. This apparent well-being in the presence of high fever is a

feature of uncomplicated *Brucella* infection, and in this case was unaffected by the presence of a *Brucella* endocarditis. Only when septal lesions occurred did the patient's condition rapidly deteriorate.

A second noteworthy feature was the failure of penicillin, streptomycin, and aureomycin to alter the course of the disease; indeed, the last-named appeared to precipitate the only symptoms he had during his first stay in the ward. Apparently in spite of therapy his temperature-pulse-respiration chart and general condition slowly improved in a manner not usually seen in other forms of bacterial endocarditis. Physical signs abated rather than increased, and the few doubtful petechiae seen on admission to the ward never recurred. It was this slow and apparently steady improvement in signs and symptoms which lulled us into a sense of false security. The diagnosis of *Brucella* endocarditis was seriously considered at an early stage in view of the past history of valvular damage and the positive blood cultures; but because of the extreme rarity of this condition and the patient's apparently steady improvement it was not considered very likely until late in the course of the disease.

Clinical Analysis of Published Cases

Comparison with other cases of abortus endocarditis in the literature throws only limited light on the clinical aspect, since, generally speaking, the clinical findings and reports of investigations are scanty. Of the 12 cases* considered, four (including our own) may be regarded as proved beyond doubt (Cases 3, 6, 9, and 10) and the remainder highly probable.

Aetiology and Duration.—All were males. The ages varied from 21 to 61. Occupations were farmer (6), labourer (2), wool-packer (1); in three the occupations were not stated. Death occurred within three to eleven months of the onset of symptoms, and where recorded appears to have been cardiac in type, usually with terminal pulmonary oedema. Embolic and renal deaths, so common in subacute bacterial endocarditis, were not recorded.

Clinical Features.—Aortic regurgitant murmurs were heard in conjunction with a harsh systolic component in six cases; aortic regurgitation with no mention of systolic accompaniment in three. Mitral stenotic murmurs were heard in seven cases. Pericardial friction was twice recorded. Comparison with the necropsy findings (where aortic lesions predominate) makes it seem possible that some of these mitral murmurs were of Austin Flint type; but clinical data, as a whole, are indifferently reported as compared with necropsy findings.

White Blood Cells.—Counts varied from 2,800 to 14,100 per c.mm., with a terminal count of 20,000 per c.mm. in one instance. Neutrophils varied from 66% to 82% of the total.

Chest Radiographs.—Four of the six cases reported showed cardiac enlargement to the left; bilateral bronchiectasis was reported in one, pulmonary infarction in another.

Electrocardiograms.—These were reported in only seven cases—too few and too uninformative to merit

* (1) and (2) Call *et al.* (1944). (3) Hart *et al.* (1951). (4) Quintin and Stalker (1946). (5) Rennie and Young (1936). (6) Rothman (1935). (7) Scott and Saphir (1928). (8) Smith and Curtis (1939). (9) Spink and Nelson (1939). (10) Spink, Titrud, and Kabler (1942). (11) Voth (1949). (12) Wechsler and Gustafson (1942).

detailed description. In four out of six cases shown at necropsy to have aneurysms of the sinuses of Valsalva, there were disturbances of conduction in the form of slurring or notching of the QRS wave (Case 9), delayed A-V condition (Case 1), right bundle-branch block (Case 8), or complete heart-block (Case 3).

Pathological Analysis of Published Cases

In the 12 cases analysed, certain morbid anatomical features recur too frequently to be dismissed as coincidental, and taken together may be considered to constitute a fairly characteristic type of lesion.

Weight of Heart.—This was not recorded in three cases; otherwise it was significantly increased, varying from 465 to 646 g. It is probably relevant to note that in all nine cases there was an aortic valvulitis, old or recent.

Previous Valvular Lesions.—As in the case of subacute bacterial endocarditis the vegetations generally occurred on a valve rendered abnormal by previous disease or congenital malformation. Antecedent rheumatic valvulitis was either diagnosed during life or demonstrated at necropsy in seven cases (Nos. 1, 2, 3, 4, 7, 8, and 10), while two others showed a bicuspid aortic valve (Cases 11 and 12). In this connexion it is worth recalling the evidence presented by Gross (1937), who suggested that most bicuspid aortic valves are not congenital anomalies but the result of healed rheumatism.

Fibrosis and Calcification.—Fibrous thickening of the affected cusp was present in all 12 cases, with added calcification in eight. Doubtless this was largely due to old rheumatism, but it has been pointed out by Libman and Friedberg (1948) that in prolonged subacute bacterial endocarditis both these phenomena may be found as evidence of healing.

Valves Affected.—These were (a) aortic alone in eight cases (Nos. 1, 3, 4, 6, 8, 9, 11, and 12); (b) mitral alone in two cases (Nos. 5 and 10); and (c) aortic and mitral in two cases (Nos. 2 and 7). In group (a) one case (No. 11) showed a calcified mitral valve without vegetations, while in group (b) there was one uncomplicated aortic stenosis (Case 10).

Aneurysm of Sinus of Valsalva.—In no fewer than six of the twelve cases (Nos. 1, 3, 8, 9, 11, and 12) aneurysmal dilatation of the sinuses of Valsalva was recorded, with spread of the infection through the aortic wall into the auricular septum (Cases 8 and 12), the ventricular septum (Cases 3 and 9), the myocardium (Case 11), or the pericardial sac causing fatal haemopericardium (Case 1). It is known that aneurysms of the sinuses of Valsalva may complicate aortic lesions in subacute bacterial endocarditis, with rupture into the pericardium (Libman and Friedberg, 1948), or into the septa causing bundle-branch block (Rothschild, Sacks, and Libman, 1927), but nowhere do the authorities quoted suggest that such accidents are other than very rare.

Tricuspid Ulceration.—The extreme rarity of tricuspid valvulitis makes its incidence in four cases a notable observation (Cases 3, 8, 9, and 12). In all four infection had spread from the sinuses of Valsalva through the aortic wall and cardiac septa to involve the medial leaflet of the tricuspid valve.

Myocarditis.—Focal myocarditis was observed in six cases (Nos. 1, 2, 4, 6, 10, and 12), usually in the form of groups of necrotic myocardial fibres, with aggrega-

tions of leucocytes and fibroblasts. In Case 4 infective emboli from the aortic vegetations had given rise to mycotic aneurysms along the line of the coronary arteries.

Infarcts.—These were recorded in the following organs: spleen, 9; kidneys, 3; and lungs, 1.

Nephritis.—In seven cases (Nos. 1, 2, 3, 4, 5, 6, and 12) a renal lesion of some sort was present, though the nomenclature employed is variable and includes such terms as "glomerulo-nephritis" (6), "toxic glomerulo-nephritis" (1), "subacute nephritis" (2), "diffuse subacute pyelo-nephritis" (4), and "acute interstitial nephritis" (12). Our own case showed a mild form of focal embolic nephritis, but in none of the case records was a typical "flea-bitten" kidney described.

Comparison with *Brucella (Melitensis)* Endocarditis

Eight case records* of endocarditis due to *Br. melitensis* have been analysed for the sake of comparison. Again only males were affected, but there were significant differences in the pathological picture. In Table II the incidence of the various features is given. It should be stressed that the case records are scanty in comparison with abortus endocarditis.

TABLE II

	Abortus	Melitensis
Previous lesion	9/12 (75%)	Nil
Aortic valve	10/12 (83%)	4/8 (50%)
Mitral valve	4/12 (33%)	4/8 (50%)
Fibrosis	12/12 (100%)	4/8 (50%)
Calcification	8/12 (67%)	1/8 (12%)
Aneurysm of sinus of Valsalva ..	6/12 (50%)	1/8 (12%)
Septal involvement	5/12 (42%)	Nil
Tricuspid ulceration	4/12 (33%)	"
Acute myocarditis	6/12 (50%)	"
Nephritis	7/12 (58%)	2/8 (25%) *
Infarcts	9/12 (75%)	2/8 (25%)

Discussion

The foregoing data indicate that *Br. abortus* endocarditis is a distinct entity with certain characteristic features. Occurring predominantly in the male sex, the disease runs a slow and, until the present, fatal course, death occurring within three to eleven months of the onset of symptoms. More often than not there is a previous history of a heart damaged by rheumatism or a congenital abnormality.

So far the disease resembles subacute endocarditis due to a non-haemolytic streptococcus, although the sex incidence in *Brucella* endocarditis is more striking than in subacute bacterial endocarditis. In the latter the M/F ratio is only 3:2 (Blumer, 1923), whereas all the recorded cases of the former have been in males. The nature of the patient's occupation is not in itself a sufficient explanation of this fact, since female farm-workers drink the same milk and are also prone to uncomplicated brucellosis.

It is difficult to assess the significance of the frequency of aortic lesions in such a small series, but it is clearly aortic valvulitis which produces the most typical cardiac lesions. The tendency to ulceration of the surrounding tissues leads to mycotic aneurysms of the sinuses of Valsalva, resulting in septal myocarditis, tricuspid ulceration, or haemopericardium. The frequency of septal involvement greatly exceeds

* (1) Casanova and d'Ignazio (1933). (2) De la Chapelle (1929). (3) Gounelle and Warter (1935). (4-7) Hughes (1897, Cases 5, 8, 11, and 13). (8) Levy and Singerman (1938).

other forms of bacterial endocarditis, and the lesions are large compared with those seen in streptococcal subacute bacterial endocarditis, in which gross sup-pururation is absent (Bracht and Wächter, 1909).

The few electrocardiograms reported in cases of *Brucella* endocarditis show some disturbances of conduction, and it seems likely that these are related to septal lesions. *Brucellosis without* endocarditis may be accompanied by electrocardiographic changes in the form of elevation or depression of the RS-T interval, and low isoelectric or inverted T waves (Rubegni, 1939); however, these changes rapidly revert to normal as the fever and symptoms abate, though Friedberg (1949) has reported a case with inversion of T waves for two months after.

The defects in conduction noted in our own case and in Cases 1, 8, and 9 (the lesion in each case being aortic) have not been recorded in uncomplicated brucellosis, and are extremely rare in streptococcal subacute bacterial endocarditis. Libman and Friedberg (1948) reported prolongation of the P-R interval to 0.21–0.36 second in 15% of cases of subacute bacterial endocarditis, but state that the QRS phase is rarely widened in this disease, and that bundle-branch block was noted in only one of their series of 109 cases, due to pressure of a bacterial aneurysm of the sinus Valsalva on the interventricular septum. Complete heart-block, according to the same authors (p. 346) has been reported, but was not seen in their series. White (1944) states that very rarely in subacute bacterial endocarditis aneurysm or perforation of the ventricular septum may occur, and that again very rarely the A-V bundle of His may be affected, causing heart-block. Katz (1946) points out that anaemia and the underlying rheumatic process may affect the electrocardiographic picture in subacute bacterial endocarditis.

The paucity of case records in four of the melitensis series makes clinical comparisons difficult and some of the negative findings of doubtful value. In Hughes's cases, for example, the issue of previous heart disease was never really raised, and it is difficult to assess the significance of fibrosis of the valves in four out of the eight cases, especially in what is essentially a chronic inflammatory process. On the other hand, only one of the melitensis cases showed an aneurysm of the sinuses of Valsalva; and septal involvement, tricuspid ulceration, and acute myocarditis—three features which give an independent character to the lesion of abortus infections—were not observed. Only one case of suis endocarditis is recorded (De Gowin *et al.*, 1945), and that in a male with no previous history of rheumatism who died in the seventh month of his illness of haemorrhage from a mycotic aneurysm of the femoral artery. Necropsy revealed aortic vegetations with ulceration and focal myocarditis. The E.C.G. revealed left axis deviation and increasing negativity of T3. The kidneys showed diffuse nephritis and chronic granulomata.

There seems to be a greater tendency to gross infarction of other organs in abortus endocarditis than in either the streptococcal subacute bacterial or the melitensis forms. The accounts of the concomitant nephritis in abortus endocarditis are very variable, but the condition is presumably of focal embolic origin.

All the antibiotics used in our case failed to control the disease, perhaps because dosage was discontinued too soon, but Spink *et al.* (1948) reported a case in which *Br. abortus* was isolated from the blood during

life after 118 g. of streptomycin had been given over a period of 31 days; at necropsy, however, positive cultures could not be obtained, although aortic vegetations were present. With the newer antibiotics such cases may be seen more often in the future.

Summary

The literature of *Brucella* endocarditis has been reviewed and the case records analysed. A new case of *Br. abortus* endocarditis is reported.

All cases of *Brucella* endocarditis, whether abortus, melitensis, or suis, have been in males.

Br. abortus endocarditis is a distinct clinico-pathological entity, with a duration of three to eleven months. Death in all the recorded cases has been a cardiac one, usually with marked pulmonary oedema.

The frequency of myocardial lesions, especially in the cardiac septa, where they give rise to disturbances of conduction, appears to set abortus endocarditis apart from other forms of bacterial endocarditis, including melitensis infections.

Aortic lesions predominate in abortus endocarditis. In both melitensis and abortus endocarditis, aneurysms of the sinuses of Valsalva, septal involvement, and heart-block have occurred only with aortic lesions. To date only one case of *Br. suis* endocarditis has been reported.

There is no clear evidence that the use of antibiotics has so far altered the course of the disease. Aureomycin, streptomycin, penicillin, and chloramphenicol in short courses all failed to benefit our own case.

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