A vitreoretinal service

John Richardson, Christopher M Wood, Louisa J Mackay, Elizabeth S Gardner

Abstract

Many serious disorders that threaten eyesight can now be treated with vitreoretinal surgery. As there was no regional facility for this treatment a service was developed to provide it. Among the first 100 patients treated over half had diabetic vitreoretinal disease. The remainder had ocular trauma (15), non-diabetic vasculopathy (10), rhegmatogenous retinal detachment (10), and miscellaneous disorders including diagnostic procedures (14). Sight was improved in most cases, 27 diabetic and 21 non-diabetic patients regaining navigating vision. Few patients were made worse: one only of the 49 non-diabetic patients and 12 of the 51 diabetic patients, and none whose vision was better than the ability to count fingers before operation.

The many indications for this procedure, the size of the population that could benefit (an estimated minimum of 3800 operations per year in the United Kingdom in patients with diabetes alone), and the great potential benefit of the procedure all suggest the need for regional services. These would be cost effective in preventing blindness.

Introduction

The advent of vitreoretinal microsurgery was an important development in ophthalmology. Pars plana (posterior) vitrectomy[1-3] using common gauge microsurgery[4] allows prolonged operations to be carried out in a "closed" eye.[5] Using three spaced 1 mm pars plana sclerotomies (fig 1) we can ensure that normal intraocular pressure is maintained while performing a variety of endocular manoeuvres. The intraocular contents are viewed by the surgeon through an operating microscope and corneal contact lens (fig 2).

Closed vitrectomy enables the surgeon to excise the vitreous and remove intraocular opacities, sever vitreoretinal adhesions and resect epiretinal membranes, remove subretinal fluid internally, perform endocular laser phototherapy, extract retained intraocular foreign bodies safely, introduce drugs, air, gas, and silicone oil to the posterior segment, and make the contents of the vitreous body available for study. The lens may be removed using the vitrectomy incisions. This refined surgical technique has revolutionised the management of vitreoretinal disease and enabled patients with many potentially blinding disorders to be treated successfully.

In March 1985 a vitreoretinal service was started at our hospital with one weekly clinic and a weekly operating list dedicated to vitreoretinal surgery. The clinic was open for secondary referrals from consultants and also for primary referrals from general practitioners.

We present an analysis according to the indication for surgery and the outcome for vision in the first 100 patients treated by pars plana vitrectomy. We describe the requirements for such a service and the problems encountered in establishing and maintaining it and estimate the need for a regional facility to perform vitreoretinal surgery.

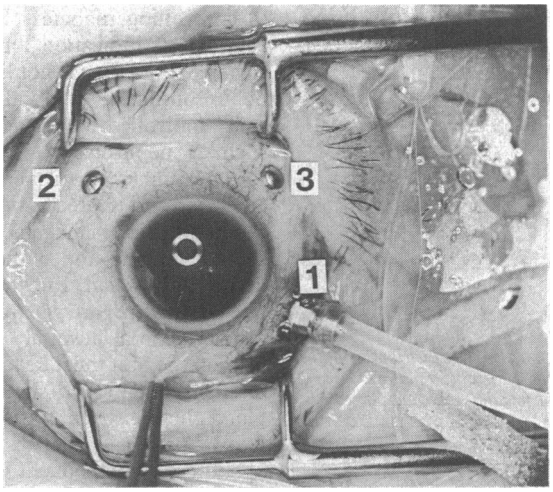

FIG 1—*Three sclerotomies were performed. The lower temporal sclerotomy (1) was made first and accepts the infusion cannula containing Ringer's solution which remains in place throughout the procedure. Intraocular pressure is maintained during surgery by the height of the infusion bottle. This line can also be used to introduce gas, air, or silicone as required. Upper nasal (2) and upper temporal (3) sclerotomies are occluded by plugs while endocular instruments are not in use. The surgeon uses these two sclerotomies interchangeably to introduce either the "passive" instrument (fibreoptic endoilluminator) or the "active" instrument. There are many active instruments including suction-cutting devices (Ocutome in this series); lensectomy instrument (Fragmatome in this series); endolaser for intraoperative retinal phototherapy; scissors, forceps, spatulas, pics; extrusion cannulas to vacate blood and subretinal fluid; diathermy; and "others"*

Methods

All patients had the following assessment before the operation.

OPHTHALMOLOGICAL ASSESSMENT

Full ophthalmological examination was performed, including biomicroscopy, direct and indirect ophthalmoscopy, applanation tonometry, fundus photography with fluorescein angiography when possible, and electroretinography and visual evoked potentials as indicated.[4,6]

ULTRASOUND

Ultrasound assessment of the globe is mandatory.[7] Since we often see patients with an opaque vitreous visual examination of the ocular contents is limited and the surgeon needs verification by ultrasound[8] of (*a*) the state of the vitreous[9]; (*b*) the location and extent of any intraocular lesion visible by ultrasound[10]; (*c*) the condition of the retina, especially the macula[11]; (*d*) the motility of the contents of the globe; and (*e*) the

Eye Infirmary, Sunderland SR2 9HP
John Richardson, FRCS, *consultant ophthalmic surgeon*
Christopher M Wood, FRCSED, *senior registrar*
Louisa J Mackay, FFARCS, *consultant anaesthetist*
Elizabeth S Gardner, DO, *associate specialist*

Correspondence to: Mr John Richardson, Sunderland Eye Infirmary, Queen Alexandra Road, Sunderland SR2 9HP.

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relation between the vitreous and the retina, mapping vitreoretinal adhesions.[2]

We use a mechanical B scanner with a 7·5 MHz transducer and a 20 mm focus, purpose built by the medical physics department at Newcastle University. As well as having a Polaroid camera for hard copy the equipment includes a video facility that provides a record of each scan, allows comparison with previous scans, and can be used for teaching.

Each patient has a routine scan before surgery, and a report (including Polaroid photograph) is attached to the notes. The video record is stored.

MEDICAL ASSESSMENT AND MANAGEMENT

A detailed assessment of the patient's medical condition is carried out, and particular attention is paid to controlling diabetes. Diabetic retinopathy is the commonest indication for posterior vitrectomy, and since the operation is not life saving the patient should be in optimum physical health, and the diabetes well controlled. Extraocular features of diabetes such as nephropathy, autonomic neuropathy, and cardiovascular impairment are also assessed before operation and treated as necessary.

The medical management of patients with diabetes should remain under the control of the referring diabetic physician. Inevitably there will be eye units, like ours, which are geographically separated from the district general hospital, so the medical and nursing staff on the unit must be familiar with the medical care of such patients and should be equipped to monitor blood glucose concentrations.

If a patient's diabetes is not under control the operation is postponed. Patients whose diabetes is poorly controlled by oral hypoglycaemic drugs are managed with short acting insulin over the period of surgery. Those whose diabetes is well controlled with oral drugs receive no hypoglycaemic drugs before the operation on the day of surgery. Patients who take insulin are managed during the operation with a continuous infusion of 10% dextrose with added short acting insulin and potassium.[13] The infusion is maintained during and after the operation, and blood glucose concentrations are measured every two hours. The infusion is discontinued when the patient can eat, at which time the normal diabetic regimen is resumed.

TABLE I—*Age distribution of the 100 patients (59 males and 41 females) who had vitrectomy*

Age (years)	No of patients
0-9	1
10-19	5
20-29	12
30-39	11
40-49	11
50-59	24
60-69	25
70-79	11

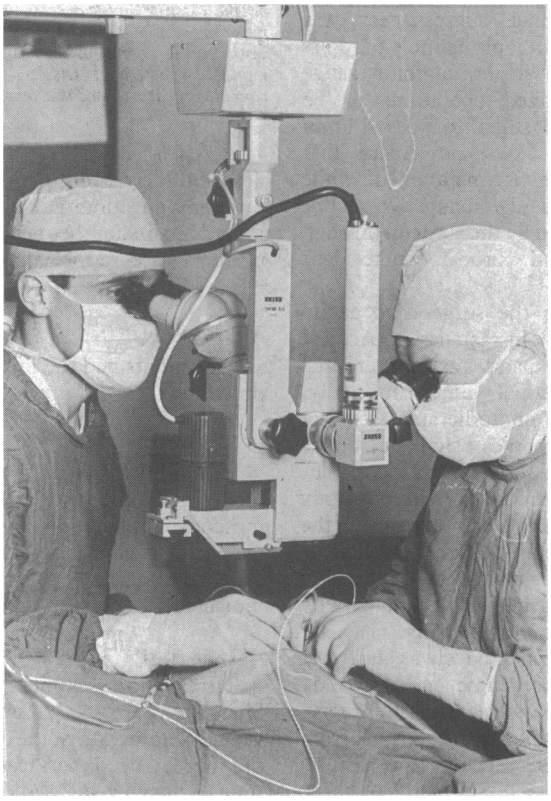

FIG 2—*Vitrectomy. A television camera is mounted on the microscope. The endoilluminator is in the surgeon's left hand, the Ocutome vitreous cutter in the surgeon's right hand. The assistant (left) holds a corneal contact lens*

SURGICAL MANAGEMENT

The surgical technique requires three spaced sclerotomies through the pars plana, which provide access to the posterior segment (fig 1). The surgery is performed through the second and third (superior) sclerotomies, and the first sclerotomy is occupied throughout surgery by an infusion cannula (fig 2). "Common gauge" instruments are used—normally 20 G. When sclerotomies enlarge through repeated use 19 G instruments may be used. By matching infusion with outflow a closed system with controlled intraocular pressure is produced. The surgeon views the posterior segment through an operating microscope. An irrigating corneal contact lens is held by the assistant to allow sharp focusing on vitreoretinal structures (fig 2).

ANAESTHETIC MANAGEMENT

The operation usually takes a long time and is performed in the dark. As access for the anaesthetist is limited it is most important that the patient is in an ideal position and that the endotracheal tube and intravenous line are properly secured. Full monitoring is required, with visual and audible alarms. The anaesthetic technique must avoid sudden changes in intraocular pressure. Surgery often entails introducing a gas-air mixture into the posterior segment of the eye, so nitrous oxide anaesthesia is contraindicated as this gas will diffuse into the intraocular bubble causing a rise in pressure.[14] Halothane should be used with caution as patients will often require further operations at short intervals and arrhythmias may occur when it is used at the same time as adrenaline containing mydriatics. The new short acting agent propofol can be used as a continuous infusion to maintain anaesthesia, thus avoiding the need for volatile agents.[15] Recovery is rapid when the infusion is stopped, and there is good control of intraocular pressure. Opiates are not ideal for postoperative analgesia as they may cause nausea. We normally perform a retrobulbar block with a 2 ml dose of the long acting local anaesthetic bupivacaine (0·75%). A television monitoring screen allows the anaesthetist to follow the surgical procedure and helps to maintain vigilance.

POSTOPERATIVE MANAGEMENT

The positioning of the patient after the operation is important, especially if an intraocular gas bubble is present. A face down posture may be necessary so that the gas will rise to tamponade the required area of the fundus.

Results

We present a strictly consecutive series of 100 patients, 59 males and 41 females, aged 8-79 years (mean 50 years) (table I). Fourteen patients required surgery to both eyes, so 114 eyes are reported. The patients were followed up for six to 50 months (mean 20 months). They are divided into five groups according to the reason for the operation (table II).

VITREORETINAL DISEASE IN DIABETICS

Diabetes was the most important indication for vitrectomy, occurring in 51 patients, 11 of whom needed surgery to both eyes. The indications for surgery were often multiple and included non-clearing

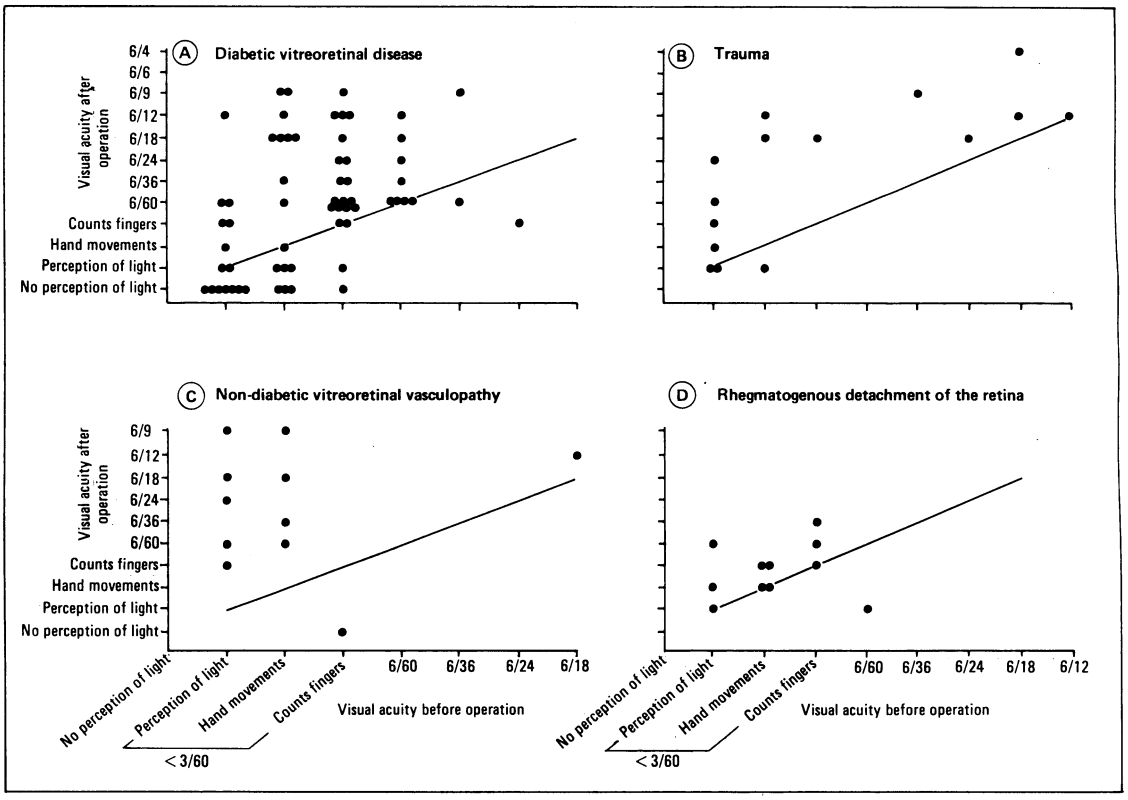

FIG 3—*Visual acuity before and after operation using Snellen notation in four groups of patients (a-d). Each symbol represents one eye. The position of the symbol in relation to the continuous line denotes that acuity was improved (above the line), unchanged (on the line), or worse (below the line). In (a) the symbols for perception of light, hand movements, and counts fingers show those patients who had less than 3/60 vision before operation*

vitreous haemorrhages, retinal detachments, progressive proliferative retinopathy, massive preretinal haemorrhage, massive fibrin response, and progressive retrolental fibrovascular proliferation.[16] The commonest conditions in our patients were non-clearing haemorrhage and traction retinal detachment, but there were examples of the other indications. Laser treatment reduces the vitrectomy rate by protecting the patient from progressive ocular disease. Among our patients we considered that 35 eyes (57%) had received inadequate preoperative laser treatment (<1000 burns) and only 10 eyes (16%) had received undisputedly adequate treatment (>2000 burns).

TABLE II—*Diagnosis by age and sex*

Diagnosis	No of males	No of females	Average age (years)
Diabetes mellitus			
Insulin dependent	19	18	49
Non-insulin dependent	11	3	62
Trauma	13	2	28
Non-diabetic retinal vasculopathy	2	8	62
Rhegmatogenous retinal detachment	7	3	56
Miscellaneous	7	7	50

Effects of vitrectomy on vision—Figure 3(*a*) shows the results of vitrectomy. Vision was improved in 32 eyes (52%), unchanged in 18 (29%), and made worse in 12 (19%). Improvement was defined as two lines on the Snellen chart or regaining navigating vision (3/60 or better). Twenty seven patients regained navigating vision.

Eleven eyes became unable to perceive light after operation. In seven of these vision before operation had been reduced to perception of light only, whereas in the other four vision had been better than perception of light. In no case, however, was a patient unable to perceive light when their vision before the operation was better than the ability to count fingers. It is accepted that the prognosis for patients undergoing vitrectomy because of diabetes is unfavourable if the preoperative vision is <3/60,[17] and in our series preoperative vision was this poor in 51 of 62 eyes (82%).

CONDITIONS IN NON-DIABETICS

Ocular trauma—Ocular trauma occurred in 15 (unilateral) eyes; in 14 there was a perforating injury. There were three retained foreign bodies, and in the remaining cases the reason for vitrectomy was persistent vitreous haemorrhage with traumatic vitreoretinopathy. Five out of 10 eyes that had lost navigating vision regained it. Overall, vision improved in 11 of 15 eyes, was unchanged in three, and worsened in one (fig 3(*b*)).

Non-diabetic vitreoretinal vasculopathy—Ten non-diabetic patients (11 eyes) had vitreoretinal vasculopathy, nine with persisting vitreous haemorrhages after retinal vein occlusions and one with bilateral proliferative arteriosclerotic retinopathy. Seven out of 11 eyes regained navigating vision, and one deteriorated from the ability to count fingers to no perception of light. Five eyes which had previously been able to perceive light or hand movements became 6/24 or better (fig 3(*c*)).

Rhegmatogenous retinal detachment—Ten patients (11 eyes) had rhegmatogenous retinal detachment. Five had had three previous detachment procedures. Only one patient (with detachment secondary to a macular hole) had received no previous conventional surgical treatment. The severe degree of proliferative vitreoretinopathy in this group mainly accounts for the poor prognosis, with only three eyes regaining navigating vision. Vision deteriorated in one eye (fig 3(*d*)).

Miscellaneous vitreoretinal disorders—Table III gives the reasons for vitrectomy in the group with miscellaneous disorders. Seven patients with persistent vitreous haemorrhage all regained their previous vision. In three patients vitreous aspirate was used for

TABLE III—*Miscellaneous group: diagnosis and reason for vitrectomy*

Reason for vitrectomy	Diagnosis
Persistent vitreous haemorrhage	Subarachnoid haemorrhage (2)
	Xenon for choroidal melanoma
	Cyclocryotherapy for glaucoma
	Retinal detachment surgery
	Cataract surgery
	Associated with retinoschisis
Diagnostic/therapeutic	Intraocular lymphoma
	Endophthalmitis (2)
	Acute retinal necrosis
Traction retinal detachment	Retinopathy of prematurity
	Idiopathic retinal vasculopathy
	Toxocariasis

diagnosis, and in three others there was non-diabetic traction retinal detachment.

Results in non-diabetic patients—There were 49 non-diabetic patients altogether (52 eyes). Of 41 who had lost navigating vision, 21 regained it, and only one of 11 who had navigating vision before the procedure lost it. The overall risk of not being able to perceive light for non-diabetics was one in 52. Two patients had worse visual acuity after operation, 26 were unchanged, and 24 were improved. Patients with unchanged vision predominantly represent a "stabilised" group in whom progressive loss of sight is averted.

Discussion

DIABETIC VITREORETINAL DISEASE

Managing eye disease in diabetic patients requires early detection of lesions and treatment with argon laser phototherapy.[18,19] Pars plana vitrectomy is normally reserved for patients with advanced or unresponsive disease.[20] The vitrectomy rate should thus depend on the rate of provision of laser therapy. Unfortunately, with current levels of staffing in ophthalmology departments it is almost impossible to provide adequate laser treatment (only 16% of the patients in our series had received "adequate" phototherapy before operation). At least 1% of the population is diabetic and 8% of diabetics may require phototherapy. To treat this population of diabetics adequately would require that all the consultant ophthalmologists in Britain devote two sessions a week solely to the treatment of diabetic retinopathy,[21] which is impracticable. The vitrectomy rate may thus remain higher than it should owing to inadequate laser treatment. In a consecutive series of 100 vitrectomies reported by Aaberg in 1977[22] eye disease in diabetics accounted for half of the cases; a decade later diabetes still provides the primary indication for vitrectomy.

Laser phototherapy seems to forestall the more gross changes that occur later and are not responsive to this treatment. These changes result in vitreoretinal adhesions causing retinal traction, which may be tangential (along the surface) or radial, pulling the retina towards the centre of the globe.[2] These disturbances can be relieved only by surgery. About 16% of them arise despite adequate previous laser treatment. Other lesions caused by diabetes such as secondary rhegmatogenous retinal detachment, massive preretinal haemorrhage, and massive fibrin response are also unresponsive to laser treatment and may require surgery.[16] Vitrectomy is being carried out early in some cases in the hope of forestalling more advanced disease indefinitely.[23] For these reasons the numbers of patients who are likely to benefit from vitrectomy may not change even if laser treatment is more widely available. Visual improvement after pars plana vitrectomy in patients with diabetes with advanced retinal disease is maintained for as long as 10 years.[20] The social and financial implications of this undoubtedly successful treatment of blinding disease are enormous.

OTHER INDICATIONS FOR VITRECTOMY

Trauma to the eye is a major indication for vitrectomy.[4] After a penetrating eye injury epiretinal and transvitreal membranes may form, which because they are contractile cause retinal sequelae such as detachment. Vitrectomy can prevent these complications by removing the scaffold for cellular proliferation provided by the vitreal disturbance. It may be difficult to analyse the results of such procedures because of the many manifestations of ocular trauma,[24] but our small series gave encouraging results.

In non-diabetic vitreoretinal vasculopathy bleeding occurs from the retinal surface and may lead to associated retinal traction. There may be intrinsic retinal pathology from the basic disease process[25] which may compromise the final outcome. In our patients most cases were associated with occlusion of a branch retinal vein, and the results are encouraging. Vitrectomy for rhegmatogenous retinal detachment usually becomes necessary when vitreous disease prevents conventional treatment, and it is performed in cases in which normal detachment surgery is unlikely to be successful. We have used the procedure mainly in cases where the prognosis was poor after repeated operations but have nevertheless found it valuable. Diagnostic vitrectomy is becoming increasingly important,[26,27] enabling adequate samples to be obtained for microbiological study and at the same time allowing infected vitreous to be removed and antibiotics or other drugs to be given. Ophthalmologists are moving towards this more aggressive management of endophthalmitis, which seems to offer a greater chance of success.

ESTABLISHING A VITREORETINAL SERVICE

Some of the problems in establishing a vitreoretinal service are expense; acquiring the techniques; establishing an anaesthetic service with the necessary skills and a reliable ultrasound facility, preferably with a medical input; training nursing staff; and acquiring skilled technical help in maintaining complex equipment. We are convinced of the need for a regular reliable team for this specialised form of surgery. We think, however, that we have shown beyond doubt that there is a need for the service. We estimate that the potential workload is large, and by the nature of the diseases we deal with in most cases operations cannot be delayed. There is thus some urgency to ensure that this need is met.

The general ophthalmologist cannot be expected to perform vitreous surgery because acquiring the technique would be too time consuming (even now not all ophthalmic trainees are adequately exposed to vitreoretinal surgery) and because the administrative and practical workload of such a service would restrict the amount of general ophthalmic surgery that a general surgeon can do. Where an ophthalmologist chooses to adopt these techniques there will be a reduction in the provision of general ophthalmic care since vitreoretinal surgical cases will inevitably have to be given priority. Thus we advocate that each NHS region should appoint additional surgeons trained in vitreoretinal surgery who would dedicate most of their time to the specialty. Grey and Morris estimated that at least 20 surgeons are required nationally to perform vitrectomies on patients with diabetes alone, assuming a minimum of about 3800 operations a year.[28] As the indications for vitrectomy for diabetic patients increase this could prove to be an underestimate. Since diabetes accounts for only half of the patients needing pars plana (posterior) vitrectomy, the number of surgeons needs to be doubled. In many cases the alternative to vitreoretinal surgery is blindness, thus all ophthalmic units should have easy access to what is now a routine ophthalmic operation. This may be difficult in times of

scarce resources, but the benefits in social and financial terms are clear.

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Hammersmith Staff Rounds

The heart in systemic lupus erythematosus

A cause of myocardial infarction in a man of 20

Department of Medicine, Hammersmith Hospital, London W12 0HS
Case presented by:
R A Barker, MB, *senior house officer*
Chairman:
S R Bloom, FRCP, *professor of endocrinology*
Discussion group:
C M Oakley, MD, *consultant cardiologist*
M J Walport, MRCP, *senior lecturer in rheumatology*
P Nihoyannopoulos, MD, *lecturer in clinical cardiology*
C R Thompson, MD, *senior lecturer, Medical Research Council lipoprotein team*
A J Rees, FRCP, *consultant physician in renal unit*

Series edited by:
Dr Robert Winter.

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History

March 1982—An 18 year old man presented with a three week history of abdominal distension and swelling of the face and ankles. He did not have a history of risk factors for ischaemic heart disease. He was febrile (38°C), and the physical findings were of massive leg and sacral oedema, ascites, and a left sided pleural effusion. Table I gives details of the investigations. A chest radiograph showed a left sided pleural effusion. Renal biopsy specimens showed mesangiocapillary glomerulonephritis, and skin biopsy specimens showed deposition of IgG and complement at the dermoepidermal junction. After immunosuppressive treatment was started his serum albumin concentrations increased to 28 g/l and the DNA binding fell to 30%.

December 1982—He presented with acute pleuritic pain in association with a deep venous thrombosis of his right leg. A ventilation-perfusion lung scan showed mismatch strongly suggestive of pulmonary embolism, and he was treated with warfarin. He had a further episode of pleuritic pain six months later.

July 1984—He presented with a five day history of increasing central chest pain. An electrocardiogram showed an acute inferior myocardial infarction. Other investigations showed a creatinine concentration of 95 μmol/l and a 24 hour urinary protein measurement of 11·9 g. Lupus anticoagulant and anticardiolipin antibodies were present. A coronary angiogram showed normal coronary arteries, but an echocardiogram showed inferior akinesis. His fasting cholesterol concentration was 8·0 mmol/l. Immunosuppressive treatment was continued with azathioprine and prednisolone. He made an uneventful recovery and was free of symptoms with unlimited effort tolerance for the next four years.

August 1988—He presented with a history of central

TABLE I—*Results of investigations in man aged 18 presenting with abdominal distension and oedema*

Measurement	
Blood pressure	120/70 mm Hg
Proteinuria	4+
Haemoglobin	115 g/l
White cell count	2·6×10⁹/l
Platelet count	113×10⁹/l
Erythrocyte sedimentation rate	100 mm in first hour
Direct Coombs' test	Weakly positive
Cryoglobin	0·2 ng/ml
Blood urea	16·4 mmol/l
Creatinine	95 μmol/l
Creatinine clearance	0·82 ml/s
Serum albumin	15 g/l
Urinary protein excretion	4 g/24 h
Fasting cholesterol	11 mmol/l
Prothrombin time	Normal
Partial thromboplastin time	Normal
Antithrombin III	Normal
Lupus anticoagulant	Present
Venereal Disease Research Laboratory Test	Positive
Trepanoma pallidum haemagglutination test	Negative
Complement*:	
C3	23%
C4	24%
CH50	10%
Antinuclear factor	Positive†
DNA binding	98%‡

*Expressed as percentage of normal serum concentrations.
†1/160 Homogenous pattern.
‡Normal <30%.