Eponyms in medicine revisited

Purtscher’s retinopathy

Sally A Buckley, Bruce James

Summary
Purtscher’s retinopathy presents to the clinician as loss of vision in a patient with a history of a possible precipitating event such as recent major trauma, pancreatitis, childbirth or renal failure. The ophthalmological picture is one of ischaemia at the posterior pole with white patches of oedema and haemorrhages concentrated around the optic disc. The most probable pathological cause is embolisation of the peripapillary terminal arterioles supplying the superficial peripapillary capillary net. The nature of the embolic particles remains uncertain. Complement-mediated aggregates, fat, air, fibrin clots and platelet clumps may all be involved in what is most likely to be a multifactorial process. There is at present no recognised treatment for the condition.

Keywords: Purtscher’s retinopathy, retinal ischaemia, complement activation, leukocyte aggregates

Ophthalmoscopic features of Purtscher’s retinopathy

- cotton wool spots: ischaemic areas of the nerve fibre layer resulting in white fluffy areas of axonal swelling by inhibition of the axoplasmal flow; they can cover blood vessels
- Purtscher flecken: areas of retinal whitening. They have a typical polygonal shape and never adjoin or cover neighbouring arterioles. They possibly represent areas of capillary bed infarction (there is a capillary-free zone adjacent to retinal arteries)
- retinal haemorrhages: flame shaped : superficial nerve fibre layer; dot and blot: deeper retinal layers
- optic disc: acutely appears normal but papilloedema may develop later

Box 1

Garnet, 1 Main Road, Knockholt, Sevenoaks, Kent TN14 7LD, UK
SA Buckley

Eye Unit, Stoke Mandeville Hospital, Aylesbury, Bucks, UK
B James

Accepted 13 November 1995

In 1910, Otmar Purtscher described multiple superficial white retinal patches and retinal haemorrhages surrounding an apparently normal optic disc in patients with visual loss following severe head trauma.¹

Since this first report, a similar retinal appearance has been seen in other forms of trauma such as long bone fractures and compression injuries of the trunk.^{2,3} A Purtscher’s-like retinopathy has also been reported in a wide variety of conditions including pancreatitis,^{4,5} childbirth,⁶ renal failure,⁷ barotrauma,² steroid injections in and around the orbit and nasal passages,⁸ retrobulbar anaesthesia,⁹ and connective tissue disorders.¹⁰

Clinical symptoms and signs

The striking fundal abnormalities of Purtscher’s retinopathy may be unilateral or bilateral. They are localised to the peripapillary area and posterior pole of the retina. The ophthalmoscopic characteristics are outlined in box 1, and shown photographically in figure 1.^{3,6,11}

During the acute retinal picture visual acuity is often reduced and visual field defects may vary from a central, paracentral or annular scotoma to large segmental defects. Fluorescein angiography to demonstrate retinal perfusion, shows areas of retinal arteriolar and capillary nonperfusion (figure 2).³

After four to six weeks the white retinal patches fade away (figure 3) and eventually the fundus may appear normal, though there may be residual pigmentary mottling and optic atrophy.¹¹ There is no known treatment for the retinopathy and although some authorities advocate the use of systemic steroids^{12,13} there is no proof as to their efficacy.⁵ The majority of the patients recover useful vision of 6/12 or better unless the macular arterioles are involved when visual prognosis is generally poor.⁵

Pathogenesis

The pathogenesis of Purtscher’s retinopathy is unknown and indeed may be secondary to more than one initiating factor. Various hypotheses have been put forward as outlined in box 2. At the present time, retinal arteriolar embolism is considered the most likely cause of Purtscher’s retinopathy.

CONCENTRATION OF LESIONS

Understanding the anatomy of the retinal blood supply helps explain why the ischaemic lesions are concentrated at the posterior pole. The retinal capillaries form two layers with the superficial layer directly supplied by precapillary arterioles whilst the deep capillary layer is supplied by some precapillary arterioles and also by connections from the superficial capillary bed. The retinal capillary network has multiple arteriolar feedpoints so that blockage of a single terminal arteriole will not lead to total cessation of flow in the capillary bed.¹⁸

However, at the thickened posterior pole, the pattern is considerably modified. In addition to the two-layered capillary network, there is another more superficial capillary net around the optic nerve, the peripapillary radial net. This capillary system is located in the superficial peripapillary nerve fibre layer with the capillaries running relatively long, straight, paths.¹⁸ The arterioles supplying this capillary bed are 15–150 µm in diameter.¹⁹ The peripapillary radial capillary net has few arteriolar feedpoints and few anastomoses and is therefore uniquely vulnerable to ischaemic injury following obstruction of terminal arterioles.

Occlusion of arterioles feeding the radial peripapillary capillaries would give the geographic distribution of ischaemic patches in the posterior pole seen in Purtscher’s retinopathy. Histopathology of the few cases coming to autopsy has confirmed focal retinal atrophy, retinal arteriolar occlusion, and capillary bed destruction posterior to the equator of the eye.²⁰

Purtscher's retinopathy: possible pathogenesis
<ul style="list-style-type: none">● Purtscher's theory: the white intraretinal changes are secondary to lymph extravasated from retinal vessels during a sudden increase in intracranial pressure¹● venous reflux or secondary arteriolar spasm: sudden increase in intrathoracic pressure as occurs in severe chest compression may cause traumatic asphyxia and possible transmission of the pressure back to the orbits. Patients with this show proptosis, 25% may show retinal haemorrhages and a few may show features of Purtscher's retinopathy. A similar picture has been described in a pilot bailing out at high altitude and supersonic speed (hydrostatic pressure syndrome).² This theory cannot explain unilateral Purtscher's retinopathy in chest trauma¹⁴● retinal arteriolar embolism: the onset is sudden, the lesions are multifocal, and the obstruction of the retinal vessels is demonstrated on fluorescein angiogram. Possible emboli are given in box 3

Box 2

Purtscher's retinopathy: potential emboli
<ul style="list-style-type: none">● air: known to occur in chest injuries; postulated as a factor in a case following retrobulbar anaesthesia● steroid suspension particles: accidentally injected into blood vessels in orbit and sinuses.● fat: cause trauma and acute pancreatitis. Emboli can be 10–50 µm but most are 12–15 µm. Block capillary beds. Fat embolism syndrome● fibrin clots (disseminated intravascular coagulation): trigger factors (eg, malignancy, infection, hypovolaemia, burns and eclampsia) and complement activate the clotting cascade. Clotting factors and platelets are consumed and fibrin strands are deposited in small vessels● leukocyte aggregates: complement activation in trauma, acute pancreatitis, renal failure, amniotic fluid embolism, haemodialysis and connective tissue disorders can cause aggregates of neutrophils 60–80 µm across. Could block quite large terminal arterioles

Box 3

Ocular signs and symptoms
<p><i>Fat embolism syndrome</i></p> <ul style="list-style-type: none">● retinal lesions in 50–60%. Consist of cotton wool spots and small blot haemorrhages● can occur anywhere in fundus● acutely most patients are visually asymptomatic● evidence of systemic fat embolism <p><i>Purtscher's retinopathy</i></p> <ul style="list-style-type: none">● larger white retinal patches representing areas of confluent ischaemia● located in peripapillary area and posterior pole● acutely most patients are aware of visual problems● may have no evidence of systemic fat embolism

Box 4

Purtscher's-like retinopathy: associations between pathology and complement activation
<ul style="list-style-type: none">● trauma: ARDS¹²● acute pancreatitis: ARDS^{12,17}; C5a-induced granulocyte activity present in plasma of 67% of patient with acute pancreatitis¹⁷● connective tissue disorders (polyarteritis nodosa, dermatomyositis, Behcets, systemic lupus erythematosus): lupus retinal arteriolitis. Immune complexes can activate complement^{10,28} and initiate retinal arteriolar occlusion. More likely to be progressive than true Purtscher's retinopathy● amniotic fluid: ARDS²⁹● chronic renal failure and renal transplants: patients are immunocompromised and infection may initiate complement activation and Purtscher's retinopathy⁷● haemodialysis: ARDS³⁰

Box 5

POTENTIAL SOURCES OF EMBOLI
There is much debate as to the most likely source of emboli. Indeed there may be more than one source, given the wide range of problems which can cause a Purtscher's retinopathy picture. Potential emboli are listed in box 3, and discussed in more detail below.

Air
Chest compression injuries have been documented to cause air emboli. It has been postulated that unilateral Purtscher's retinopathy occurring in cases of severe chest trauma is secondary to air emboli.¹⁴ Accidental injection of air during retrobulbar anaesthesia may have caused a Purtscher's-like retinopathy reported in the literature.⁹

Steroid suspension particles
Several reports have outlined a rare complication of injection of extraocular long-acting steroid suspensions.⁸ It would appear that retrograde flow of the steroid particles can cause retinal arteriolar obstruction and a Purtscher's-like retinopathy.

Fat
Fat emboli are known to occur both in trauma and pancreatis²¹ and fat emboli have been postulated as the cause of Purtscher's retinopathy in these situations.^{15,22}

The fat embolism syndrome (fever, respiratory distress, central nervous system changes and a petechial rash) occurs in approximately 5% of patients with long bone fractures and affects multiple organ systems. It may be fatal in 20% of severe cases.

Fat emboli have been found in the retinal arterioles and capillaries of patients with fat embolism syndrome and documented ischaemic retinopathy.²² However, morbid evidence of fat emboli occurs in people with trauma but no evidence of the fat embolism syndrome and therefore casts doubt on fat being solely responsible for all the clinical symptoms seen.¹¹

The retinal appearance and symptoms of fat embolism syndrome and Purtscher's retinopathy are summarised in box 4.^{3,6,11}

It may well be that the ophthalmoscopic features of fat embolism and Purtscher's are two ends of a spectrum of ischaemic changes. However, the differences between them suggests that there are other factors involved in producing Purtscher's retinopathy. The most obvious variable is the size and

Case report

A 52-year-old man was admitted with a diagnosis of acute pancreatitis following 14 months of alcohol and tobacco abuse. Three weeks later he was seen by an ophthalmologist. There was no relevant previous ocular history.

Ocular examination

Hand movements vision in both eyes with a left afferent pupil defect (indicating poor function of the afferent visual pathway on the side of the defect). Profound visual field loss in both eyes. Examination of the fundi revealed retinal ischaemia and infarction with retinal pallor, cotton wool spots and haemorrhages (figure 1). Fluorescein angiography of the retinal and choroidal circulation showed large areas of capillary nonperfusion (figure 2). There was extensive involvement of macular arterioles on the left with relative sparing on the right.

General examination

Not hypertensive. Liver function tests normal. Renal function impaired with a creatinine of 466 units, due to long-standing renal disease (polycystic kidneys), but electrolytes normal. Full blood count : macrocytic anaemia with a haemoglobin of 9.4 g/dl. Vitamin B12 and folate normal.

Follow-up

After two weeks the vision in the right eye had improved to 6/12, the left remained at 2/60 with a left relative afferent pupil defect. At six weeks the visual acuity in the right had improved to 6/9, the left to 6/60 with a persistent relative afferent pupil defect. The retinal appearances were resolving (figure 3). With the improvement in his vision, the patient resumed his alcohol intake and failed to attend further follow-up.

Figure 1 The acute appearance of a case of Purtscher's retinopathy

Figure 2 Angiogram demonstrating capillary closure in a case of Purtscher's retinopathy

Figure 3 Purtscher's retinopathy four to six weeks after the onset of symptoms

Box 6

nature of the retinal emboli needed to produce occlusion of the terminal arterioles in the peripapillary layer.

Fat emboli are made up of small globules which, although documented as being between 10–50 μm in diameter, are mostly between 12–15 μm .²³ The diameter of the arterioles feeding the peripapillary capillaries is 15–150 μm ¹⁹ and the fat emboli tend to pass through these and become lodged in the capillary beds (normally 5–6 μm diameter).²³ Perhaps the fluid nature of fat at body temperature¹¹ allows the fat emboli to elongate into the smaller diameter capillaries.

Experimentally, when small lead glass emboli 15–40 μm in diameter are infused into the carotid arteries of cats and monkeys, it is possible to reproduce a picture resembling Purtscher's retinopathy.²⁴ It would appear that a larger more substantial embolus than fat is needed to occlude a terminal arteriole and cause the more confluent areas of ischaemia seen in Purtscher's retinopathy.

Fibrin clots

It has been suggested that microembolic disease may be caused by fibrin clots, eg, in disseminated intravascular coagulation following intravascular activation of the clotting system. Hypercoagulability with a characteristic profile of platelet count and fibrinogen has been demonstrated in a series of 11 consecutive patients with Purtscher's retinopathy.²⁵ In addition, it has been possible to produce a picture similar to Purtscher's by injecting fibrin clots (0.15–1.0 mm) into the ophthalmic artery of pigs.¹⁶

However, a histopathological study of seven cases with disseminated intravascular coagulation showed that the characteristic abnormality of ocular involvement was vascular occlusion in the choriocapillaris, particularly in the area of the submacular choroid. The thrombosis was accompanied by detachment of the overlying retina, but little if any evidence of retinal arteriolar occlusion.²⁶

This makes coagulopathy a less likely cause of Purtscher's retinopathy and the fibrin clots in the experimental model may have just been the correct size to cause occlusion of the retinal arterioles.

Complement activation

Diverse conditions such as trauma, haemorrhage, infusions of lipid-rich suspensions (including amniotic fluid), acute pancreatitis, haemodialysis, cardiopulmonary by-pass and sepsis (particularly Gram negative) can massively activate the complement system. Complement activation can, through the C5a component, cause leukocytes to aggregate and clump together.¹²

Experimental *in vivo* activation of complement in rats formed granulocyte aggregate able to occlude vessels up to 60 μ m in diameter.^{17,19} This resulted in vessel damage, interstitial oedema and petechial haemorrhage. Granulocyte aggregates appear to form an embolus large enough to be more effective in occluding the peripapillary retinal arterioles.¹⁹ Injection of leukocyte aggregates containing between 30 and 50 leukocytes into pigs resulted in some oedema of the inner retinal layers and haemorrhage at the optic disc.²⁷

Adult respiratory distress syndrome (ARDS), which occurs in several disorders associated with Purtscher's retinopathy, is now thought to be related to granulocyte aggregates occluding pulmonary arterioles and oxygen radicals damaging the vascular endothelium. Other factors probably playing a role in lung injury are aspiration, fluid overload, hypoproteinaemia, shock, activation of disseminated intravascular coagulation, and fat embolism.^{6,17}

Box 5 summarises pathology known to cause Purtscher's-like retinopathy and details any known or possible associations with problems secondary to complement activation. Because complement activation is an essential part of the body's defence mechanism, it may be that Purtscher's retinopathy is occurring more frequently than is reported. The true incidence may be greater but the condition is unrecognised because the patients are too sick to complain of loss of vision. Alternatively, physiological counterregulation mechanisms such as fibrinolysis and disaggregation of platelet and granulocyte aggregates may prevent its regular occurrence.

Both hypotheses may be true. The case report (box 6) would suggest that some cases of Purtscher's retinopathy may go unrecorded as there was a gap of three weeks before the patient saw an ophthalmologist. Other more life threatening situations will push visual problems into the background and since most ocular symptoms resolve spontaneously in four to six weeks the patient may never seek an ocular opinion. In addition when researchers tried to induce an experimental Purtscher's retinopathy in pigs infused with leukocyte aggregates, their success was lower than expected. The authors themselves suggested that this was due to the spontaneous disaggregation of leukocyte aggregates *in vivo*.²⁷

- Purtscher O. Noch unbekannte befunde nach schadeltrauma. *Ber Dtsch Ophthalmol Ges* 1910; 36: 294-301.
- Marr WG, Marr EG. Some observations on Purtscher's disease: traumatic retinal angiopathy. *Am J Ophthalmol* 1962; 54: 693-705.
- Williams DF, Mieler WF, Williams GA. Posterior segment manifestations of ocular trauma. *Retina* 1990; 10(suppl 1): 35-44.
- Wells AD, McDonnell PJ, Burnand KG. Purtscher's retinopathy in acute pancreatitis. *Br J Surg* 1990; 77: 820.
- Cohen SY, Gaudric A, Chaine G, et al. Retinopathy in acute pancreatitis. *J Fr Ophthalmol* 1989; 12: 261-5.
- Blodi BA, Johnson MW, Gass JD, Fine SL, Joffe LM. Purtscher's like retinopathy after childbirth. *Ophthalmology* 1990; 97: 1654-9.
- Stoumbos VD, Klein ML, Goodman S. Purtscher's like retinopathy in chronic renal failure. *Ophthalmology* 1991; 99: 1833-9.
- Wilkinson WS, Morgan CM, Baruh E, et al. Retinal and choroidal vascular occlusion secondary to corticosteroid embolisation. *Br J Ophthalmol* 1989; 73: 32-4.
- Lemagne JM, Michiels X, Van Causenbroeck S, et al. Purtscher like retinopathy after retrobulbar anaesthesia. *Ophthalmology* 1990; 97: 859-61.
- Farmer SG, Kinyoun MD, Nelson JL, et al. Retinal vasculitis associated with autoantibodies to Sjogrens syndrome A antigen. *Am J Ophthalmol* 1985; 100: 814-21.
- Duke Elder S. *System of ophthalmology. Vol XIV. Injuries Part 1*. London: Henry Kimpton, 1972; pp 717-28.
- Jacob HS, Hammerschmidt DH. Tissue damage caused by activated complement and granulocytes in shock lung, post perfusion lung, and after amniotic fluid embolism: ramifications for therapy. *Ann Chirug Gynaecol* 1982; 71(suppl 196): 3-9.
- Atabay C, Kansu T, Nurlu G. Late visual recovery after intravenous methylprednisolone treatment of Purtscher's retinopathy. *Ann Ophthalmol* 1993; 25: 330-3.
- Burton TC. Unilateral Purtscher's retinopathy. *Ophthalmology* 1980; 87: 1096-105.
- Roden D, Fitzpatrick G, O'Donoghue H, et al. Purtscher's retinopathy and fat embolism. *Br J Ophthalmol* 1989; 73: 677-9.
- Behrens Baumann W, Scheurer G, Schroer H. Pathogenesis of Purtscher's retinopathy: an experimental study. *Graefe's Arch Clin Exp Ophthalmol* 1992; 230: 286-91.
- Jacob HS, Craddock PR, Hammerschmidt DG, et al. Complement induced granulocyte aggregation. An unsuspected mechanism of disease. *N Engl J Med* 1980; 302: 789-94.
- Wise GN, Dollery CT, Henkind P. *The retinal circulation*. New York: Harper and Row, 1971.
- Shapiro I, Jacob HS. Leukoembolization in ocular vascular occlusion. *Ann Ophthalmol* 1982; 14: 60-3.
- Kincaid MC, Green WR, Knox D, et al. A clinicopathological case report of retinopathy of pancreatitis. *Br J Ophthalmol* 1982; 66: 219-26.
- Lynch MJ. Nephrosis and fat embolism in acute hemorrhagic pancreatitis. *Arch Intern Med* 1954; 94: 709-17.
- Fritz M, Hogan M. Fat embolization involving the human eye. *Am J Ophthalmol* 1948; 31: 527-34.
- Rask J. Post traumatic fat embolism located at the retina. *Acta Ophthalmol* 1968; 46: 218-22.
- Ashton N, Henkind P. Experimental occlusion of retinal arterioles using graded glass ballotini. *Br J Ophthalmol* 1965; 49: 225-34.
- Behrens-Baumann W, Scheurer G. Morbus Purtscher. Variationsbreite der klinischen Manifestationen bei 11 Patienten und Überlegungen zur Pathogenese. *Klin Monatsbl Augenheilkd* 1991; 198: 99-107.
- Cogan DG. Ocular involvement in disseminated intravascular coagulopathy. *Arch Ophthalmol* 1975; 93: 1-9.
- Scheurer G, Praetorius G, Damerau B, Behrens-Baumann W. Vascular occlusion of the retina. An experimental model. I Leucocyte aggregates. *Graefe's Arch Clin Exp Ophthalmol* 1991; 230: 275-80.
- Abramson S, Belmont HM, Hopkins P, et al. Complement activation and vascular injury in systemic lupus erythematosus. *J Rheumatol* 1987; 14(suppl 13): 43-6.
- Hammerschmidt DE, Ogburn PL, Williams JE. Amniotic fluid activates complement. A role in amniotic fluid embolism syndrome? *J Lab Clin Med* 1984; 104: 901-7.
- Arora N, Lambrou F, Stewart MW, et al. Sudden blindness associated with central nervous symptoms in a haemodialysis patient. *Nephron* 1991; 59: 490-2.