Iris Angiography of the Anterior Segment

Ulrich Demeler, Franz Diekstall, and Wilhelm Kröncke
Augenklinik, Zentralkrankenhaus St.-Jurgen-Strasse, Bremen, Federal Republic of Germany

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Introduction

Since the basic studies of Novotny and Alvis in 1960 and 1961,[1,2] fluorescein angiography has been applied routinely for the examination of physiological and pathological processes of the retinal vasculature. However, such studies have only been performed on iris vessels since 1968, when Jensen and Lundbaek[3] succeeded in photographing vessels of the human iris after an intravenous injection of fluorescein. In the subsequent years, innumerable angiographic iris examinations have been performed on patients with different ophthalmic and general diseases, the best known authors being Friedburg and Kottow.[4-8]

Materials and Methods

We use a modified Zeiss slit-lamp for iris angiography, mounted with a Contax camera and autowinder, which is coupled to a power supply unit allowing pictures to be taken at 0.6- to 1.5-sec intervals. A Zeiss iris fluorescein high intensity lamp is mounted onto a pivot arm of the slit-lamp. A Kodak 485 excitation filter is placed in front of the slit-lamp, and a Kodak 520 barrier filter is inserted into the camera back. Photographs are taken on Kodak Tri-X pan ASA 400 film, with apertures from f14 to f16 in patients with dark irides, and between f16 and f22 in patients with light irides. Five milliliters of a 10% sodium fluorescein solution are injected into an antecubital vein within a few seconds, and recordings are taken within the first half minute at 1.5-sec intervals, and in the late angiographic phase at 1- and 5-min intervals.

Indications for Iris Fluorescein Angiography

The following figures demonstrate some typical clinical and iris angiographical examples of different disorders of the anterior chamber and iris, such as tumors and cysts of the iris, degenerative diseases, new vessel formation of the iris in patients suffering from diabetes mellitus or retinal vascular occlusion, and finally, abnormal vascular formations and an angioma of the iris.

Figure 1(A) shows a normal iris angiogram with the beginning arterial, full and late venous angiographical phases. In the normal iris angiogram, the peripheral arteries begin to stain approximately 14-16 sec after injection and, 2-3 sec later, fluorescein appears at the pupillary margin. After a further 3-4 sec, venous filling occurs. The arteries, which appear of larger diameter than the veins in the angiogram, originate at the circulus arteriosus iridis major, follow a relatively straight radial course, mostly in pairs, within the superficial stroma, and reach the pupillary margin where they then divide to form a dense capillary network. The veins, which are more numerous and narrow than the arteries, are situated in the deeper stroma and traverse back to the iris periphery to join the vortex veins. Figure 1(B) demonstrates a well-developed circulus arteriosus iridis minor, which is rarely so visible.

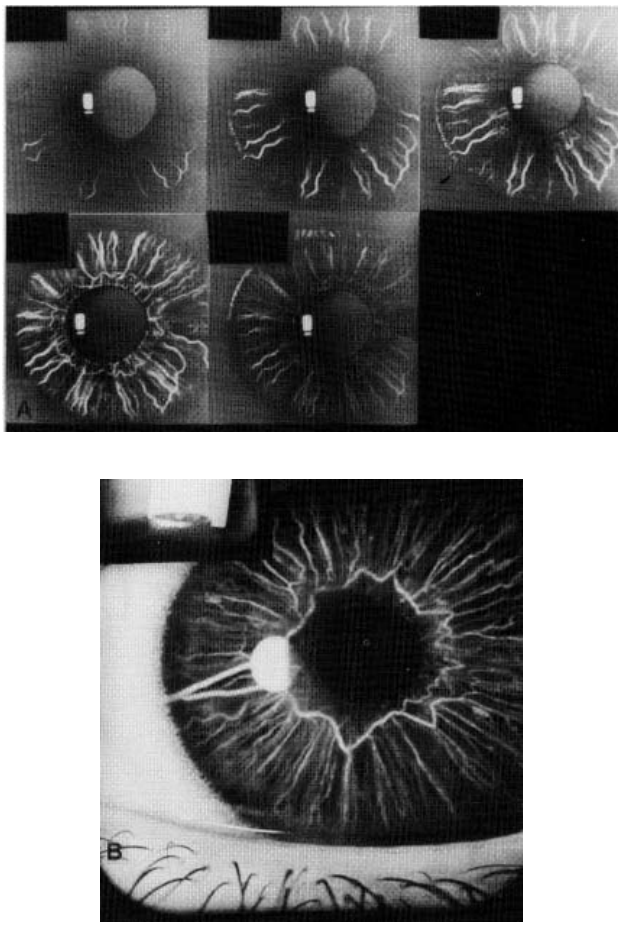


Fig. 1: (A) Normal iris angiogram. (B) Circulus arteriosus iridis minor.

Iris Tumors

On the basis of their different angiographic staining patterns, tumors of the iris are divided into three groups9:

Type I

Type I tumors of the iris are characterized by an angiographic absence of blood vessels (Fig. 2). In no phase of the angiogram does the tumor, or its vicinity take up fluorescein dye. The normal iris vessels are more or less covered by the tumor. Clinically, such tumors are usually more or less darkly pigmented, slightly if at all prominent and situated within the superficial iris stroma.

Type II

The tumors of this group (Fig. 3) are, without exception, typified by the presence of a more or less well-developed vascular system within the tumor substance, that fills in the very early angiographic phase. In the later phase, a mottled or diffuse staining of the tumor and leakage of fluorescein dye into the surrounding iris stroma and into the aqueous humor takes place. Clinically, such tumors are usually not only moderately prominent, but are situated on or within the superficial iris stroma, and always have their own vasculature, which often can be seen by slit-lamp examination.

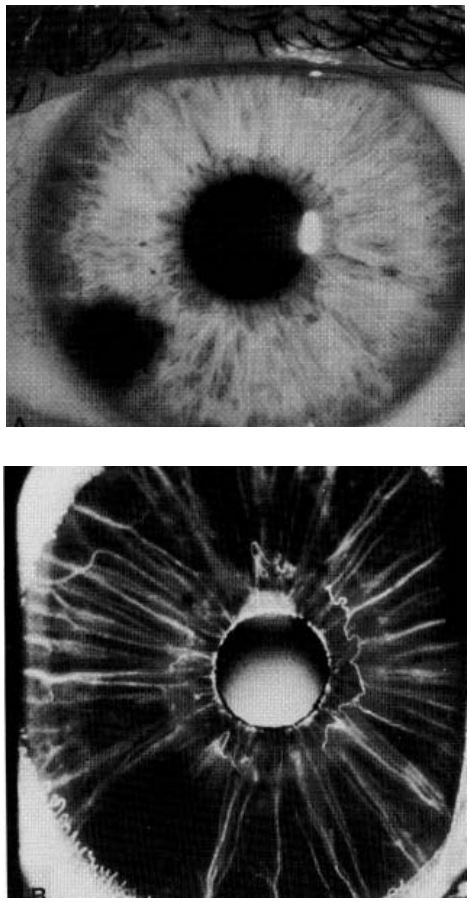


Fig. 2: (A) Clinical photograph showing an iris tumor, type I. (B) Angiogram showing an iris tumor, type I with no visible iris vessels and no dye leakage.

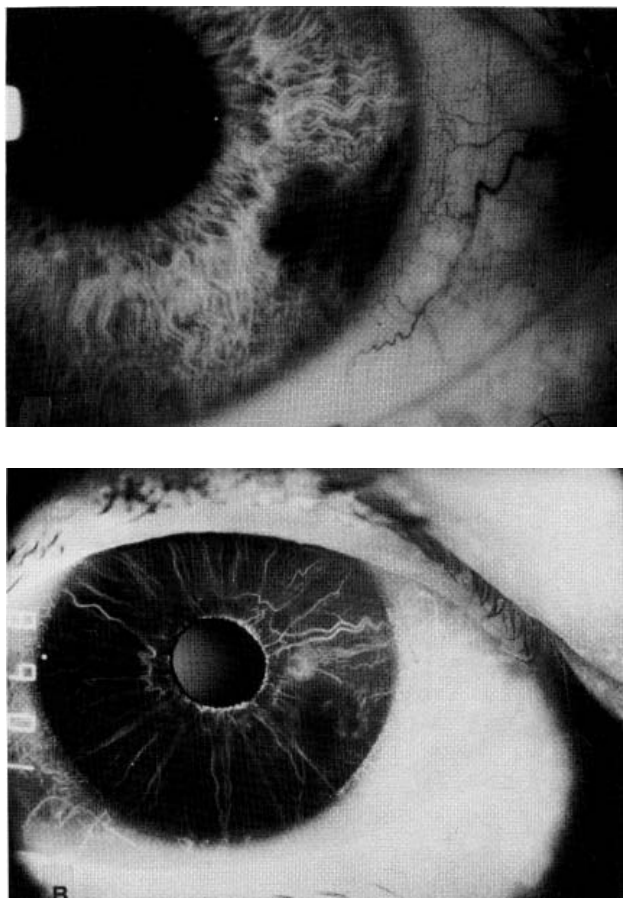


Fig. 3: (A) Clinical photograph showing an iris tumor, type II. (B) Angiogram showing an iris tumor type II, with tumor vasculature and dye leakage.

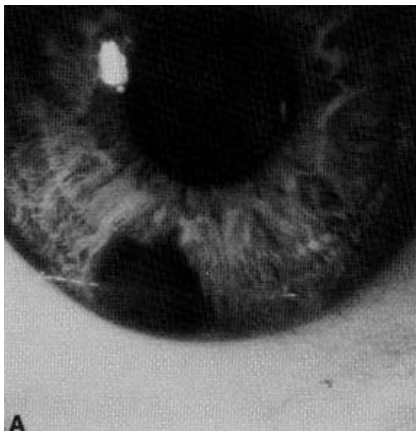
Type III

The tumors of Type III either possess their own stainable vascular system, or they contain so much pigment that the vessels are rendered invisible, so that the tumor itself remains dark until the later phases of the angiogram (Fig. 4). The feature common to all Type III tumors is a primary central faint fluorescence which becomes stronger in the later phases, and then appears as a central borderline fluorescence. As a rule, these tumors are clinically very prominent, darkly pigmented, and sharply circumscribed. They are usually situated in the peripheral iris, often reach the corneal endothelium and frequently completely occupy the chamber angle, leading to a more or less marked angle-closure glaucoma.

Besides the known clinical methods for the diagnosis of malignancy in iris tumors, fluorescein angiography of the iris adds valuable diagnostic criteria, not only for follow-up examinations, but also for the differential diagnosis. From our experience following intraocular surgery and histological examination of more than 50 patients with tumors of the iris and ciliary body, we feel that tumors of Type I are benign, Type II are potentially malignant, and Type III are definitely malignant.

Iris Metastase

Figures 5(A) and (B) show an extremely vascularized tumor near the pupillary margin, clinically extremely prominent and



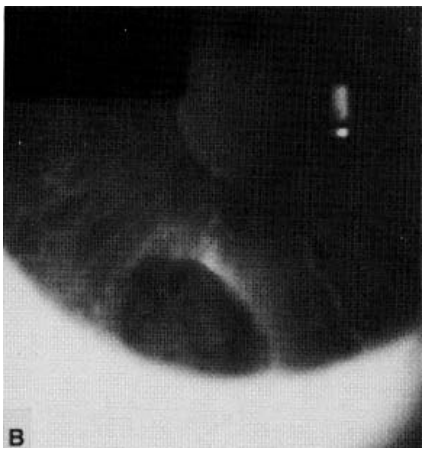
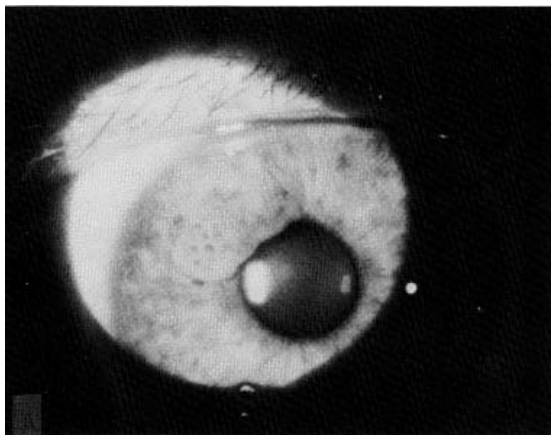


Fig. 4: (A) Clinical photograph showing an iris tumor, type III. (B) Angiogram showing an iris tumor type III, with tumor vasculature and central borderline fluorescence.



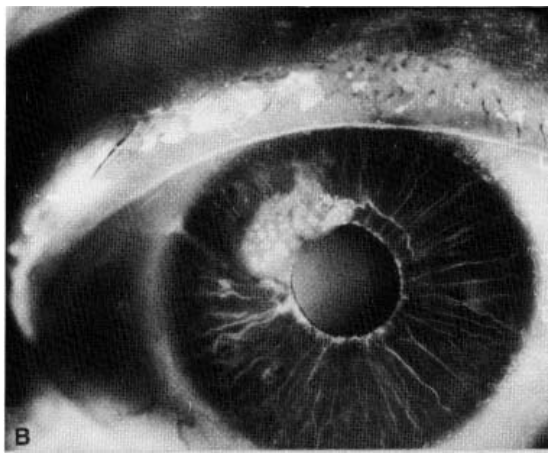
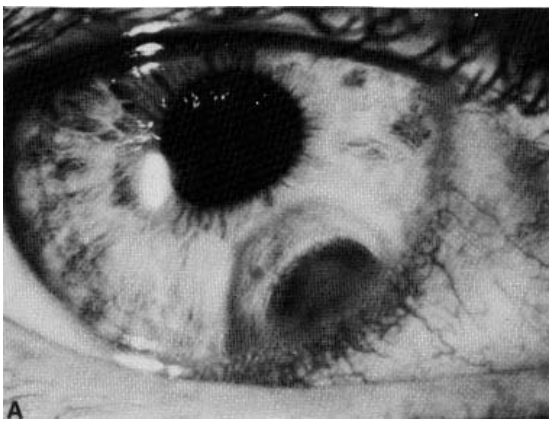


Fig. 5: (A) Clinical photograph showing an iris metastase of a carcinoma of the lung. (B) Angiogram showing an iris metastase, tumor with vasculature and massive dye leakage.

sharply circumscribed. The patient had a histologically proven "oatcell"-carcinoma of the lung. The angiogram reveals a strong staining of the tumor,s own vessels with diffuse dye leakage already in the very early phase of dye circulation.

Iris Cysts

The next two cases demonstrate the typical different angiographical staining patterns of a congenital cyst of the iris compared to a cyst of the anterior chamber after epithelial downgrowth. [10] Congenital iris cysts push the peripheral iris backwards. The angiogram (Fig. 6) demonstrates that the iris vessels within the cyst are pushed backwards also, but they do not show dye leakage. The cyst developed over a very long period of time, so that the vessels were not disturbed as much as in the next case of epithelial downgrowth cyst. Figures 7(A) and (B) show a case of traumatic epithelial downgrowth. Within the cyst there can only be seen some dye leakage from damaged iris vessels, and a slight line of fluorescence at the



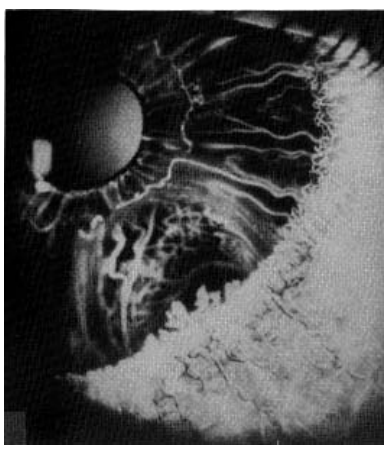


Fig. 6: (A) Clinical photograph showing a congenital iris cyst. (B) Angiogram showing the iris cyst, with dislocated iris vessels, but no dye leakage.

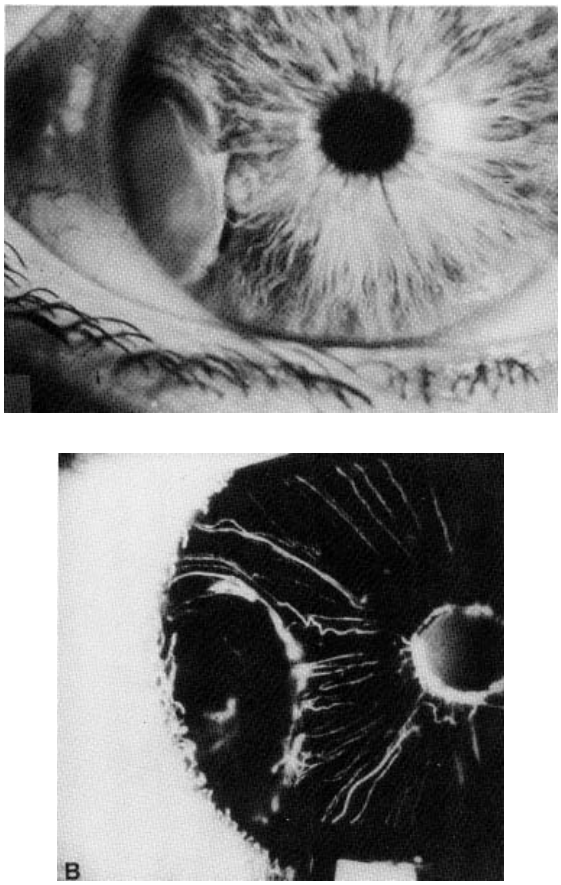


Fig. 7: (A) Clinical photograph showing an epithelial down-growth cyst. (B) Angiogram showing some dye leakage from the displaced and disturbed iris vessels.

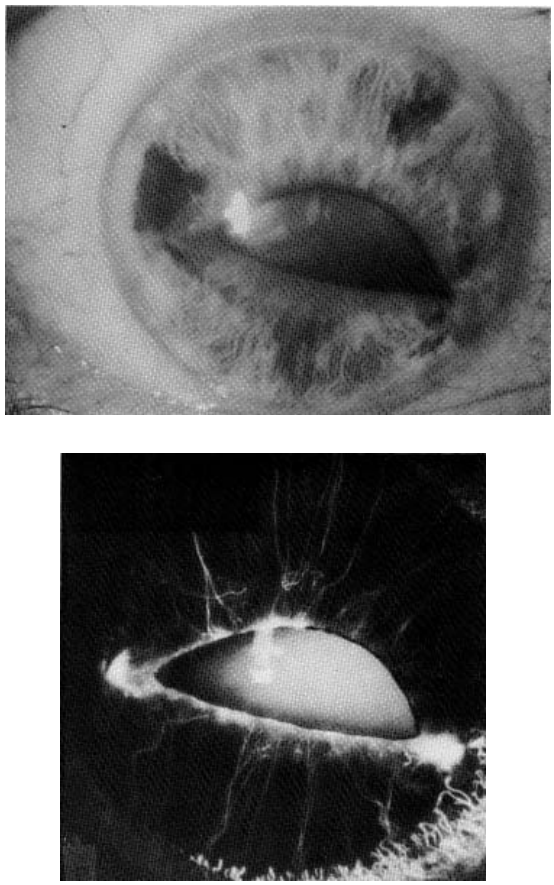


Fig. 8: (A) Clinical photograph showing essential progressive iris atrophy. (B) Angiogram showing mottled staining around the pupillary margin and new vessel formations.

central border of the cyst. This cyst developed so quickly, within a few months time, that the underlying iris vessels were considerably damaged, lost their normal appearance and became permeable to fluorescein.

Essential Progressive Iris Atrophy

The typical features of essential progressive iris atrophy are a distortion of the pupil and defects in the iris stroma and pigment layer [Fig. 8(A)]. In the angiogram a mottled staining in most parts of the pupillary margin and new vessel formation are visible, with diffuse dye leakage at both ends of the pupillary distortion [Fig. 8(B)].11

Persistent Pupillary Membrane

Figure 9 demonstrates a case of persistent pupillary membrane. The angiogram reveals the staining of vessels crossing the pupil, and a mottled and diffuse dye leakage around the pupillary margin, and out of the vascularized membrane.12

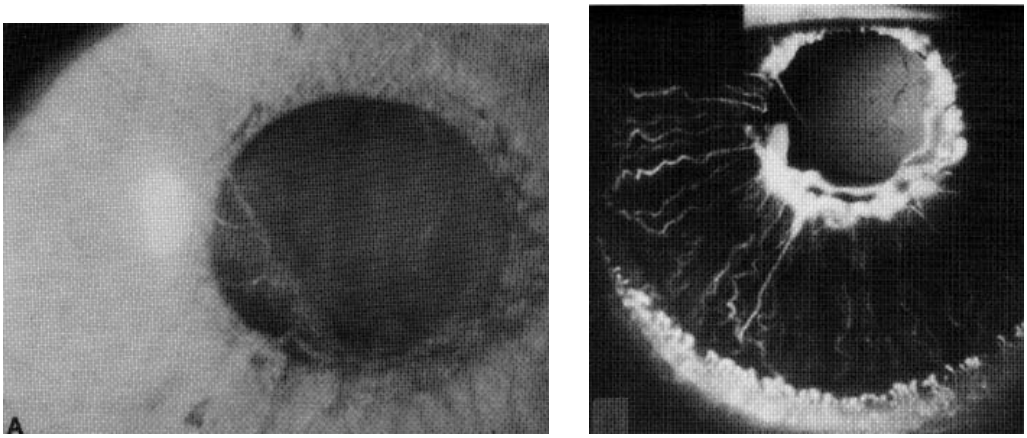


Fig. 9: (A) Clinical photograph showing a persistent pupillary membrane. (B) Anglogram showing massive dye leakage around the pupillary margin and the vascularized membrane.

Diabetic Iridopathy and Other Cases of Rubiosis Iridis

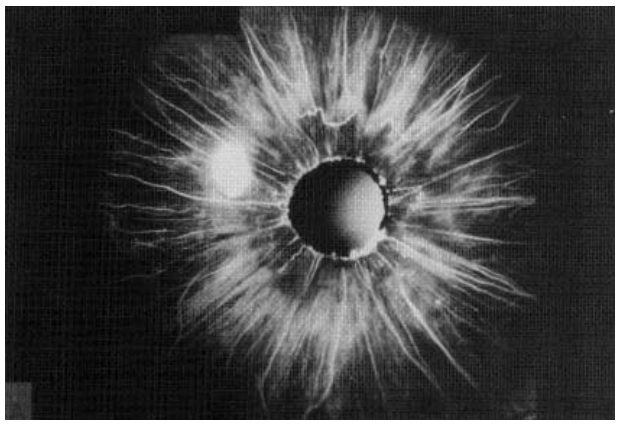
In an early diabetic iridopathy, some spots of dye leakage can be found around the pupillary margin [Fig. 10(A)]. The clinical appearance of new vessel formation is called "rubeosis iridis" [Fig. 10(B)]. Three different kinds of new vessel formation can be revealed by the iris angiogram.13

Loops

The first kind of new vessel formation, small loops, arises mostly near the circulus arteriosus iridis minor. They are always permeable to fluorescein, due to the fenestrated structure of their walls. Figure 11(A) shows a case of chronic uveitis.

Sprouts

The second form of neovascularization is the development of so-called sprouts, seen here in a case of severe iridocyclitis with acute secondary glaucoma [Fig. 11(B)]. The angiographically characteristic feature of these sprouts is that they always arise around the pupillary margin, being later irregularly disseminated over the surface of the iris, and finally spreading into the chamber-angle, leading to a closed-angle glaucoma with the typical filling defects in the angiogram. The sprouts are as permeable to fluorescein as the loops.



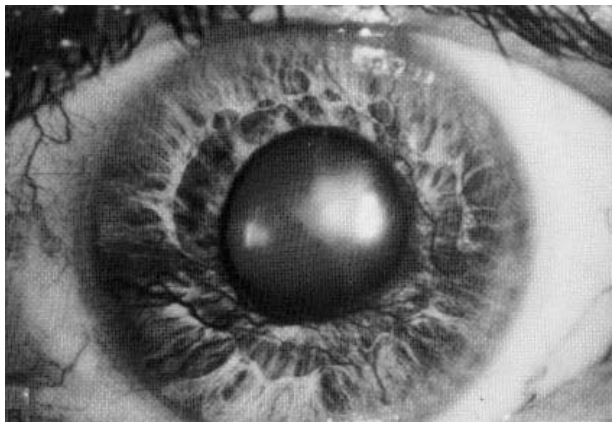
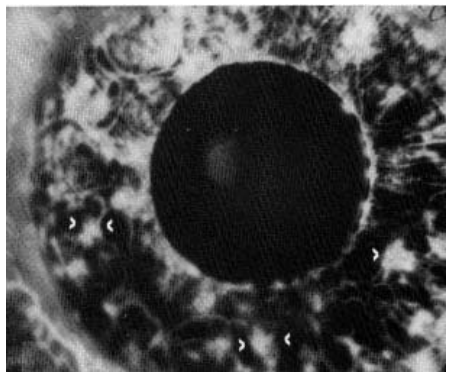
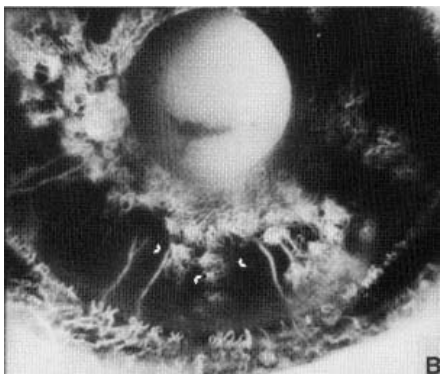
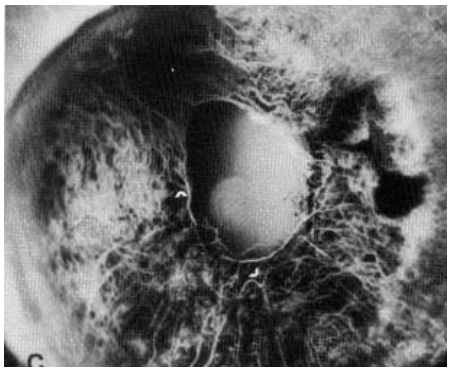


Fig. 10: (A) Angiogram demonstrating early diabetic iridopathy, with spots of dye leakage around the pupillary margin. (B) Clinical photograph showing newly formed vessels in rubeosis iridis.







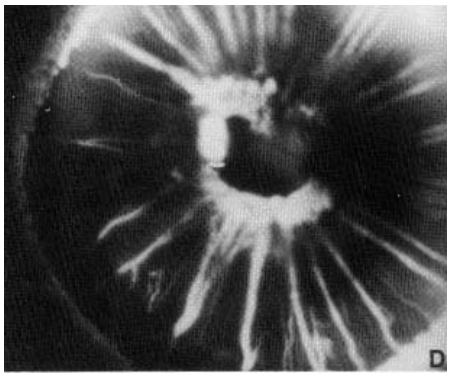


Fig. 11: (A) Angiogram showing loops in chronic uveitis (arrows). (B) Angiogram showing sprouts in long-standing amotio nonsanata (arrows). (C) Angiogram showing bifurcations in secondary closed-angle glaucoma (arrows). (D) Angiogram showing dye leakage from newly formed vessels and normal vessels in central vein occlusion.

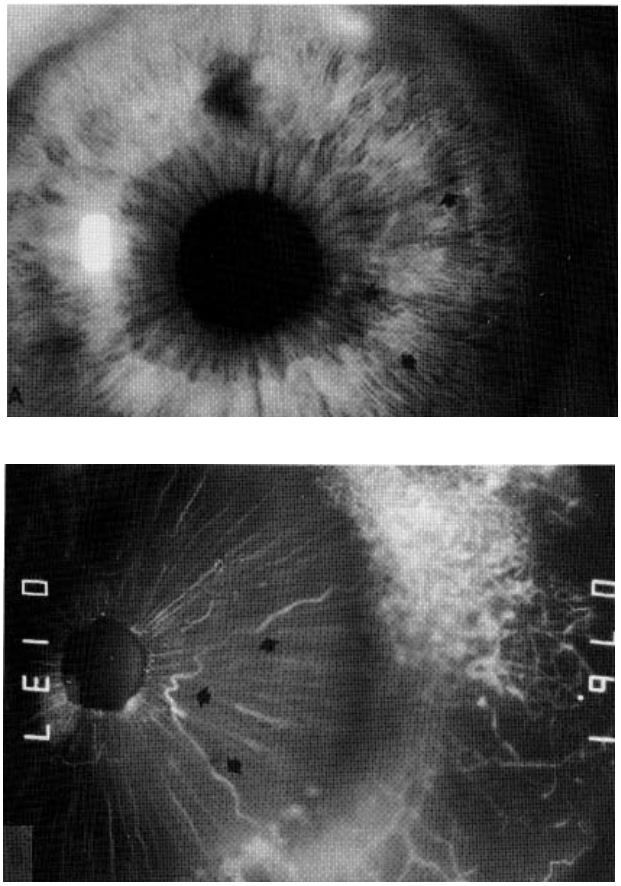


Fig. 12: (A) Clinical photograph showing abnormal iris vessels (arrows). (B) Angiogram showing these same abnormal vessels, but no dye leakage.

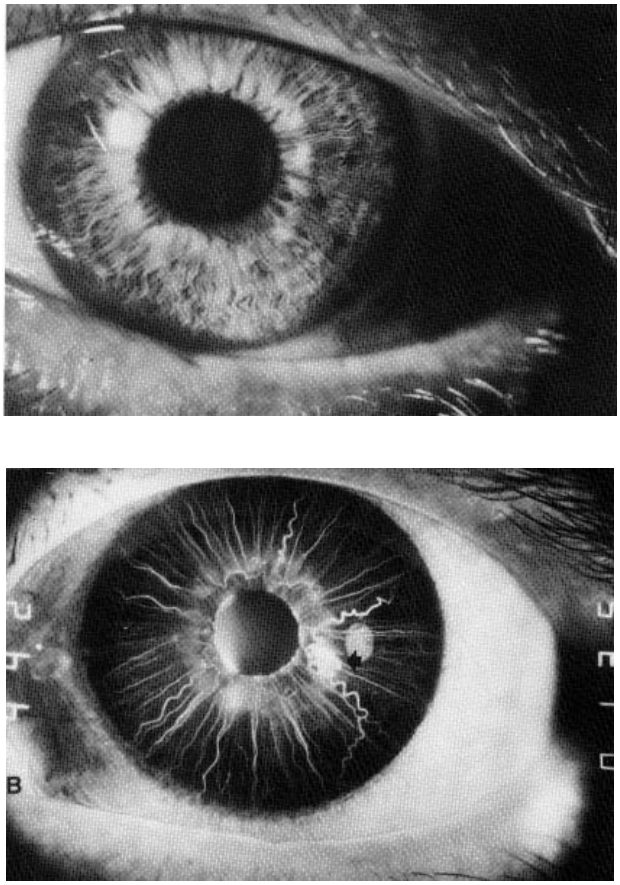


Fig. 13: (A) Clinical photograph showing an iris angioma (arrows). (B) Angiogram demonstrating that there is no dye leakage from the angioma.

Bifurcations

The third form of proliferation demonstrated by iris angiography comprises new vessels produced by an actual bifurcation of the original vessels, as in a case of a long-standing secondary closed-angle glaucoma [Fig. 11(C)]. Contrary to diabetic iridopathy, in iridopathy caused by a central vein occlusion, the typical findings are massive dye leakage out of newly formed vessels around the pupillary margin as well as simultaneous diffuse fluorescence emanating from the radial normal iris vessels [Fig. 11(D)].

Iris Anomalies

The next case neither demonstrates a new vessel formation nor a real angioma of the iris, but a simple abnormality in vessel formation. Figure 12(A) shows the clinical picture, and Figure 12(B) the abnormal iris vessels in the corresponding angiogram. The vessel is considerably thicker than a normal vessel, and shows no dye leakage. [14] Figure 13(A) and (B) show an angioma of the iris with abnormal meandering and no dye leakage.

Summary

Iris angiography is an important method for examination of disorders of the iris and anterior chamber. Fluorescein angiography reveals information about the type, and thereby about the probable malignancy of iris tumors. In cases of iris cysts, angiography allows the differential diagnosis between congenital cysts and epithelial downgrowth cysts, in which a surgical treatment for the latter is absolutely necessary. Further indications for fluorescein angiography of the iris are neovascularization of the iris (so-called, rubeosis iridis), degenerative diseases, and anomalies of iris vessel formation. In these cases fluorescein angiography permits the diagnosis or differential diagnosis as well as follow-up.

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Please address reprint requests to: Professor Dr. Ulrich Demeler, Direktor der Augenklinik, Zentralkrankenhaus St.-Jurgen-Strasse, 2800 Bremen, 1, Federal Republic of Germany.