MANUAL OF FUNDUS FLUORESCEIN ANGIOGRAPHY pdf

1: Fluorescein Angiography | Department of Ophthalmology

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This applies to investigations like fluoresceine angiography, as it allows us to see details of retina which is not visible with naked eyes. This procedure requires high quality of camera with excellent computerized digital system and fluoresceine dye. We at Drushti Eye and Retina Centre are fortunate to have one like it. Retina or the back part of the eye. Fluorescense is a property of substance to alter the wavelength of the reflected light on exciting. Angiography means recording of the angios or the blood vessels. It is basically recording and visualization of the blood vessels of the retina using fluorescein dye. In FFA, the chemical dye is injected in the vein of the hand and this dye circulates all over the body and in every blood vessel. Since retina is the only place in the body where blood vessels can be seen, it is used to visualize the retinal vasculature that is blood vessels of the retina. A special machine called the fundus camera, which has got special lens filters, is used to take photographs of the retina. We can also attach digital camera system or a printer. This property of dye is used to study the normal or abnormal anatomy of retina. This dye and the reflected light are greenish in color. The fundus camera records this. This dye would go wherever the blood vessels are present in retina and we would get the picture of that. If blood vasculature of the retina is normal, then we would get the normal pattern of the retina. If there were blockage then the dye would not go beyond it and would stop at that particular point. If there is leakage, the dye would also leak out along with the blood in the retina and we would be able to pick up the leakage. If there are certain other defects in the retina then depending on the various features seen, whether we get leakages or staining or blocked fluorescence or window defects whether the dye seen in early phase, late phase or in very late phase or delayed phase and is initially less and increasing etc, we can get very good idea of patients disease. ICG Angiography This test is done with indocyanine green dye and special camera. It helps to study the choroidal circulation and is useful for studying patients with wet type of Age related macular degeneration and choroidits patients. Also when we are not sure whether there are new vessels or not or there are certain lesions in retina, which are not easily picked up by the naked eye then FFA helps us to pickup those lesions very easily. Repeat FFA can be compared to see the changes over a period of time. Since the dye is injected, history of any allergy in the past is important. Though it is extremely rare, some patients while undergoing angiogram may have nausea or vomiting or some kind of pain in the hand, but these are very simple side effects without any long-term adverse effects. The serious reactions like death or anaphylaxis are extremely rare. Patient would have yellow colored discoloration of urine for about a day or so because the dye is excreted by kidney in the urine. Optical Coherence Tomography OCT OCT is a new diagnostic tool that can perform tomography evaluate retinal layers or cross sectional imaging of retina. Retina is easily accessible to the external light hence OCT is especially suited for retinal disorder. This is the first imaging technique that provides information regarding the retinal layers. Tomography allows measurement of structures with resolution of 10 micron. It is a non invasive technique. OCT is most commonly used to diagnose macular disorders like Age related macular degeneration, Macular edema, Macular hole, Central serous retinopathy ,Proliferative diabetic retinopathy, Macular pucker, Vitreo retinal traction, Optic nerve changes in glaucoma. Serial OCT can help in evaluating the response to treatment.

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2: Find Fluorescein Angiography Imaging Equipment

The author's stated purpose is to provide "a detailed and comprehensive account of fluorescein angiographic findings of retinal disorders." He has assembled a collection of beautiful color photographs and fluorescein angiograms for this concise volume.

Seyed Hossein Rasta, ku. Non-commercial uses of the work are permitted, provided the original work is properly cited. Abstract Open in a separate window Introduction: Retinal capillary nonperfusion CNP is one of the retinal vascular diseases in diabetic retinopathy DR patients. As there is no comprehensive detection technique to recognize CNP areas, we proposed a different method for computing detection of ischemic retina, non-perfused NP regions, in fundus fluorescein angiogram FFA images. Whilst major vessels appear as ridges, non-perfused areas are usually observed as ponds that are surrounded by healthy capillaries in FFA images. A new technique using homomorphic filtering to correct light illumination and detect the ponds surrounded in healthy capillaries on FFA images was designed and applied on DR fundus images. These images were acquired from the diabetic patients who had referred to the Nikookari hospital and were diagnosed for diabetic retinopathy during one year. Our strategy was screening the whole image with a fixed window size, which is small enough to enclose areas with identified topographic characteristics. To discard false nominees, we also performed a thresholding operation on the screen and marked images. To validate its performance we applied our detection algorithm on 41 FFA diabetic retinopathy fundus images in which the CNP areas were manually delineated by three clinical experts. Lesions were found as smooth regions with very high uniformity, low entropy, and small intensity variations in FFA images. This technique introduced a new automated detection algorithm to recognize non-perfusion lesions on FFA. This has potential to assist detecting and managing of ischemic retina and may be incorporated into automated grading diabetic retinopathy structures. Retina is a tissue with high oxygen demand even more than the brain. Since it cannot deposit oxygen within itself, the retina needs continuous and sufficient supply of blood for nourishment until it preserves its function. Non-perfusion areas of the retina are associated with the development of vascular occlusion or capillary closure. The clinical procedures for detecting retinal vasculature abnormalities and the non-perfused areas are normally achieved through screening using fundus colour and FFA images by ophthalmologists. This is a difficult job due to the fact that there is a large variation in the overall size, shape, location, and intensity of the retinal pathologiesexist. These procedures usually suffer from several drawbacks such as the variable expertise, biases in diagnosis which are also affected by quality of images. The identification of CNP in retinal images is one of the signs demonstrating the disease proceeded to a stage needing referral to an ophthalmologist therefore it could be a significant objective in automated analysis. Zheng et al used a texture segmentation framework for segmenting Capillary nonperfusion regions in FA images of ischemic diabetic maculopathy taken by acSLO. However, these methods still need to be developed getting significant results to assist for detecting and managing of ischemic retina that may be incorporated into automated grading diabetic retinopathy structures. Materials and methods A total of 41 Fundus FA images from 80 patients referred to the university eye clinic with different severities of DR were obtained in an approaching observational study. Our strategy consisted of three steps; FA image pre-processing, evaluation of image parameters, and CNP detection orsegmentation step. Image capturing and preprocessing In this study we used images acquired from the diabetic patients who have been referred to the Nikookari Hospital and were diagnosed for diabetic retinopathy during one year. The digital camera was set to use the highest quality mode for imaging with a Tiff compression. At first step, image restoration techniques were used to compensate the damage done by recognized causes. Algorithms of de-blurring and noise removal of interference patterns are classified in this category. On the next step, images were enhanced resulting in improvement of contrast and illumination. Pond detection was subsequently applied to locate the suspicious points by the image segmentation technique for marking specific zones of interest within the image. Finally, morphological opening and closing thresholding was performed to throw away false-positives among the detected CNP candidates in the image. Noise removal The unprocessed images with the high level of noise

make them unfitting for medical diagnosis. Gaussian noise, one kind of random noise, is typically present in FFA images that are acquired by digital fundus cameras.

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3: The Nuts and Bolts of Fundus Autofluorescence Imaging - American Academy of Ophthalmology

A fluorescein angiography is a medical procedure in which a fluorescent dye is injected into the bloodstream. The dye highlights the blood vessels in the back of the eye so they can be photographed.

Comments This article is from September and may contain outdated material. With the introduction of fluorescein angiography decades ago, ophthalmologists observed that, even without the use of fluorescein, parts of the fundus showed areas of fluorescence in certain conditions. Although this faint, so-called autofluorescence was at first considered to be a distraction, it was later found to have potential as a diagnostic indicator and a tool for monitoring disease progression. New instrumentation and techniques have been developed to begin harnessing its potential. The Fluorescent Fundus What causes fundus autofluorescence? The retinal photoreceptors contain light-sensing molecules, a class of retinoids that are susceptible to damage and cross-linking, said Richard F. The photoreceptors shed their damaged outer segments, which the retinal pigment epithelium RPE ingests through phagocytosis. The molecules are stored in liposomes and form lipofuscin LF. In addition to age, disease states and potentially increased oxidative damage can contribute to the buildup of LF in RPE cells. LF can be made to fluoresce by a fairly broad range of wavelengths, about to nm. Areas of excess LF accumulation will appear hyperfluorescent. Not just the RPE. Fluorescence comes from other layers of the retina as well. Fundamentals of FAF Two main methods are used to record autofluorescence: You can acquire images at nearly a video rate and add them together, Dr. Sadda said, which improves the signal-to-noise ratio and provides higher-quality images. However, because only one plane can be seen, he added, conditions that increase fluorescence from the neurosensory retina, including almost any condition causing a serous or tractional detachment, will not be detected well with a cSLO-based system. Spaide, the fundus camera FAF-imaging method uses filters exciting in the green spectrum and recording emission in the yellow-orange spectrum, said Dr. Noting that some systems use blue and others green light for excitation, Dr. However, the green spectrum may provide some additional detail in the fovea, as the blue light tends to be absorbed by the high concentration of xanthophyll pigments. Light outside of the visible spectrum can also be used. These wavelengths excite molecules other than LF, most notably, melanin. The distribution of melanin in the eye, he said, provides a different type of information about the disease process than LF alone. FAF imaging can be used to view only the posterior pole or all the way out to the periphery of the retina. The Optos uses an ellipsoidal mirror in the image pathway, said Dr. Spaide, which deflects light across a wide field of the ocular fundus. In a retrospective review, Dr. Kiss and colleagues found peripheral autofluorescent abnormalities in nearly 64 percent of eyes in patients with age-related macular degeneration AMD , compared with about 36 percent of control eyes, suggesting potential implications for diagnosing and treating different subtypes of the disease. Sadda found similar abnormal peripheral patterns in a majority of patients with a wide range of diseases. Which Conditions to Test? Unlike other imaging modalities, said Dr. Kiss, FAF provides functional information about retinal cells. Spaide, it is useful for almost any fundus disorder, including AMD, retinal detachment, inherited dystrophies, central serous chorioretinopathy, vitelliform lesions, and acute zonal occult outer retinopathy AZOOR. Kiss noted that FAF is also helpful in screening for medication toxicity, including eye problems related to hydroxychloroquine Plaquenil. Kiss, making it possible to assess emerging therapies and monitor response to medication as well as progression of the disease. However, hyperfluorescence shows up in junctional zones around geographic atrophy where the RPE is working overtimeâ€”a foreshadowing of imminent atrophy. Hyperfluorescence in areas immediately adjacent to a retinal detachment can demarcate its extent and help explain visual problems in patients, said Dr. Retinal dystrophies and degenerations also show abnormal autofluorescence, said Dr. As with dry AMD, retinal dystrophies such as retinitis pigmentosa demonstrate areas of both hyper- and hypofluorescence, a sign that the retina is burning out. However, FAF imaging shows widespread abnormalities in the fundus and also can find areas of atrophy within the lesions. Sadda finds FAF particularly useful in diagnosing Stargardt disease, in which pisciform lesions are readily apparent. Central serous chorioretinopathy CSC. Spaide, the extent of CSC is best seen with autofluorescence, not just in the area of the subretinal fluid but also in other

parts of the macula or even the other eye. As with diseases that cause a buildup of vitelliform material, said Dr. Spaide, CSC accumulates outer segments that have been shed but not yet phagocytized. However, it is highly autofluorescent in the wavelengths used to excite retinoids. Proteins do not efficiently autofluoresce in these wavelengths, so the hypothesis that the material is protein does not fit the available facts. Spaide, just as someone learning tennis first individually practices serves, backhands, volleys, and forehand shotsâ€”and then uses them together fluidly in a tennis match. FAF and fluorescein angiography. For example, both FAF imaging and fluorescein angiography provide useful and complementary information. Sometimes imaging modalities offer overlapping information, said Dr. Spaide, adding that, in such cases, it make sense to choose the one that is the least invasive, risky, or expensive. Atlas of Fundus Autofluorescence Imaging. Kiss is a consultant for and receives research funding from Optos. Spaide receives royalties from Optos and Topcon Medical Systems.

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4: Interpretation of Fundus Fluorescein Angiography | JAMA Ophthalmology | JAMA Network

Fluorescein angiography (FA), fluorescent angiography (FAG), or fundus fluorescein angiography (FFA) is a technique for examining the circulation of the retina and choroid (parts of the fundus) using a fluorescent dye and a specialized camera.

Alvis, described and demonstrated the technique of retinal fluorescein angiography FA in Technique FA requires the use of a dedicated fundus camera equipped with excitation and barrier filters. Fluorescein dye is injected intravenously, usually through an antecubital vein with sufficient speed to produce high contrast images of the early phases of the angiogram. White light from a flash is passed through a blue excitation filter. Blue light wavelength nm is then absorbed by unbound fluorescein molecules, and the molecules fluoresce, emitting light with a longer wavelength in the yellow-green spectrum nm. A barrier filter blocks any reflected light so that the images capture only light emitted from the fluorescein. Images are acquired immediately after injection and continue for ten minutes depending on the pathology being imaged. The images are recorded digitally or on 35mm film. Complications A wide range of complications can occur with FA. More severe reactions such as urticaria, pyrexia, thrombophlebitis, and syncope are more rare. Local tissue necrosis can occur with extravasation of dye, however, mild pain and redness is more typical. Severe life-threatening reactions such as anaphylaxis, cardiac arrest, and bronchospasm do occur but are extremely rare. Death is estimated to occur in 1: This is dependent on the age and cardiovascular status of the patient as well as the speed of dye injection. The filling of the choroidal circulation is seen as the choroidal flush, a patchy and mottled hyperfluorescence as the choroidal lobules fill. The retinal circulation appears seconds later seconds after injection. The early arteriovenous phase describes the filling of the retinal arteries, arterioles and capillaries. This is followed by the late arteriovenous phase or laminar venous phase as the dye fills the veins in a laminar pattern. In the normal macula, the capillary-free zone is seen as dark due to blockage of choroidal fluorescence by xanthophyll pigment and tightly packed retinal pigment epithelial cells. The peak phase with maximal fluorescence occurs at approximately 30 seconds and recirculation phases follow. Hypofluorescence is a reduction from the normal expected fluorescence and hyperfluorescence refers to an increased or abnormal fluorescence. Blockage of normal fluorescence may result when any opacity occurs anterior to the fluorescence. Examples include corneal scar, cataract, vitreous hemorrhage, and nerve fiber layer hemorrhage. A vascular filling defect will cause an absence or delay of normal fluorescence in the tissue affected. This may occur with retinal or choroidal vascular occlusion or with occlusion of the short posterior ciliary arteries supplying the optic nerve. Hyperfluorescence can occur because of fluorescein leakage, staining, pooling or by transmission defects and autofluorescence. Leaking fluorescein can come from incompetent blood vessels such as with choroidal neovascularization or diabetic neovascularization or though a diseased retinal pigment epithelium that no longer blocks leakage of fluorescein from the choroid. Areas of leakage in an FA show gradual enlargement and blurring of their margins. This is in contrast to structures that stain. Staining results in increasing fluorescence throughout the angiogram but the margins remain distinct. Normal structures such as optic nerve head and sclera will stain but pathology, such as drusen and disciform scars, also stain with fluorescein. Pooling results when fluorescein gradually fills a fluid-filled space. A transmission, or window defect, occurs when a layer that normally blocks fluorescence is missing. This most commonly occurs when RPE is missing and the bright choroidal fluorescence is seen early in the FA. The intensity of the fluorescence fades and the margins remain distinct. Autofluorescence can be seen before fluorescein dye is injected when structures such as optic nerve head drusen and lipofuscin normally fluoresce. Some specifically equipped scanning laser ophthalmoscopes and fundus cameras can use the fluorescence of lipofuscin to document the health of the RPE layer. Summary FA has contributed to our understanding of many pathologic processes in the retina and remains the preferred method to image the choroidal and retinal circulation. It is an essential tool used by many Ophthalmologists to diagnose a multitude of retinal diseases. Late arteriovenous phase angiogram of the right eye demonstrating early hyperfluorescence in the macula. Late phase angiogram demonstrating leakage from a choroidal neovascular membrane. Red-free photo, early arteriovenous phase,

peak phase , and late phase angiogram of a left eye with choroiditis. Early angiogram demonstrates hypofluorescence of the choroidal lesions with the development of circumferential hyperfluorescence and leakage in the later stages of the angiogram. Late arteriovenous phase angiogram demonstrates hyperfluorescence of microaneurysms as well as some irregular and abnormal retinal vessels in the macula. Early arteriovenous phase angiogram demonstrating hypofluorescence from a large blocking affect from preretinal hemorrhage. Peak phase angiogram in a patient with diabetes demonstrates areas of hyporfluorescence in the superior macula secondary to a vascular filling defect as well as hyperfluorescent microaneurysms. Late phase angiogram demonstraing diffuse macular leakage from microaneurysms, vascular leakage, incompetent retinal pigment epithelium, and tractional affect from a preretinal membrane. Late arteriovenous or laminar venous phase angiogram in a patient with a superotemporal branch retinal vein occlusion. Hypofluorescence is noted along the superotemporal arcade secondary to capillary dropout. Late arteriovenous phase demonstrates leakage from the supertemporal retinal vessels. Additional Resources American Academy of Ophthalmology. American Academy of Ophthalmology, A method of photographing fluorescence in circulating blood in the human retina. A combined technique of fluorescein fundoscopy and angiography of the eye. Fluorescein angiography complication survey. Safety of fluorescein angiography during pregnancy. Safety of fluorescein angiography during pregnancy [letter]. Interpretation of fundus fluorescein angiography. Stereoscopic atlas of macular diseases:

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5: Fluorescein angiography - Wikipedia

*Fluorescein angiography was first successfully used in the human eye in * and has evolved since then as one of the fundamental imaging techniques in the eye. It is a test that helps in the differentiation of retinal disease and is used to determine if laser treatment of the retina is warranted.*

URL of this page: These are the two layers in the back of the eye. How the Test is Performed You will be given eye drops that make your pupil dilate. You will be asked to place your chin on a chin rest and your forehead against a support bar to keep your head still during the test. The health care provider will take pictures of the inside of your eye. After the first group of pictures is taken, a dye called fluorescein is injected into a vein. Most often it is injected at the inside of your elbow. A camera-like device takes pictures as the dye moves through the blood vessels in the back of your eye. How to Prepare for the Test You will need someone to drive you home. Your vision may be blurry for up to 12 hours after the test. You may be told to stop taking medicines that could affect the test results. Tell your provider about any allergies, particularly reactions to iodine. You must sign an informed consent form. You must remove contact lenses before the test. Tell the provider if you may be pregnant. How the Test will Feel When the needle is inserted, some people feel slight pain. Other others feel only a prick or sting. Afterward, there may be some throbbing. When the dye is injected, you may have mild nausea and a warm feeling in your body. These symptoms go away quickly most of the time. The dye will cause your urine to be darker. It may be orange in color for a day or two after the test. Why the Test is Performed This test is done to see if there is proper blood flow in the blood vessels in the two layers in the back of your eye the retina and choroid. It can also be used to diagnose problems in the eye or to determine how well certain eye treatments are working. Normal Results A normal result means the vessels appear a normal size, there are no new abnormal vessels, and there are no blockages or leakages. What Abnormal Results Mean If blockage or leakage is present, the pictures will map the location for possible treatment. An abnormal value on a fluorescein angiography may be due to: Blood flow circulatory problems, such as blockage of the arteries or veins.

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6: Retinal Camera + Fundus Fluorescein Angiography - Non-mydriatic

Fundus Photography and Film Fluorescein Angiography Procedure, and 3) Modified 7-Standard Field/Modified 3-Standard Field Color Fundus Photography and Film Fluorescein Angiography Procedure, and is designed for clinics electing to use a digital capture system instead of film for.

The test does not involve any direct contact with the eyes. Your eyes will be dilated before the procedure. As dye passes through the blood vessels of your eye, photographs are taken to record the blood flow in your retina. The photographs can reveal abnormal blood vessels or damage to the lining underneath the retina. The images will be captured in black and white. The dye will fluoresce in the blood vessels and be recorded as light grey or white in the image. Interpretation of the abnormal angiogram relies on the identification of areas that exhibit hypofluorescence darkness or hyperfluorescence brightness. Fluorescein angiograms are often recommended to follow the course of a disease and to monitor treatment results. It is particularly useful in the management of diabetic retinopathy and macular degeneration. What will you experience? The actual procedure will take minutes. The average length of stay in our department can be hours. Your medical history will be reviewed by a nurse before the test. Some individuals might experience slight nausea during the procedure. The feeling passes within a few seconds. If the dye leaks out of a fragile vein during the injection, some localized burning and yellow staining of the skin may occur. Allergic reactions to the dye are rare. If they occur, they may cause a skin rash and itching. This reaction is treated with antihistamines. Severe allergic reactions are extremely rare. Your pupils will be dilated for the FA. After the pupils are dilated your vision may become blurred. Driving is not recommended when your pupils are dilated. DRINK an extra cups of water before the procedure. AVOID coffee, tea, or caffeinated beverages. BRING your lens case, if you wear contact lenses, as you will need to remove the contacts.

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7: Fluorescein angiography: MedlinePlus Medical Encyclopedia

For nearly 50 years, fundus photography and fluorescein angiography have been valuable in expanding our knowledge of the anatomy, pathology, and pathophysiology of the retina and choroid. 1 Initially, fluorescein angiography was used primarily as a laboratory and clinical research tool; only later was it used for the diagnosis of fundus diseases. An understanding of fluorescein.

Published September 15, Face Off: Fluorescein How do these two principal players measure up in the diagnosis and monitoring of retinal diseases? Ophthalmic practitioners have an arsenal of instruments and procedures available to them to aid in the diagnosis and treatment of ocular pathologies. The principal players in the diagnosis of retinal diseases include intravenous fluorescein angiography IVFA and optical coherence tomography OCT. Although some have suggested that the advancement of OCT technology will render IVFA obsolete, both of these tools have uniquely useful capabilities, allowing each to remain relevant and necessary in the eye care arena. In , the first ocular photos were taken, demonstrating IVFA as a useful tool for assisting in the treatment of ophthalmic disease. A yellow-green barrier filter nm limits the light that is returning to the film plane of the camera to the exclusive wavelength of the excited dye. The light given off by the energized dye leaves the eye and encounters the film plane of the camera through the barrier filter, which only allows the excited yellow-green light to be recorded onto film. For example, in cases where choroidal neovascularization is suspected, the majority of photographs typically are taken at the beginning of the test and with greater rapidity, because these vascular malformations begin to leak profusely in the choroidal flush phase. OCT image depicting macular pucker. In cases of diabetic clinically significant macular edema CSME , the capillary leakage is slow and not apparent until later phases, dictating a strategy of a spread out sequence with tighter frequency in the middle. Cystoid macular edema CME often is not apparent for five to 10 minutes after the start of the test, so these studies are adapted to place emphasis on capturing more photographs of the recirculation phase. The rest remains unbound in the circulation as free fluorescein. The retina has both inner and outer blood-retinal barriers which, when intact, prevent the leakage of blood products. The outer blood-retinal barrier is formed as a result of the tight junctional complexes between adjacent retinal pigmented epithelial RPE cells. Fluorescein flows from the injection site to the heart and then, is pushed into the systemic vascular tree. The time it takes for the dye to reach the eye via this pathway is known as transit time. The dye moves into the eye via the internal carotid system. As the dye moves downstream into the ophthalmic artery, it transitions into the long and short posterior ciliary arteries and into the fenestrated capillary network of the choriocapillaris. The fenestrations allow fluorescein to mingle in the choroid, illuminating the entire vascular watershed. This defines the choroidal flush. The pre-arterial phase in a normal subject begins approximately 10 to 12 seconds post-injection. Increased transit times suggest vascular impediments to efficient blood flow. The dye simultaneously works its way into the central retinal artery and retinal circulation. Here, the arterioles sequentially become filled with fluorescein, while the venules remain unfilled. The arterial phase begins just seconds after the choroidal flush phase, with almost simultaneous filling of the entire arterial tree. The blood flow in contact with the lumen of the vessels is moving more slowly than the blood in the middle of the vessel, secondary to increased friction. As the transition occurs, this causes the blood positioned along the sides of the venules to fluoresceâ€”first creating the pathognomonic appearance of a locomotive track. The vascular property is known as laminar flow. Here, there is complete venous filling with the beginnings of venous drainage from the eye. The venous phase is marked by complete filling of the veins, usually within 30 to 35 seconds of injection. Here, the clinician may observe second and third passes of the dye both into and out of the eye. In this phase, the fluorescence is greater in the venules than the arterioles. Hypofluorescence occurs by one of two mechanisms: Intraretinal bleeding, RPE hyperplasia and hypertrophy, subretinal or choroidal neovascular membranes CNVM that extensively leak blood and serosanguinous fluid into the retina or choroid are among the primary causes of blockage defects. The three main etiologies of hyperfluorescence include: Accumulation of the dye in abnormal spaces. Ocular tissues permitting increased visibility of the dye as seen in defects of the RPE. Leakage is found when there is a breakdown of the blood-retinal barrier. This includes

pathologies that can produce intraretinal microaneurysms, telangiectasia and neovascularization. Fluorescein also can pool in the spaces that are created following sub-RPE or sub-sensory retinal detachment. It also enables the treating surgeon to discover landmarks that help in aiming the laser. Indocyanine Green Angiography While IVFA is most useful in diseases that involve the retina, it is limited in the treatment of hemorrhagic retinal or subretinal disease because a more detailed view of the structures is required for both diagnosis and treatment. Sodium fluorescein is a relatively small molecule whose observation is camouflaged in the presence of intraretinal or preretinal blood and whose properties make it incapable of remaining within the choroidal vasculature. Therefore, many disease entities cannot be discerned to allow the initiation of therapeutic treatment. A study that may augment the treatment of subretinal pathologies is indocyanine green angiography ICGA. Its excitation and emission peak at nm to nm and nm respectively in the near-infrared spectrum, allowing for better penetration of viewing through pigments such as xanthophyll, hemoglobin and melanin. ICG is a well-tolerated, tricarbocyanine dye, with a molecular weight of daltons that absorbs light at nm to nm and has a peak emission at nm. The scanning laser ophthalmoscope SLO and digital capturing systems have mainstreamed image capture, improved image resolution and increased image contrast to provide a system for better visualization of pathology. The use of OCT to obtain noninvasive structural images of ocular structures has been incorporated into diagnostic equipment since the early s. Today, OCT technology is capable of providing real-time, high-resolution images of ocular tissues. Optical tomography utilizes diffraction tomography, diffuse optical tomography and OCT. The depth resolution is not bound by transverse or axial resolution, allowing for advantageous application toward ocular scans inside the limited aperture of the pupil. In addition, OCT also provides a relatively high scanning depth within scattering media. It does so in a contact-free manner. A portion of this light is known as the reference beam. It is directed toward a reference mirror by the beam splitter. The remaining portion of the coherent beam that is directed into the pupil and reflected by the incident ocular tissue is known as the sampling beam. Both the reference beam and the sampling beam return to the beam splitter and are simultaneously reflected, creating the detector beam. The detector beam is captured by a photo detector. The photo detector measures the relative difference in time or change in wavelength between the respective beams. The relative position of the plane of the beam splitter compared to the plane of the ocular tissue can be adjusted to provide a transverse scanning pattern. The distance between the beam splitter and the reference mirror can be adjusted to provide a structural baseline for tomographic data. Then, this raw data is compiled and interpreted with a computer and integrated software to create various dimensional scans of the selected tissue. Individual cells are suspended within an extracellular matrix, comprised of various structural proteins, and are packed within diffuse hydrated gels. These irregularities result in almost constant changes in the reflection, absorption and scattering of the sampling beam as it passes through the ocular tissue. The scanning beams range from nm to nm for optical tomography. Time domain refers to the analysis of time delay between the reference beam and the sampling beam, the photo detector and microprocessor. The Fourier transformation refers to a complex mathematical construct. The axial component of the scan is determined by an inverse Fourier analysis of the spectrum of reflected light from the sampling beam. Multiple focal scans are combined in a transverse fashion to form a two-dimensional cross section. These scans can then be compiled longitudinally to provide an overall scan of the tissue retina or optic nerve. The deck of cards represents the overall OCT scanning data, with each individual card representing an individual OCT image that is then removed from the deck for viewing. Each playing cardâ€”â€”an OCT imageâ€”â€”correlates to a specific plane within the scanned ocular structure. Depending on the resolution and computing capacity of the OCT platform, a 3-D representation of the scanned structure also can be extrapolated from the combination of conventional transverse scans. Individual scanning data may be combined through the use of analytical software to provide a more global representation of a given ocular structure. Depending upon the given OCT platform, various software strategies can be used to provide epidemiological and statistical analysis of selected scan data. A circular scanning pattern will provide a rotating series of scans centered upon a given focal point of interest. The circular scanning pattern often is selected within TD-OCT platforms to increase the likelihood of obtaining an individual scan through a focal area of interest. The relative decrease in spacing between individual transverse scans in the SD-OCT provides

increased resolution, making a linear scan preferred. Thus, the viewer can be assured of the orientation of the individual scan within the given ocular structure. This focal ocular reflectivity is then represented within the cross-sectional OCT image through a correlating artificial color scheme. OCT images can be represented in either color or grayscale. Depending upon resolution and the individual diagnostic purpose of the scan, both color schemes may be independently advantageous. Individual structures that present with this level of reflectivity include the RPE, nerve fiber layer and choriocapillaris. Layers that correlate to more intermediate levels of reflectivity are represented by yellow or light grey, respectively. These include the inner and outer plexiform layers of the retina. Other ocular tissues that present with reduced reflectivity, such as the inner and outer nuclear layer of the retina, are represented by green or dark grey, respectively. In contrast, structures that provide minimal reflectivity, such as the photoreceptor layer, vitreous, serous exudate or blood, normally will be represented by blue or black. By contrast, traditional IVFA can be used for qualitative analysis of retinal vasculature and sensory retinal integrity. The classic IVFA pattern seen secondary to CME is described as a petalloid or honeycomb pattern of hyperfluorescence that increases in size and intensity over the course of the angiographic time frame. These patterns are thought to represent dye leakage and pooling within cystoid spaces between the layers of the retina. In comparative studies of CME between fluorescein angiograms and OCT images, the petalloid hyperfluorescence and cross-sectional OCT images define cystoid spaces within the outer plexiform layer in the vast majority of cases. Interestingly, some of the petalloid angiographic patterns correlated only to diffuse retinal swelling on OCT analysis. Instead, it adds a noninvasive capability for diagnosing and monitoring macular edema. In cases that require treatment, IVFA localizes the landmark positions where the laser should be placed. Here, edema may continue despite appropriately guided focal laser treatment. In cases where edema is being provoked by vitreomacular traction, surgical or pharmacological treatments may provide more efficacious results compared to focal laser treatment alone. These findings indicate that reduced visual acuity is a multifactoral result based on damage or disruption to the retinal architecture, including direct photoreceptor damage rather than reversible intraretinal swelling.

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8: Drushti Eye and Retina Centre|Disease and Treatments| Fundus Fluorescein Angiography

Color and Monochrome Digital Photography and Fundus Fluorescein Angiography of patients Retina. This Ophthalmic Diagnostic Instrument delivers H.Q. imaging & FFA, and comes standard with electric lift table.

Equipment[edit] Exciter filter: Allows only blue light to illuminate the retina. Allows only yellow-green light from the fluorescence to reach the camera. Both filters are interference bandpass filters , which means they block out all light except that at a specific wavelength. Fundus camera , either digital or with camera body containing black and white, or slide positive film. Technique[edit] Baseline color and black and white red-free filtered images are taken prior to injection. The black and white images are filtered red-free a green filter to increase contrast and often gives a better image of the fundus than the color image. A 6-second bolus injection of cc of sodium fluorescein into a vein in the arm or hand. A series of black-and-white or digital photographs are taken of the retina before and after the fluorescein reaches the retinal circulation approximately 10 seconds after injection. The early images allow for the recognition of autofluorescence of the retinal tissues. Photos are taken approximately once every second for about 20 seconds, then less often. A delayed image is obtained at 5 and 10 minutes. Some doctors like to see a minute image as well. The camera may however pick up signals from pseudofluorescence or autofluorescence. In pseudofluorescence, non-fluorescent light is imaged. This occurs when blue light reflected from the retina passes through the filter. This is generally a problem with older filters, and annual replacement of these filters is recommended. In autofluorescence, fluorescence from the eye occurs without injection of the dye. This may be seen with optic nerve head drusen , astrocytic hamartoma , or calcific scarring. Normal circulatory filling[edit] 0 seconds â€” injection of fluorescein 9. The ophthalmic artery supplies the choroid via the short posterior ciliary arteries and the retina via the central retinal artery , however, the route to the choroid is typically less circuitous than the route to the retina. This accounts for the short delay between the "choroidal flush" and retinal filling. Pathologic changes are recognized by the detection of either hyperfluorescence or hypofluorescence.

9: Fluorescein Angiography - EyeWiki

Correlation of optical coherence tomography and fundus fluorescein angiography following photodynamic therapy for choroidal neovascular membranes. Br J Ophthalmol. Mar;90(3)

MANUAL OF FUNDUS FLUORESCEIN ANGIOGRAPHY pdf

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