

- Palareti G, Legnani C, Guazzaloca G, et al. Activation of blood coagulation after abrupt or stepwise withdrawal of oral anticoagulants: a prospective study. *Thromb Haemost* 1994; 72:222–226.
- Genewin U, Haerberli A, Straub PW, et al. Rebound after cessation of oral anticoagulant therapy: the biochemical evidence. *Br J Haematol* 1996;92:479–485.

Evaluation of Patient Age as a Risk Factor for Intraocular Pressure Elevation After Intravitreal Triamcinolone

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PURPOSE: To evaluate the effect of patient age on intraocular pressure (IOP) response after intravitreal injection of triamcinolone acetonide (IVTA).

DESIGN: Interventional case series.

METHODS: A total of 164 outpatients (164 eyes) aged 21 to 80 years (mean, 56.8 years), presenting with exudative age-related maculopathy (51) or macular edema of various etiologies (113), received IVTA (4 mg/0.1 ml). The primary outcome measure was IOP elevation >21 mm Hg. Patients were re-evaluated at one week, and one, three, and six months.

RESULTS: The mean baseline IOP was 15.07 mm Hg; the mean rise was 6.6 mm Hg. IOP >21 mm Hg was

observed in 42 (25.6%) patients. In the age group ≤45 years, IOP rise occurred in 45% (14/31) patients, compared with 21% (28/133) of older patients ($P = .006$). The groups were similar in baseline IOP, IOP rise, mean time-lag to maximum IOP, and response to treatment. **CONCLUSIONS:** IVTA caused more frequent IOP elevation in younger patients; other aspects of IOP response and its treatment were similar to older patients. (*Am J Ophthalmol* 2007;144:453–454. © 2007 by Elsevier Inc. All rights reserved.)

SEVERAL STUDIES HAVE EVALUATED THE RISK FACTORS for raised intraocular pressure (IOP) after intravitreal injection of triamcinolone acetonide (IVTA).^{1,2–4} Some of them claimed that younger patients were more likely to develop such a pressure response.^{3,4} We evaluated the effect of IVTA on IOP, specifically looking at age as a risk factor.

This prospective interventional study enrolled 164 consecutive patients (164 eyes) with exudative age-related macular degeneration ($n=51$; 31%) and macular edema from diabetic retinopathy ($n=60$; 37%), retinal vein occlusion ($n=41$; 25%), or other causes ($n=12$; 7%). Patients with primary/secondary open-angle glaucoma or ocular hypertension, or previous IVTA injections were excluded from the study. All patients signed an informed consent. Triamcinolone acetonide (Tricort40, Cadila, Ahmedabad) 4 mg/0.1 ml was injected intravitreally under sterile precautions. Reevaluations were scheduled at one week, and at one, three, and six months. If IOP exceeded 21 mm Hg, topical anti-glaucoma medications were started. The primary outcome measure was IOP response to intravitreal triamcinolone. The study population was stratified into four arbitrary age groups (≤45, 46 to 55, 56 to 65, and ≥66 years). Statistical analysis was performed using STATA 7.0 software (College Station, Texas, USA).

Mean age of the patients was 56.83 (range, 21 to 82) years; 62 were women. The mean baseline IOP was 15.07 mm Hg; mean rise in the IOP was 6.58 (range, eight to 54)

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TABLE. Age-wise Intraocular Pressure Profile in Patients Receiving Intravitreal Triamcinolone Injection

Age Group in Years	Number of Patients	Incidence of IOP >21 mm Hg n (%)	Mean Initial IOP in mm Hg (95%CI)	Mean P _{max} in mm Hg (95%CI)	Percent IOP Rise (95%CI)	Time in Months to Reach P _{max} (95%CI)
≤45	31	14 (45)	15.68 ± 3.09 (14.55–16.81)	24.76 ± 9.85 (21.15–28.37)	66.19 ± 70.18 (40.45–91.93)	2.45 ± 1.82 (1.78–3.12)
46–55	42	11 (26)	15.90 ± 2.60 (15.09–16.71)	22.12 ± 11.13 (18.65–25.59)	46.32 ± 58.01 (28.24–64.40)	2.81 ± 1.81 (2.25–3.37)
56–65	47	14 (30)	15.38 ± 2.96 (14.51–16.25)	22.98 ± 11.63 (19.57–26.39)	55.04 ± 61.90 (36.87–73.21)	2.55 ± 1.73 (2.04–3.06)
≥66	44	3 (7)	13.52 ± 2.75 (12.68–14.36)	17.61 ± 3.76 (16.47–18.75)	36.41 ± 34.76 (25.84–46.98)	2.23 ± 1.75 (1.70–2.76)

IOP = intraocular pressure; P_{max} = maximum IOP recorded during the follow-up; CI = confidence intervals.

mm Hg. Postinjection IOP >21 mm Hg was observed in 42 (25.6%) patients. Mean time of IOP rise was 2.60 (median 3; range, one to six) months. The proportion of patients with increased IOP (14/31) in age group ≤45 years was more than that (28/133) among patients >45 years ($P = .006$) (Table). Linear regression analysis demonstrated an increase of 0.1 mm Hg in post-IVTA IOP for every year of decrease in patient's age ($P = .040$), after adjusting for baseline IOP and indications for IVTA. The mean maximum IOP was also higher in the group ≤45 years as compared with the older group (24.76 vs 20.93 mm Hg; $P = .05$). The mean time to reach the maximum IOP and the percent IOP rise were similar between the two groups (P values 0.641 and 0.07, respectively). Response to antiglaucoma pharmacotherapy was also similar in patients ≤45 and >45 years of age ($P = .381$).

The mean age of the patients in large-scale studies on post-IVTA IOP ranged from 70 to 77 years.^{1-3,6} The incidence of IOP elevation varied widely (10% to 53%) because of the variability in definition of IOP elevation, frequency/technique of IOP measurements, length of follow-up, drug dose, and selection criteria. Jonas and associates implicated younger patient age as a risk factor; but did not actually evaluate young patients (mean age, 70 to 74 years) to draw this conclusion.^{3,4} Notwithstanding the scarce data on post-IVTA IOP profile in younger age groups, multicenter trials on IVTA are recruiting patients ≥18 years of age.⁵

Unlike us, most authors do not consider ocular hypertension, history of steroid-induced glaucoma, or medically controlled open-angle glaucoma as contraindications for IVTA, though these conditions predispose to greater IOP spikes and optic nerve damage.^{1-4,6} Repeated steroid injections, employed in many of these studies, further enhance the risk for IOP rise.⁶ We therefore restricted ourselves to a single injection of IVTA.

The study had certain limitations. The number of young patients (≤45 years) was too small to definitively comment on their pressure response. The postoperative IOP profile in various age groups was assessed at the same endpoint (six months) for consistency in comparison. Because of this time confinement, we might have missed the late IOP spikes. Further, we did not recruit patients according to preset age groups, though we achieved balanced groups when dividing the enrolled patients age-wise.

Corticosteroids induce ocular hypertension by increased outflow resistance, through structural changes in the trabecular meshwork, reduced endothelial phagocytosis, and increased extracellular matrix deposition.⁷ Innately higher endogenous cortisol levels probably make younger patients more vulnerable to these effects of exogenous steroids. Our study found that the main concern while injecting younger patients with IVTA is a greater frequency of IOP elevation; the severity of this complication and its response to treatment remain similar to that in the older patients.

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and conduct of study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. This study was approved by the institutional review board.

REFERENCES

1. Thompson JT. Cataract formation and other complications of intravitreal triamcinolone for macular edema. *Am J Ophthalmol* 2006;141:629-637.
2. Smithen LM, Ober MD, Maranan L, et al. Intravitreal triamcinolone acetonide and intraocular pressure. *Am J Ophthalmol* 2004;138:740-743.
3. Jonas JB, Degenring RF, Kreissig I, et al. Intraocular pressure elevation after intravitreal triamcinolone acetonide injection. *Ophthalmology* 2005;112:593-598.
4. Jonas JB, Kreissig I, Degenring RF. Intraocular pressure after intravitreal injection of triamcinolone acetonide. *Br J Ophthalmol* 2003;87:24-27.
5. National Eye Institute. Clinical studies database. The standard care vs corticosteroid for retinal vein occlusion (SCORE) study: two randomized trials to compare the efficacy and safety of intravitreal injection(s) of triamcinolone acetonide with standard care to treat macular edema. Available at: <http://www.nei.nih.gov/neitrials/viewStudyWeb.aspx?id=99>. Accessed Date: September 2, 2006.
6. Rhee DJ, Peck RE, Belmont J, et al. Intraocular pressure alterations following intravitreal triamcinolone acetonide. *Br J Ophthalmol* 2006;90:999-1003.
7. Kersey JP, Broadway DC. Corticosteroid-induced glaucoma: a review of the literature. *Eye* 2006;20:407-416.

The Risk of Endophthalmitis Following Intravitreal Triamcinolone Injection in the DRCRnet and SCORE Clinical Trials

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PURPOSE: To report the incidence of endophthalmitis following intravitreal injection using a standardized injection procedure.

DESIGN: Two randomized clinical trials.

METHODS: Nonpreserved intravitreal triamcinolone acetonide in prefilled syringes (Allergan, Inc, Irvine, California, USA) was injected intravitreally in the Diabetic Retinopathy Clinical Research Network (DRCRnet) and the Standard Care vs Corticosteroid for Retinal Vein Occlusion (SCORE) clinical trials. The standardized injection procedure did not include the use of topical antibiotics during the days prior to the injection.

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