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MD Research News

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This free weekly bulletin lists the latest published research articles on macular degeneration (MD) as indexed in the NCBI, PubMed (Medline) and Entrez (GenBank) databases. These articles were identified by a search using the key term “macular degeneration”.

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Drug treatment

Br J Ophthalmol. 2013 Jul 13. doi: 10.1136/bjophthalmol-2013-303232. [Epub ahead of print]

Safety of ranibizumab in routine clinical practice: 1-year retrospective pooled analysis of four European neovascular AMD registries within the LUMINOUS programme.

Holz FG, Bandello F, Gillies M, Mitchell P, Osborne A, Sheidow T, Souied E, Figueroa MS; on behalf of the LUMINOUS Steering Committee.

Collaborators (13)

Department of Ophthalmology, University of Bonn, Bonn, Germany.

PURPOSE: Evaluation of 1-year safety profile of intravitreal ranibizumab 0.5 mg in neovascular age-related macular degeneration (NV-AMD) within routine clinical practice.

METHODS: The LUMINOUS programme comprises a prospective observational study assessing ranibizumab 'real-world' safety and clinical effectiveness across licensed indications worldwide and an annual retrospective pooled safety analysis from completed NV-AMD ranibizumab registries. 1-year data from four European registries are available. This retrospective pooled safety analysis assessed 1-year incidence rates for safety events of particular interest (key ocular or systemic events possibly related to the injection procedure or vascular endothelial growth factor inhibition) together with treatment exposure. Patients were treated according to local protocols within the ranibizumab licence.

RESULTS: Data of 4444 patients from registries in Germany (n=3470), the Netherlands (n=243), Belgium (n=260) and Sweden (n=471) were retrospectively pooled. Between 70.4% and 84.4% of enrolled patients completed 1 year of follow-up. Most frequent overall ocular events of particular interest were retinal pigment epithelial tears (27 patients; <1%) and intraocular pressure-related events (12 patients; <0.3%). Most frequent non-ocular event of particular interest was stroke (19 patients; 0.4%); annual incidence of stroke was low across all registries (0.0-0.5%).

CONCLUSIONS: Ranibizumab demonstrated favourable 1-year safety profile for NV-AMD in this routine clinical practice sample, consistent with previous reported trial data. Additional data from a larger patient population are needed to better describe the long-term safety profile of ranibizumab in routine clinical practice and further evaluate risk for infrequent but serious events in 'real-life' settings. The 5-year LUMINOUS prospective observational study will address this need.

PMID: 23850682 [PubMed - as supplied by publisher]

Graefes Arch Clin Exp Ophthalmol. 2013 Jul 18. [Epub ahead of print]

Reduction in choroidal thickness of macular area in polypoidal choroidal vasculopathy patients after intravitreal ranibizumab therapy.

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BACKGROUND:To evaluate changes in retinal and choroidal thickness changes after three intravitreal ranibizumab (IVR) injections for polypoidal choroidal vasculopathy (PCV) using enhanced depth-imaging-optical coherence tomography (EDI-OCT).

METHODS:In this retrospective, observational case series, EDI-OCT was used to measure changes in choroidal thickness at nine points in a lattice shape in the macula before and after introductory-stage IVR.

RESULTS:Choroidal thickness was decreased at all nine points in the lattice shape, but was significantly decreased only at the fovea.

CONCLUSION:The subfoveal choroidal thickness may be reduced by introductory-stage IVR in patients with PCV. In particular, choroidal thickness at the fovea was reduced during the early stage of treatment.

PMID: 23864437 [PubMed - as supplied by publisher]

Retina. 2013 Jul 11. [Epub ahead of print]

INTRAVITREAL RANIBIZUMAB FOR CHOROIDAL NEOVASCULARIZATION WITH LARGE SUBMACULAR HEMORRHAGE IN AGE-RELATED MACULAR DEGENERATION.

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PURPOSE: To evaluate the effects of intravitreal ranibizumab injections in the treatment of choroidal neovascularization with large submacular hemorrhage secondary to age-related macular degeneration.

METHODS: Prospective interventional case series. Patients presenting occult choroidal neovascularization with flat large submacular hemorrhage >50% of the entire lesion were considered. The protocol required 3 monthly consecutive injections, followed by repeat injections over the 12-month follow-up on the basis of optical coherence tomography parameters and angiographic features.

RESULTS: Twenty-three patients were enrolled in the study and prospectively followed up. Mean best-corrected visual acuity and mean central macular thickness at the baseline were 0.82 ± 0.22 (logarithm of the minimum angle of resolution ± standard deviation) and 342 ± 56 μm, respectively. At 12-month examination, mean visual acuity improved significantly to 0.68 ± 0.41 ($P = 0.04$), and mean central macular thickness decreased to 236 ± 26 μm ($P < 0.0001$). A progressive resolution of macular bleeding was registered in 22 of 23 patients. No side effect or complication was registered.

CONCLUSION: Intravitreal ranibizumab can be considered a beneficial approach for the management of choroidal neovascularization with flat large submacular hemorrhage secondary to age-related macular degeneration.

PMID: 23851632 [PubMed - as supplied by publisher]

J Ocul Pharmacol Ther. 2013 Jul 13. [Epub ahead of print]

Comparison of the Effect of Unilateral Intravitreal Bevacizumab and Ranibizumab Injection on Diabetic Macular Edema of the Fellow Eye.

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Abstract Purpose: To find out whether intravitreally administered bevacizumab and ranibizumab affect the contralateral, untreated, eyes of patients with bilateral diabetic macular edema (DME).

Methods: A retrospective review of patients with bilateral DME, who were treated with intravitreal bevacizumab or ranibizumab, was performed. All enrolled patients received intravitreal 1.25 mg bevacizumab or 0.5 mg ranibizumab in the eye with more severe macular edema. As outcome measures, best-corrected visual acuity (BCVA) was assessed with the Early Treatment Diabetic Retinopathy Study chart and central foveal thickness (CFT) measurement was obtained using optical coherence tomography-3 before and at 2 and 4 weeks after injections.

Results: The study included 55 eyes of 55 patients who received bevacizumab (group 1) and 32 eyes of 32 patients who received ranibizumab (group 2). The mean age of the 55 patients [35 female (63.6%), 20 male (36.4%)] in group 1 was 54.31±12.67 years, and the mean age of the 32 patients [20 female (62.5%), 12 male (37.5%)] in group 2 was 56.01±13.29 years. The median BCVA in the uninjected eye showed no statistically significant change at any visit after either bevacizumab or ranibizumab injection (P=0.302, P=0.582, respectively). In group 1, the median CFT in the uninjected eye was 417 µm at baseline; this was reduced to 401 µm at 2 weeks and 372 µm at 4 weeks. The change in CFT was found to be statistically significant (P=0.009). No statistically significant change was found in the median CFT of uninjected eyes of patients treated with ranibizumab (399, 403, and 407 µm before and at 2 and 4 weeks after treatment, respectively).

Conclusions: Compared with ranibizumab, intravitreal administration of bevacizumab resulted in a greater decrease in macular thickness in the untreated eye, in patients with bilateral DME.

PMID: 23848950 [PubMed - as supplied by publisher]

Graefes Arch Clin Exp Ophthalmol. 2013 Jul 17. [Epub ahead of print]

Patient preference of ranibizumab treatment regimen for neovascular age-related macular degeneration - monthly injections versus pro re nata.

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PURPOSE:To identify preference of treatment regimen in patients with anti-VEGF therapy for neovascular age-related macular degeneration (AMD) in real life.

METHODS:A cross-sectional study was conducted in 200 patients receiving ranibizumab therapy on a pro re nata regimen with monthly controls. One hundred and twenty-four patients were recruited in a tertiary health care clinic, and 76 patients were recruited in a private practice. Patients were asked to respond to a 14-item questionnaire covering items such as treatment burden and preference for treatment: either monthly injections or pro re nata.

RESULTS:Mean time under anti-VEGF treatment was 33.7 months, and the mean number of intravitreal injections was 17.7. Despite a high treatment burden in 60.3 % of patients, there was an acceptance rate for monthly examinations or injections of 93 %. The proportion of patients who favoured a PRN regimen

was 53.0 %, whereas 37.9 % of patients favoured continuous injections. Major concern was recurrent disease activity in 54.5 %.

CONCLUSION:We identified two groups of patients of considerable size who would prefer either monthly injections or as-required. Overall, there was a high acceptance rate despite a high treatment burden. Nevertheless, efforts should be undertaken to improve examination and injection procedures and to consider the patient's preference for a treatment regimen.

PMID: 23860798 [PubMed - as supplied by publisher]

Jpn J Ophthalmol. 2013 Jul 17. [Epub ahead of print]

Maintenance therapy with pegaptanib sodium for neovascular age-related macular degeneration: an exploratory study in Japanese patients (LEVEL-J study).

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PURPOSE:To explore the efficacy and safety of pegaptanib sodium as maintenance therapy in Japanese patients with neovascular, age-related macular degeneration (AMD) after induction therapy (LEVEL-J study).

METHODS:A multi-center, prospective study was conducted at 21 medical institutions between 2009 and 2011. Of Japanese neovascular AMD patients with choroidal neovascularization who showed improvement in visual acuity (VA) with induction therapy, those who were scheduled for intravitreal injections of pegaptanib as maintenance therapy were recruited. LogMAR VA was assessed. Booster treatment (unscheduled treatment with other agents) was allowed during the study period if symptoms were judged to have worsened. Safety was assessed by monitoring adverse events and intraocular pressure (IOP).

RESULTS:Of 75 patients included in the analysis, 80 % completed the 54-week study period. Their mean age was 74.7 ± 6.9 years, and 54 patients (72.0 %) were men. The mean number of pegaptanib injections was 5.7 ± 2.6. Booster treatment was not required in 40 eyes (53.3 %). Mean logMAR VA was 0.61 ± 0.31 before induction therapy, 0.26 ± 0.24 before maintenance therapy, and 0.29 ± 0.28 at 54 weeks. No notable change in VA was observed during maintenance therapy. Adverse events were reported in 4 patients (5.3 %), including increased intraocular pressure, cancer, gallstones and recurrence of breast cancer, but mean IOP remained stable during maintenance therapy.

CONCLUSIONS:The results of this exploratory study suggest that maintenance therapy with pegaptanib is potentially an effective and well-tolerated option in Japanese patients with neovascular AMD in whom induction therapy has been successful.

PMID: 23860781 [PubMed - as supplied by publisher]

Clin Ophthalmol. 2013;7:1357-62. doi: 10.2147/OPTH.S44109. Epub 2013 Jul 5.

Twelve months of follow-up after intravitreal injection of ranibizumab for the treatment of idiopathic parafoveal telangiectasia.

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AIMS: To report the anatomic and functional outcomes of intravitreal ranibizumab in idiopathic parafoveal

telangiectasia (IPT).

MATERIAL AND METHODS: Four eyes of three patients were included in this interventional case series. One patient (two eyes) had bilateral IPT (type 2) and two patients (two eyes) had unilateral (type 1) IPT. Retreatment was scheduled in case of leakage persistence in combination with visual acuity (VA) deterioration. Fluorescein angiography and optical coherence tomography were performed together with a full ophthalmic examination at baseline, 1, 3, 6, 9, and 12 months after injection.

RESULTS: One intravitreal injection of ranibizumab was performed in all four eyes. Complete cessation of leakage was documented postintervention in three eyes and partial cessation in one eye, followed by improvement of best corrected VA in one of them. In all eyes, structural changes of the photoreceptor layer were detected in tomography and were responsible for visual loss, which was in most cases, refractory to the applied therapy.

CONCLUSION: Use of ranibizumab might be efficient in eliminating leakage activity in the macular region in patients with IPT. Nevertheless, improvement in VA was infrequent. Preexisting early photoreceptor alteration in IPT might render such patients unable to improve VA.

PMID: 23861579 [PubMed]

Int J Mol Med. 2013 Jul 16. doi: 10.3892/ijmm.2013.1444. [Epub ahead of print]

Therapeutics targeting angiogenesis: Genetics and epigenetics, extracellular miRNAs and signaling networks (Review).

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Abstract: Angiogenesis is a process of neovascular formation from pre-existing blood vessels, which consists of sequential steps for vascular destabilization, angiogenic sprouting, lumen formation and vascular stabilization. Vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF), angiopoietin, Notch, transforming growth factor-β (TGF-β), Hedgehog and WNT signaling cascades orchestrate angiogenesis through the direct or indirect regulation of quiescence, migration and the proliferation of endothelial cells. Small-molecule compounds and human/humanized monoclonal antibodies interrupting VEGF signaling have been developed as anti-angiogenic therapeutics for cancer and neovascular age-related macular degeneration (AMD). Gene or protein therapy delivering VEGF, FGF2 or FGF4, as well as cell therapy using endothelial progenitor cells (EPCs), mesenchymal stem cells (MSCs) or induced pluripotent stem cells (iPSCs) have been developed as pro-angiogenic therapeutics for ischemic heart disease and peripheral vascular disease. Anti-angiogenic therapy for cancer and neovascular AMD is more successful than pro-angiogenic therapy for cardiovascular diseases, as VEGF-signal interruption is technically feasible compared with vascular re-construction. Common and rare genetic variants are detected using array-based technology and personal genome sequencing, respectively. Drug and dosage should be determined based on personal genotypes of VEGF and other genes involved in angiogenesis. As epigenetic alterations give rise to human diseases, polymer-based hydrogel film may be utilized for the delivery of drugs targeting epigenetic processes and angiogenesis as treatment modalities for cardiovascular diseases. Circulating microRNAs (miRNAs) in exosomes and microvesicles are applied as functional biomarkers for diagnostics and prognostics, while synthetic miRNAs in polymer-based nanoparticles are applicable for therapeutics. A more profound understanding of the spatio-temporal interactions of regulatory signaling cascades and advances in personal genotyping and miRNA profiling are required for the optimization of targeted therapy.

PMID: 23863927 [PubMed - as supplied by publisher]

Biomaterials. 2013 Jul 10. pii: S0142-9612(13)00759-X. doi: 10.1016/j.biomaterials.2013.06.044. [Epub ahead of print]

Long-term suppression of ocular neovascularization by intraocular injection of biodegradable polymeric particles containing a serpin-derived peptide.

Shmueli RB, Ohnaka M, Miki A, Pandey NB, Lima E Silva R, Koskimaki JE, Kim J, Popel AS, Campochiaro PA, Green JJ.

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Abstract: Aberrant angiogenesis can cause or contribute to a number of diseases such as neovascular age-related macular degeneration (NVAMD). While current NVAMD treatments target angiogenesis, these treatments are not effective for all patients and also require frequent intravitreal injections. New agents and delivery systems to treat NVAMD could be beneficial to many patients. We have recently developed a serpin-derived peptide as an anti-angiogenic agent. Here, this peptide is investigated for activity in human retinal endothelial cells in vitro and for reducing angiogenesis in a laser-induced choroidal neovascularization mouse model of NVAMD in vivo. While frequent intravitreal injections can be tolerated clinically, reducing the number of injections can improve patient compliance, safety, and outcomes. To achieve this goal, and to maximize the in vivo activity of injected peptide, we have developed biodegradable polymers and controlled release particle formulations to extend anti-angiogenic therapy. To create these devices, the anionic peptides are first self-assembled into nanoparticles using a biodegradable cationic polymer and then as a second step, these nanoparticles are encapsulated into biodegradable poly(lactic-co-glycolic acid) (PLGA) microparticles. In situ, these particles show approximately zero-order, linear release of the anionic peptide over 200 days. These particles are made of safe, hydrolytically degradable polymers and have low endotoxin. Long-term in vivo experiments in the laser-induced neovascularization model for NVAMD show that these peptide-releasing particles decrease angiogenesis for at least fourteen weeks in vivo following a single particle dose and therefore are a promising treatment strategy for NVAMD.

PMID: 23849876 [PubMed - as supplied by publisher]

Other treatment & diagnosis

DNA Cell Biol. 2013 Jul 13. [Epub ahead of print]

Predictive Model for Earlier Diagnosis of Suspected Age-Related Macular Degeneration Patients.

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Abstract: The primary goal of tailored medicine is to presymptomatically identify individuals at high risk for disease using information of each individual's genetic profile and collection of environmental risk factors. Recently, algorithms were given the strong recognition of several replicated risk factors for age-related macular degeneration (AMD), this distant goal is beginning to seem less mysterious. The purpose of the study was to develop a statistical model for AMD. This study includes total 106 subjects. To identify the risk of earlier diagnosis of suspected AMD patients, 22 independent variables were included in the study. Forward stepwise (likelihood ratio) binary logistic regression has been used to find significant variables associated with the risk of AMD. Prediction equation, based on significant risk factors, and model authenticity have been developed. Hosmer-Lemeshow goodness of fit statistic ($\chi 2$=0.143, df=8, p=1.0), which is nonsignificant, indicates the appropriateness of the logistic regression model to predict AMD. After going through stepwise logistic regression, only 6 variables out of the 22 independent variables, namely, serum complement factor H (CFH), serum chemokine (C-C motif) ligand 2 (CCL2), serum superoxide

dismutase 1 (SOD1), polymorphism in CCL2 (rs4586), stress, and comorbidity were found to be significant ($p<0.05$). The binary logistic regression model is an appropriate tool to predict AMD in the presence of serum CFH, serum CCL2, serum SOD1, polymorphism in CCL2 (rs4586), stress, and comorbidity with high specificity and sensitivity. The area under the receiver operating characteristic curve (0.909, $p=0.001$) with less standard error of 0.034 and close 95% confidence intervals (0.842-0.976) further validates the model.

PMID: 23848218 [PubMed - as supplied by publisher]

Doc Ophthalmol. 2013 Jul 17. [Epub ahead of print]

The effect of pre-adapting light intensity on dark adaptation in early age-related macular degeneration.

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BACKGROUND: This study aimed to identify the pre-adapting light intensity that generated the maximum separation in the parameters of dark adaptation between participants with early age-related macular degeneration (AMD) and healthy control participants in the minimum recording time.

METHODS: Cone dark adaptation was monitored in 10 participants with early AMD and 10 age-matched controls after exposure to three pre-adapting light intensities, using an achromatic annulus (12° radius) centred on the fovea. Threshold recovery data were modelled, and the time constant of cone recovery (τ), final cone threshold, and time to rod-cone-break (RCB) were determined. The diagnostic potential of these parameters at all pre-adapting intensities was evaluated by constructing receiver operating characteristic (ROC) curves.

RESULTS: There were significant differences between those with early AMD and healthy controls in cone τ and time to RCB ($p < 0.05$) at all pre-adapting 'bleaching' intensities. ROC curves showed that the diagnostic potential of dark adaptometry was high following exposure to all three pre-adapting intensities, generating an area under the curve in excess of 0.87 ± 0.08 for cone τ and time to RCB for all conditions.

CONCLUSIONS: Dark adaptation was shown to be highly diagnostic for early AMD across a range of pre-adapting light intensities, and therefore, the lower pre-adapting intensities evaluated in this study may be used to expedite dark adaptation measurement in the clinic without compromising the integrity of the data obtained. This study reinforces the suggestion that cone and rod dark adaptation are good candidate biomarkers for early AMD.

PMID: 23860602 [PubMed - as supplied by publisher]

Invest Ophthalmol Vis Sci. 2013 Jul 16. pii: iovs.13-12037v1. doi: 10.1167/iovs.13-12037. [Epub ahead of print]

Handheld Shape Discrimination Hyperacuity Test on a Mobile Device for Remote Monitoring of Visual Function in Maculopathy.

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PURPOSE: Frequency monitoring of age-related macular degeneration (AMD) and diabetic retinopathy (DR) is crucial for timely intervention. This study evaluated a handheld shape discrimination hyperacuity

(hSDH) test iPhone app designed for visual function self-monitoring in patients with AMD and DR.

METHODS: 100 subjects (27 normal, 37 AMD, 36 DR) were included based on clinical documentation and visual acuity (VA) 20/100 or better. The hSDH test was implemented on the iOS platform. A cross-sectional study was conducted to compare the hSDH test with a previously established desktop SDH (dSDH) test and to assess the effect of disease severity on hSDH. A user survey was also conducted to assess the usability of hSDH test on the mobile device.

RESULTS: The hSDH and dSDH were highly correlated ($r=0.88$, $p<0.0001$). Bland-Altman analysis indicated no significant difference in hSDH and dSDH measurements. One-way ANOVA indicated that the mean hSDH of the eyes with advanced AMD (n=16) or with severe non-proliferative DR (NPDR) (n=12) was significantly worse than that of the eyes with intermediate AMD (n=11) or with mild-to-moderate NPDR (n=11), respectively ($p<0.0001$). 98% of 46 patients (10 AMD and 36 DR) who completed the usability survey reported hSDH was easy to use.

CONCLUSIONS: This study demonstrated that hSDH test on a mobile device is comparable to PC-based testing method. As a mobile app, it is intuitive to use, readily accessible, and sensitive to the severity of maculopathy. It has the potential to provide patients with maculopathy a new tool to monitor their vision at home.

PMID: 23860761 [PubMed - as supplied by publisher]

Pathogenesis

Biochim Biophys Acta. 2013 Jul 10. pii: S0167-4889(13)00251-6. doi: 10.1016/j.bbamcr.2013.06.028. [Epub ahead of print]

ER stress-induced cell death mechanisms.

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Abstract: The endoplasmic-reticulum (ER) stress response constitutes a cellular process that is triggered by a variety of conditions that disturb folding of proteins in the ER. Eukaryotic cells have developed an evolutionarily conserved adaptive mechanism, the unfolded protein response (UPR), which aims to clear unfolded proteins and restore ER homeostasis. In cases where ER stress cannot be reversed, cellular functions deteriorate, often leading to cell death. Accumulating evidence implicates ER stress-induced cellular dysfunction and cell death as major contributors to many diseases, making modulators of ER stress pathways potentially attractive targets for therapeutics discovery. Here, we summarize recent advances in understanding the diversity of molecular mechanisms that govern ER stress signaling in health and disease. This article is part of a Special Issue entitled: Cell Death Pathways.

PMID: 23850759 [PubMed - as supplied by publisher]

Methods Mol Biol. 2013;1040:137-52. doi: 10.1007/978-1-62703-523-1_11.

Reconstituting the NLRP1 Inflammasome In Vitro.

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Abstract: Nucleotide-binding domain leucine-rich-repeat containing receptors; NOD-Like Receptors (NLRs) were originally described as microbial sensors involved in host defense against pathogens that comprise an

important component of the innate immune system. Recently, their cellular functions have expanded beyond classical pathogen detection, to danger sensors that may contribute to the pathophysiology of a wide range of inflammation-driven human illnesses such as metabolic diseases (atherosclerosis, obesity, type 2 diabetes, gout, age-related macular degeneration) and neurological disorders (Alzheimer's disease). Pathogen-stimulated NLRs such as NLR family Pyrin domain-containing protein 1 (NLRP1) assemble into molecular platforms called "inflammasomes" to activate inflammatory protease caspase-1, which processes pro-IL-1β and pro-IL-18 into active cytokines. We describe methods for reconstituting the human NLRP1 inflammasome in vitro. Protocols are provided for: (a) expression and purification of inflammasome core components (NLRP1 and pro-caspase-1 proteins) using the baculovirus/insect cell expression system, and (b) functional monitoring of NLRP1-mediated caspase-1 activation in response to NLRP1 ligand muramyl dipeptide (MDP) and ATP.

PMID: 23852602 [PubMed - in process]

Diet

Cutan Ocul Toxicol. 2013 Jul 18. [Epub ahead of print]

Lutein protects retinal pigment epithelium from cytotoxic oxidative stress.

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Abstract Context: Lutein (LUT) and zeaxanthin (ZEA) are currently under investigation in clinical trials as prophylactic nutritional agents for age-related macular degeneration (AMD). However, dose used in these trials is empirical and not been investigated in in vitro studies.

Objective: In this study, we investigated the dose-response effect of LUT and ZEA in protecting retinal pigment epithelium (RPE) from oxidative stress, a common underlying pathology in AMD. Methods: Three thousand cultured human retinal pigment epithelial cells (ARPE-19) were plated in 72-well plate and after 24 h were exposed to increasing concentrations of hydrogen peroxide (H2O2). ARPE-19 cells were exposed to four different concentrations of LUT (0.5, 1, 2 and 4 μg/mL) and ZEA (0.1, 0.2, 0.4 and 0.8 μg/mL). After 24 h incubation, cells were subjected to oxidative stress induced with H2O2. Cultures containing saline solution and dichloromethane served as controls. Cell viability was assessed using the WST-1 assay. Pathophysiological pathways were evaluated by measuring caspase-3 levels as an indicator of apoptosis induction. Reactive oxygen species (ROS) levels were measured using dihydrorhodamine-123.

Results: Cell viability as a percentage of control was 81.3%, 81.1%, and 88.8% at 0.5, 1, and 2 μg/ml, respectively of LUT ($p < 0.001$). The maximum cytoprotective effect was seen with LUT at 2 μg/mL. ZEA did not show any cytoprotective effect at all concentrations used in the study. Caspase-3 showed a corresponding decrease in levels with LUT (1 and 2 μg/ml). Significant decrease in ROS levels were measured only with LUT at 4 μg/ml ($p = 0.02$).

Discussion and conclusions: Results from our study provide in vitro data to support the epidemiologic studies, which are currently underway to provide evidence that lutein may act as cofactor that modulates processes implicated in AMD pathogenesis.

PMID: 23862688 [PubMed - as supplied by publisher]