



Recent References (2010-Present) on the Administration of Vascular Endothelial Growth Factor  
Using ALZET® Osmotic Pumps

**Q8486:** O. Gawrys, *et al.* Polyprenol-Based Lipofecting Agents for In Vivo Delivery of Therapeutic DNA to Treat Hypertensive Rats. *Biochemical Genetics* 2021;59(1):62-82

**Agents:** vascular endothelial growth factor, DNA **Vehicle:** Glucose; **Route:** CSF/CNS (medula); **Species:** Rat; **Pump:** 2001; **Duration:** 1 week;

**ALZET Comments:** 5% glucose used; Controls received mp w/ vehicle; animal info (Male, adult spontaneously hypertensive rats, 16 weeks old, 299 +- 4); Blood pressure measured via telemetry transmitters; vascular endothelial growth factor aka VEGF-A; ALZET brain infusion kit 2 used; gene therapy;

**Q7573:** R. Lin, *et al.* Systemic Factors Trigger Vasculature Cells to Drive Notch Signaling and Neurogenesis in Neural Stem Cells in the Adult Brain. *Stem Cells* 2019;37(3):395-406

**Agents:** Biotin, recombinant vascular endothelial growth factor 165 **Vehicle:** Saline; **Route:** IV (Femoral); **Species:** Mice; **Pump:** Not Stated; **Duration:** 3 days;

**ALZET Comments:** Dose (1 mg/kg); Controls received mp w/ vehicle; animal info (9-week old CD-1 mice);

**Q6971:** Y. S. Hu, *et al.* Self-assembling vascular endothelial growth factor nanoparticles improve function in spinocerebellar ataxia type 1. *Brain* 2019;142(2):312-321

**Agents:** Vascular endothelial growth factor, mouse recomb.; Vascular endothelial growth factor, synthetic peptide (Nano-VEGF) **Vehicle:** CSF, artificial; **Route:** CSF/CNS (right lateral ventricle); **Species:** Mice; **Pump:** 1002; **Duration:** 2 weeks;

**ALZET Comments:** animal info (8-10, and 24 week-old mice); behavioral testing (rotating rod assay); Brain coordinates (A/P -0.5mm, M/L -1.1mm, D/V -2.5mm);

**Q7841:** Z. H. Dailiana, *et al.* Vascular endothelial growth factor for the treatment of femoral head osteonecrosis: An experimental study in canines. *World J Orthop* 2018;9(9):120-129

**Agents:** Vascular Endothelial Growth Factor **Vehicle:** Saline; **Route:** SC; **Species:** Dog; **Pump:** Not Stated; **Duration:** Duration;

**ALZET Comments:** Dose (500 ng); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Beagle); Vascular endothelial Growth Factor aka VEGF;

**Q6340:** M. Piazza, *et al.* Simulating vasogenic brain edema using chronic VEGF infusion. *J Neurosurg* 2017;127(4):905-916

**Agents:** Vascular endothelial growth factor **Vehicle:** PBS; Rat serum albumin; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2001; 1007D; **Duration:** Not Stated;

**ALZET Comments:** Dose (2, 10, and 20 ng/hr); 0.1% rat serum albumin used; Controls received mp w/ vehicle; animal info (275-350g Male Fischer-344 rats); Brain coordinates (2.5 mm to the right of and 1 mm anterior to bregma); cyanoacrylate adhesive;

**Q6022:** Y. Dai, *et al.* The paracrine effect of cobalt chloride on BMSCs during cognitive function rescue in the HIBD rat. *Behavioural Brain Research* 2017;332(99-109)

**Agents:** Vascular Endothelial Growth Factor **Vehicle:** Saline; **Route:** CSF/CNS (Left Lateral Ventricle); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (17 weeks); behavioral testing (Morris water maze); Therapeutic indication (Hypoxia-inducible factor-1 $\alpha$  Cobalt chloride Hypoxic-ischemic encephalopathy);

**Q5190:** Y. H. Rhee, *et al.* Neural stem cells secrete factors facilitating brain regeneration upon constitutive Raf-Erk activation. *Sci Rep* 2016;6(32025)

**Agents:** Raf-Transducer cells, conditioned media; leukemia inhibitory factor; fibroblast growth factor 2; vascular endothelial growth factor **Vehicle:** CSF, artificial; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 1007D; **Duration:** 6 days;

**ALZET Comments:** Controls received mp w/ vehicle or control media; animal info (male, C57Bl6, 50-100g); ALZET brain infusion kit 2 used; immunology; cyanoacrylate adhesive; Brain coordinates;



**Q5561:** A. E. Kline, *et al.* Combination therapies for neurobehavioral and cognitive recovery after experimental traumatic brain injury: Is more better? *Prog Neurobiol* 2016;142(45-67)

**Agents:** Vascular endothelial growth factor, Fibroblast Growth Factor 2 **Vehicle:** Saline; **Route:** CSF/CNS (lateral ventricle); **Species:** Mice; **Pump:** Not Stated; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ vehicle; VEGF and FGF-2 were administered singly or in combination in same pump; Therapeutic indication (Traumatic brain injury); Dose (VEGF (10 mg/mL), FGF-2 (2.5 mg/mL));

**Q4609:** S. L. Taylor, *et al.* VEGF can protect against blood brain barrier dysfunction, dendritic spine loss and spatial memory impairment in an experimental model of diabetes. *NEUROBIOLOGY OF DISEASE* 2015;78(1-11)

**Agents:** Vascular endothelial growth factor (165) **Vehicle:** CSF, artificial; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 2006; **Duration:** 8 weeks;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, C57BL6J, 2 months old); ALZET brain infusion kit 3 used; behavioral testing (Morris water maze); diabetes;

**Q5243:** J. Oller, *et al.* C/EBPbeta and Nuclear Factor of Activated T Cells Differentially Regulate Admts-1 Induction by Stimuli Associated with Vascular Remodeling. *Mol Cell Biol* 2015;35(19):3409-22

**Agents:** Vascular Endothelial Growth Factor, Angiotensin II, Losartan, Cyclosporine **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 21 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (Calcineurin (CN) B1 (Cnb1<sup>-/-</sup>) conditional knockout mice, C57BL/6 mice); dose-response; vegf aka vascular endothelial growth factor; Dose (VEGF 25 ug/kg/day, AngII 1 ug/kg/min, CsA 5 mg/kg/day, Losartan 10 mg/kg/day);

**Q3348:** A. D. Lassaletta, *et al.* Microvascular Notch Signaling Is Upregulated in Response to Vascular Endothelial Growth Factor and Chronic Myocardial Ischemia. *Circulation Journal* 2014;78(3):743-751

**Agents:** Vascular endothelial growth factor, recombinant human **Vehicle:** Heparin; Saline; **Route:** Intrapericardial; **Species:** Pig; **Pump:** 2ML4; **Duration:** 4 weeks;

**ALZET Comments:** Animal info (male, Yorkshire miniswine, 13-22kg); ischemia (cardiac, chronic); stress/adverse reaction: (see pg. 746); post op. care (Enrofloxacin 68mg PO daily for 5 days; aspirin 325 mg/day for 5 days; buprenorphine HCL 0.3 mg/kg, transdermal fentanyl patch 4mcg/kg for 72h); cardiovascular;

**Q3833:** F. Chehrehasa, *et al.* An Acute Growth Factor Treatment that Preserves Function after Spinal Cord Contusion Injury. *Journal of Neurotrauma* 2014;31(1807-1813)

**Agents:** Vascular endothelial growth factor; platelet-derived growth factor-BB **Vehicle:** PBS; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ saline; animal info (female, Wistar, 20-25 weeks, 300g); spinal cord injury; post op. care (cephalothin; buprenorphine; manual bowel and bladder expression BID); behavioral testing (locomotor behavior; gait and footprint analysis); used Rat intrathecal catheter; pumps primed in 37C saline overnight;

**Q2881:** A. Zechariah, *et al.* Vascular Endothelial Growth Factor Promotes Pericyte Coverage of Brain Capillaries, Improves Cerebral Blood Flow During Subsequent Focal Cerebral Ischemia, and Preserves the Metabolic Penumbra. *Stroke* 2013;44(6):1690-U393

**Agents:** Vascular endothelial growth factor **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 2004; **Duration:** 3, 10 days; **ALZET Comments:** Controls received mp w/ saline; animal info (male C57BL6/j, 20-25g); ischemia

**Q2468:** X. W. Xiao, *et al.* Hypoglycemia Reduces Vascular Endothelial Growth Factor A Production by Pancreatic Beta Cells as a Regulator of Beta Cell Mass. *Journal of Biological Chemistry* 2013;288(12):8636-8646

**Agents:** Vascular endothelial growth factor, A **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 2004; **Duration:** Not Stated;

**ALZET Comments:** Animal info (C57BL/6, MIP-GFP, male, 8 wks old);



**Q2611:** A. H. Siddiqui, *et al.* Angiotensin Receptor Agonistic Autoantibody-Mediated Soluble Fms-Like Tyrosine Kinase-1 Induction Contributes to Impaired Adrenal Vasculature and Decreased Aldosterone Production in Preeclampsia. *Hypertension* 2013;61(2):472-U526

**Agents:** Vascular endothelial growth factor, 121 **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice (pregnant); **Pump:** Not Stated; **Duration:** 5 days;

**ALZET Comments:** Animal info (C57BL/6)

**Q2990:** J. W. Shim, *et al.* VEGF, which is elevated in the CSF of patients with hydrocephalus, causes ventriculomegaly and ependymal changes in rats. *Experimental Neurology* 2013;247(:):703-709

**Agents:** Vascular endothelial growth factor-A165; Bevacizumab **Vehicle:** Saline; BSA; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2001D; **Duration:** 1 day;

**ALZET Comments:** Controls received mp w/vehicle, or (saline, BSA); Peptides; animal info (male Sprague-Dawley rats, 250g); Brain infusion kit (2) used;

**Q2593:** L. Shan, *et al.* Vascular endothelial growth factor B prevents the shift in the ocular dominance distribution of visual cortical neurons in monocularly deprived rats. *Experimental Eye Research* 2013;109(:):17-21

**Agents:** Vascular endothelial growth factor B **Vehicle:** CSF, artificial; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 1007D; **Duration:** Not Stated;

**ALZET Comments:** Control animals received mp w/ vehicle; animal info (Long Evans hooded); PE60 tubing used

**Q2833:** L. Wang, *et al.* Hepatic Vascular Endothelial Growth Factor Regulates Recruitment of Rat Liver Sinusoidal Endothelial Cell Progenitor Cells. *Gastroenterology* 2012;143(6):1555-U239

**Agents:** Vascular endothelial growth factor **Vehicle:** Not Stated; **Route:** IP; **Species:** Rat; **Pump:** Not Stated; **Duration:** Not Stated;

**ALZET Comments:** Animal info (Lewis, VEGF KO, hepatectomy); infusion rate of 1 ul/hr

**Q1819:** O. Thau-Zuchman, *et al.* SUBACUTE TREATMENT WITH VASCULAR ENDOTHELIAL GROWTH FACTOR AFTER TRAUMATIC BRAIN INJURY INCREASES ANGIOGENESIS AND GLIOGENESIS. *Neuroscience* 2012;202(:):334-341

**Agents:** Vascular endothelial growth factor **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Mice; **Pump:** Not Stated; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (adult, Sabra, 40 g)

**Q1655:** O. Thau-Zuchman, *et al.* Combination of Vascular Endothelial and Fibroblast Growth Factor 2 for Induction of Neurogenesis and Angiogenesis after Traumatic Brain Injury. *Journal of Molecular Neuroscience* 2012;47(1):166-172

**Agents:** Vascular endothelial growth factor **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Sabra, adult, 40 g)

**Q1620:** R. Reitmeir, *et al.* Vascular endothelial growth factor induces contralesional corticobulbar plasticity and functional neurological recovery in the ischemic brain. *Acta Neuropathologica* 2012;123(2):273-284

**Agents:** Vascular endothelial growth factor **Vehicle:** NaCl; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 2002; 2004; **Duration:** 4 weeks;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, C57Bl6/j, 8-10 wks old, 23-25 g); ischemia (MCAO); stress/adverse effects, "complications related to pump insertion" pg 274; behavioral testing (Rotarod, grip strength test)

**Q1775:** C. Lutton, *et al.* Combined VEGF and PDGF Treatment Reduces Secondary Degeneration after Spinal Cord Injury. *Journal of Neurotrauma* 2012;29(5):957-U479

**Agents:** Vascular endothelial growth factor; platelet-derived growth factor **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (Wistar, male, adult, 300 g, 20-25 wks old); functionality of mp verified in vitro; "catheter was... sutured to the muscle to keep it in place" pg 959



- Q1810:** J. Herz, *et al.* Intracerebroventricularly delivered VEGF promotes contralesional corticorubral plasticity after focal cerebral ischemia via mechanisms involving anti-inflammatory actions. *NEUROBIOLOGY OF DISEASE* 2012;45(3):1077-1085  
**Agents:** Vascular endothelial growth factor, recomb. human **Vehicle:** Not Stated; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 2002; 2004; **Duration:** 4 weeks;  
**ALZET Comments:** Controls received mp w/ saline; animal info (male, C57BL/6J, 8-10 wks old, 23-25 g); ischemia
- Q2316:** E. G. Argandona, *et al.* Effect of intracortical vascular endothelial growth factor infusion and blockade during the critical period in the rat visual cortex. *Brain Research* 2012;1473(:):141-154  
**Agents:** Vascular endothelial growth factor; anti-VEGF **Vehicle:** PBS; **Route:** CSF/CNS (cortex); **Species:** Rat; **Pump:** 1007D; **Duration:** Not Stated;  
**ALZET Comments:** Control animals received mp w/ vehicle; animal info (Long Evans, P18); ALZET brain infusion kit used; cyanoacrylate adhesive used
- Q1347:** A. H. Siddiqui, *et al.* Recombinant Vascular Endothelial Growth Factor 121 Attenuates Autoantibody-Induced Features of Pre-eclampsia in Pregnant Mice. *American Journal of Hypertension* 2011;24(5):606-612  
**Agents:** Vascular endothelial growth factor 121 **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice (pregnant); **Pump:** 1007D; **Duration:** 5 days;  
**ALZET Comments:** Animal info (C57BL/6, 8 wks old)
- Q0878:** N. Ortuzar, *et al.* Combination of intracortically administered VEGF and environmental enrichment enhances brain protection in developing rats. *Journal of Neural Transmission* 2011;118(1):135-144  
**Agents:** Vascular endothelial growth factor **Vehicle:** Not Stated; **Route:** CSF/CNS (cortex); **Species:** Rat; **Pump:** 1007D; **Duration:** 7 days;  
**ALZET Comments:** Controls received mp w/ PBS or no implantation; animal info (Long-Evans, P18); cyanoacrylate adhesive; ALZET brain infusion kit 3 used; "Total operating time was approximately 25 min." pg 137
- Q1236:** E. A. Miyasaka, *et al.* In vivo growth of a bioengineered internal anal sphincter: comparison of growth factors for optimization of growth and survival. *Pediatric Surgery International* 2011;27(2):137-143  
**Agents:** Fibroblast growth factor-2; Vascular endothelial growth factor-2; Platelet-derived growth factor **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1004; **Duration:** 28 days;  
**ALZET Comments:** Controls received mp with no growth factors; animal info (C57BL/6); good methods, pg 138; tissue perfusion (internal anal sphincter); silicone catheter used; "the osmotic pumps we used completed delivery of the growth factors by 28 days, which would clearly limit the duration of exposure to the growth factor, lessening the risk of malignancy"
- Q2201:** J. Mateus, *et al.* Endothelial growth factor therapy improves preeclampsia-like manifestations in a murine model induced by overexpression of sVEGFR-1. *American Journal of Physiology Heart and Circulatory Physiology* 2011;301(5):H1781-H1787  
**Agents:** Vascular endothelial growth factor 121 **Vehicle:** PBS; **Route:** SC; **Species:** Mice (pregnant); **Pump:** 2002; **Duration:** 10 days;  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (CD-1); functionality of mp verified by residual volume and plasma drug levels
- Q7415:** Y. Huang, *et al.* Resuscitating cancer immunosurveillance: selective stimulation of DLL1-Notch signaling in T cells rescues T-cell function and inhibits tumor growth. *Cancer Research* 2011;71(19):6122-31  
**Agents:** Vascular endothelial growth factor receptors, VEGFR2-sel, VEGFR1-sel **Vehicle:** PBS; **Route:** SC; **Species:** Mice; **Pump:** 2004; **Duration:** 28 days;  
**ALZET Comments:** Dose (50 ng/h); Controls received mp w/ vehicle; animal info (6-8 week old mice); cancer (T-cell leukemia);
- Q1664:** L. M. Chu, *et al.* Resveratrol supplementation abrogates pro-arteriogenic effects of intramyocardial vascular endothelial growth factor in a hypercholesterolemic swine model of chronic ischemia. *Surgery* 2011;150(3):390-399  
**Agents:** Vascular endothelial growth factor, recomb. human **Vehicle:** Not Stated; **Route:** Intrapericardial; **Species:** Pig;  
**ALZET Comments:** Animal info (intact, male, Yorkshire); stress/adverse effects "sudden cardiac death", pg 393



**Q1355:** O. Thau-Zuchman, *et al.* Vascular endothelial growth factor increases neurogenesis after traumatic brain injury. *Journal of Cerebral Blood Flow and Metabolism* 2010;30(5):1008-1016

**Agents:** Vascular endothelial growth factor **Vehicle:** Not Stated; **Route:** CSF/CNS; **Species:** Mice; **Pump:** Not Stated; **Duration:** 6, 7 days;

**ALZET Comments:** Controls received mp w/ vehicle or were sham operated; animal info (adult, Sabra, male, 40 g); infusion rate of 0.5 ul/hr

**Q1592:** L. B. Romo, *et al.* VEGF protects spinal motor neurons against chronic excitotoxic degeneration in vivo by activation of PI3-K pathway and inhibition of p38MAPK. *Journal of Neurochemistry* 2010;115(5):1090-1101

**Agents:** Isoxazolepropionate, alpha amino-3-hydroxy-5-; vascular endothelial growth factor, recomb., 164; SU14980, tyrphostin; LY294002; wortmannin; PD-98059; SB203580; neurodegenerative (amyotrophic lateral sclerosis); **Vehicle:** PBS; DMSO; **Route:** CSF/CNS (intrathecal, spinal cord); **Species:** Rat; **Pump:** 2004; **Duration:** 2, 10, 20 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (Wistar, male, 270-290 g, adult); alpha amino-3-hydroxy-5-isoxazolepropionate also known as AMPA; wound clips used; post op. care, pg 1091 (penicillin); good methods, pg 1091; multiple pumps used (2); multiple intrathecal catheters used; wound clips used; 2% DMSO used; enzyme inhibitor (p38 mitogen-activated protein kinase, p38MAPK)

**Q0712:** J. N. Nicoletti, *et al.* Vascular endothelial growth factor attenuates status epilepticus-induced behavioral impairments in rats. *Epilepsy & Behavior* 2010;19(3):272-277

**Agents:** Vascular endothelial growth factor, 165, recomb. human; vascular endothelial growth factor, inactivated **Vehicle:** PBS, sterile; **Route:** CSF/CNS (hippocampus); **Species:** Rat; **Pump:** 2002; **Duration:** 2 weeks;

**ALZET Comments:** Controls received no surgical manipulations or protein infusions; animal info (male Sprague-Dawley, 250-350 g); behavioral testing (Morris water maze, Grid locomotor activity, Light-dark exploration)

**Q1197:** C. Lee, *et al.* Vascular Endothelial Growth Factor Is Involved in Mediating Increased De Novo Hippocampal Neurogenesis in Response to Traumatic Brain Injury. *Journal of Neurotrauma* 2010;27(3):541-553

**Agents:** Vascular endothelial growth factor 164; SU5416; uridine, bromodeoxy **Vehicle:** CSF, artificial; DMSO; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2002; **Duration:** 13 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (young, Sprague Dawley, male, 270-300 g); 1% DMSO used

**R0287:** S. S. Glaser, *et al.* Vascular factors, angiogenesis and biliary tract disease. *Current Opinion in Gastroenterology* 2010;26(3):246-250

**Agents:** Vascular endothelial growth factor, alpha **Vehicle:** BSA; **Route:** IP; **Species:** Rat; **Pump:** Not Stated; **Duration:** 1 week;

**ALZET Comments:** animal info (BDL+HAL)

**Q0400:** E. Bogaert, *et al.* VEGF protects motor neurons against excitotoxicity by upregulation of GluR2. *NEUROBIOLOGY OF AGING* 2010;31(12):2185-2191

**Agents:** Vascular endothelial growth factor **Vehicle:** Not Stated; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2004; **Duration:** 1 week;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (80 days old)

**Q0354:** A. Ahmed, *et al.* A New Mouse Model to Explore Therapies for Preeclampsia. *PLoS One* 2010;5(10):U325-U333

**Agents:** Vascular endothelial growth factor (121) **Vehicle:** PBS, sterile; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 7 days;

**ALZET Comments:** Animal info (CBA/J x DBA/2 and CBA/J x BALB/c)