References on the Intra-Arterial Administration of Agents 
Using ALZET® Osmotic Pumps


Agents: KN-92; KN-93 Vehicle: Not Stated; Route: IA (femoral); Species: Woodchuck; Pump: 2ML1; Duration: 24 hours; ALZET Comments: Dose ((KN-92 125 μg/kg/h), (KN-93 125 μg/kg/h)); Controls received mp w/ KN-92; animal info (1-2 years, male and female, wild-caught, 2-3kg); KN-92 is an inactive analog of KN-93. KN-93 is a membrane-permeable CaMKII inhibitor; ischemia (coronary artery occlusion); therapeutic indication (inhibition of CaMKII activity by lessening its oxidized and/or phosphorylated levels may mediate its antiarrhythmic effects;)


Agents: Antagomir-352 Vehicle: Route: IA (femoral artery); Species: Rat; Pump: 1007; Duration: 1 week; ALZET Comments: Dose (500 nmol/kg); animal info (Adult Sprague-Dawley rats weighing 250–300 g); cardiovascular


Agents: Exisulind Vehicle: DMSO; Route: IA (carotid); Species: Rat; Pump: Not Stated; Duration: 2 weeks; ALZET Comments: Dose (0.5 mg/kg/day); Controls received mp w/ vehicle; animal info (12 week old female Sprague-Dawley rats weighing 280–310 g); function of mp verified by staining for CXCL1; immunology; cardiovascular

Q4153: M. H. M. Vries, et al. CXCL1 promotes arteriogenesis through enhanced monocyte recruitment into the peri-collateral space. Anesthesiology 2015;18(163-171

Agents: SB225002; CXCL1 Vehicle: Not Stated; Route: IA (femoral); Species: Rat; Pump: 2ML1; Duration: 1 day; 3 days; 7 days; 10 days; 14 days; animal info (male, Sprague-Dawley, 300–350g); functionality of mp verified by staining for CXCL1; immunology; cardiovascular


Agents: Estradiol, 2-methoxy Vehicle: DMSO; Route: IA (carotid artery); Species: Rat; Pump: Not Stated; Duration: 8 days, 14 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male Wistar Kyoto rats, 350 to 400 g); dose-response (E999); 0.1% DMSO; cardiovascular; cardiovascular; Balloon injury-induced neointima formation; Dose (350 ug/kg/day);

Q3638: Y. Zhao, et al. Complement anaphylatoxin C4a inhibits C5a-induced neointima formation following arterial injury. Molecular Medicine Reports 2014;10(45-52

Agents: C5a, recombinant; C4a, recombinant Vehicle: PBS; BSA; Route: IA (femoral); Species: Mice; Pump: Not Stated; Duration: 2 weeks;

ALZET Comments: Dose (Recomb C5a 1 μg/25 g of body weight); recomb C4a (1 μg/25 g of body weight)); Animal info (C57BL6N, 16 week old); cardiovascular; immunology; arterial injury


Agents: Glucagon-like peptide-1 peptide Vehicle: saline; Route: IA (carotid); iv (jugular); Species: Rat; Pump: 2001; Duration: 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male CD rats, ~400 g); Braintree Polyethylene Catheters used; Dose (40 ng/kg/min);
ALZET Comments:

Q2025: diagram of the osmotic pump


Agents: Dexamethasone; imiquimod Vehicle: Not Stated; Route: IA (carotid); Species: Rabbit; Pump: 2ML1; Duration: 3, 7 days;

ALZET Comments: Animal info (male, New Zealand, white, 2.5-4.0 kg); one group contained mixture of dexamethasone and imiquimod


Agents: PDD, 4 alpha Vehicle: Not Stated; Route: IA (carotid); Species: Rat; Pump: 2001; Duration: 7 days;

ALZET Comments: Animal info (male, Sprague Dawley, 250-300 g); post op. care (buprenorphine); figure 4a, schematic diagram of the osmotic pump


Agents: Carbaprostacyclin, cPGI2; Vehicle: Not Stated; Route: IA (femoral); Species: Mice; Pump: Not Stated; Duration: 3, 7, 14 days; 24 hours;

ALZET Comments: Controls received mp w/vehicle, or saline; animal info (C57 black mice (C57BL/6J), 8-12 wks old, acute ischemia model); multiple pumps per animal (2); two pumps with saline or cPGI2 for 24 hours); PE50 catheter


Agents: Angiotensin II Vehicle: saline; Route: IA (aorta); Species: mice; Pump: 2004; Duration: 4 weeks;

ALZET Comments: Controls: tamoxifen-injected Apoe_/_ mice; mp w/ saline; Controls: tamoxifen-injected Apoe_/_ mice; mp w/ saline; cardiovascular, aorta; Dose: 1000ng/kg; Industry authored (American Heart Association);


Agents: Prednisolone Vehicle: Not Stated; Route: IA (renal artery); Species: Rat; Pump: Not Stated; Duration: Not Stated;

ALZET Comments: Dose (4 mg/kg/day); “Local application was superior to systemic application at a dosage of 4mg/kg body weight per day, whereas i.p. or i.v. administration was ineffective at this dose. ” pg 3;
ALZET® Bibliography

Agents: Fibroblast growth factor-9 Vehicle: PBS; Route: IA (femoral); Species: Mice; Pump: 1007D; Duration: Not Stated; ALZET Comments: Controls received mp w/ vehicle; animal info (male, C57BL/6J, 9-10 mo old); polyethylene tubing used; ischemia (hind limb)

Q1446: M. C. Chan, et al. The Amiloride Derivative Phenamil Attenuates Pulmonary Vascular Remodeling by Activating NFAT and the Bone Morphogenetic Protein Signaling Pathway. MOLECULAR AND CELLULAR BIOLOGY 2011;31(3):517-530
Agents: Phenamil Vehicle: Saline; DMSO; Route: IA (carotid); Species: Rat; Pump: 2004; Duration: 21 days; ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague-Dawley, 6-7 wks old, 250-300 g); 50% DMSO used; hypobaric hypoxia; phenamil is an amiloride analog

Agents: Diethylenetriamine NONOate Vehicle: Alkaline solution; Route: IA; Species: Rabbit; Pump: Not Stated; Duration: Not Stated; ALZET Comments: Animal info (white, New Zealand); “DETA NONOate in alkaline solution (pH 8) is stable but releases NO when in contact with blood during a continuous infusion from an implanted osmotic minipump connected to a catheter indwelling the proximal or distal stump of the occluded artery.” pg 159

Agents: Phorbol didecanoate, 4-alpha Vehicle: Not Stated; Route: IA (femoral); Species: Pig; Pump: 2ML1; Duration: 7 days; ALZET Comments: Controls received mp w/ saline or sham operation; cardiovascular; animal info (male, juvenile, crossbred, 38kg, femoral artery occlusion); post op. care (cefquinome, fentanyl); ischemia (hind limb); excellent color photograph of multiple mp placement (Fig. 1); multiple pumps per animal (2)

Agents: Ephrin-A4-Fc, ligand Vehicle: PBS; Evans blue; Route: IA (femoral); Species: Rat; Pump: 1002; Duration: Not Stated; ALZET Comments: Controls received mp w/ IgG-Fc; animal info (adult, male, 250-300 g, adult, post partum, females, neonatal, Sprague-Dawley)

Agents: PDD, 4 alpha; ruthenium red Vehicle: Ethanol; NaCl; Route: IA (femoral); Species: Rabbit; Rat; Pump: Not Stated; Duration: 7 days; ALZET Comments: Controls received mp w/vehicle or sham operated; animal info (New Zealand White, 3.0 kg, Sprague Dawley, 275 g); post op. care (buprenorphine); 4-alpha PDD also known as Phorbol-12,13-didecanoate; Fig 1, schematic of femoral artery ligature with ALZET pump

Agents: Brain-derived neurotrophic factor; immunoglobulin-G; Fe; RNA, small interfering; TrkB-Fr Vehicle: NaCl; Route: IA (carotid); CSF/CNS (rostral migratory, system); Species: Mice; Pump: 1007D; Duration: 7 days; ALZET Comments: Controls received mp w/control siRNA; animal info (2-3 mo old C57BL/16); brain tissue distribution; ALZET mouse jugular catheter used; heparin added to BDNF

P9814: G. Santulli, et al. In vivo properties of the proangiogenic peptide QK. Journal of Translational Medicine 2009;7();U1-U10 Agents: Vascular endothelial growth factor-15; vascular endothelial growth factor-165; QK Vehicle: Not Stated; Route: IA (femoral); Species: Rat; Pump: 2002; Duration: 14 days; ALZET Comments: Peptides; animal info (12 wks old, WKY, normosensitive); QK is a de novo engineered VEGF mimicking peptide

Agents: Hyaluronidase, active; hyaluronidase, inactive Vehicle: Route: IA (femoral); Species: Rabbit; Pump: Not Stated; Duration: Not Stated;
ALZET Comments: Animal info (New Zealand, white, 3 kg)


Agents: Anisomycin Vehicle: Not Stated; Route: IA (carotid); Species: Rabbit; Pump: 2ML1; Duration: 3 days;
ALZET Comments: Controls received mp w/saline; animal info (male, New Zealand, White, 3.3-3.9 kg)


Agents: Angiotensin II; Candesartan Vehicle: Saline; Route: IA (femoral); Species: Mice; Pump: Not Stated; Duration: 4 weeks;
ALZET Comments: Controls received mp w/ vehicle; cardiovascular; peptides; animal info (male, C57BL/6, 20 wks old, Lr11 +/-, wt)


Agents: Platelet-derived growth factor-BB; Vascular endothelial growth factor 164 Vehicle: Saline, normal; Albumin, rat serum; Acetic acid; Route: IA (femoral); IV (femoral); Species: Rat; Pump: 2004; Duration: 28 days;
ALZET Comments: Artificial kidney; controls received mp w/ vehicle; peptides; animal info (male, Fisher 344); mp attached by cannula to bioartificial hemofilter device, which surrounded and delivered agent to the femoral vessels; nephrology


Agents: Insulin-like growth factor-binding protein-4; Insulin-like growth factor-binding protein-4, mutated; Insulin-like growth factor-1, recomb. human Vehicle: PBS; Route: IA (carotid); IA (femoral); Species: Pig; Pump: Not Stated; Duration: 21 days;
ALZET Comments: Controls received mp w/ vehicle; cardiovascular; peptides; animal info (male, female, spotted Poland/China, 12 months old); protease resistant mutant form of IGFBP-4


Agents: Substance P Vehicle: Saline; Heparin; Route: IA (femoral); Species: Rat; Pump: 2001D; Duration: 24 hours;
ALZET Comments: Controls received mp w/ vehicle; good methods (p. 758); animal info (male, Sprague-Dawley, 225-250g); pain


Agents: Peptide YY, recomb. human; peptide YY (3-36), recomb. human; Vascular endothelial growth factor 165 Vehicle: PBS; Glycerol; Sodium citrate; Tween 20; Route: IA (iliac); Species: Rat; Pump: Not Stated; Duration: 14 days;
ALZET Comments: Controls received mp w/ vehicle; replacement therapy (femoral artery occlusion); dose-response (fig. 4); half-life (p. 276) <30 minutes; cardiovascular; peptides; ischemia (hindlimb); animal info (male, Sprague-Dawley, 325-350 grams)


Agents: Cycloheximide Vehicle: Not Stated; Route: IA (carotid); Species: Rabbit; Pump: 2ML1; Duration: 3 days;
ALZET Comments: Controls received mp w/ saline; cardiovascular; animal info (male, New Zealand white, 3.1-3.8 kg); mp connected to a collar around atherosclerotic carotid arteries

Agents: Apocynin  
Vehicle: DMSO  
Route: IA (carotid); Pump: 2001; Duration: Not Stated

ALZET Comments: Controls received mp w/ vehicle; enzyme inhibitor (NADPH oxidase); cardiovascular; animal info (male, New Zealand White, 3-4kg); 0.1% DMSO; mp attached to catheter to hollow, nonoclusive silastic collar around common carotid artery


Agents: Vascular endothelial growth factor; Stromal cell-derived factor-1a  
Vehicle: PBS; Glycerol; Sodium acetate; Sodium azide;  
Route: IA (iliac); Species: Rat; Pump: Not Stated; Duration: 2 weeks

ALZET Comments: Controls received mp w/ vehicle; dose-response (table 1); cardiovascular; peptides; animal info (adult); bilateral femoral artery ligation; occlusive cardiovascular disease


Agents: Doxycycline hydrochloride  
Vehicle: Saline; SC; IP; IA (aorta); Species: Mice; Pump: 1002; Duration: 14 days

ALZET Comments: Controls received mp w/ vehicle; tissue perfusion (aorta); dose-response (table 1); comparison of oral vs. mp; half-life (p. 234), 26.5 hours; cardiovascular; animal info (C57BL/6J, male, 8-10 weeks old, 20-35 grams); catheter secured to a polyvinyl alcohol sponge positioned over the anterior surface of the aorta and secured to retroperitoneal tissues; (quote p. 233)


Agents: Fibronectin-derived peptide, synthetic  
Vehicle: PBS; Route: IA (carotid); Species: Rat; Pump: Not Stated; Duration: 24 hours

ALZET Comments: Controls received mp w/ vehicle or control peptide PRARI; peptides; ischemia (cerebral); animal info (male, Sprague-Dawley, 300-350 g); peptide: PRARIY; MCAO


Agents: Vascular endothelial growth factor, human 165  
Vehicle: Saline, sterile; Heparin;  
Route: IA (renal); Perivascular (arterial collar); Species: Rat; Pump: 2004; Duration: 28 days

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by VEGF serum immunoassay; comparison of CDNA plasmid micro-injections vs. mp; gene therapy; peptides; animal info (male, Sprague-Dawley); urology; 2000 Units of heparin used


Agents: Atrial natriuretic peptide; Natriuretic peptide, C-type  
Vehicle: Saline, sterile; Heparin; Route: IA (renal); Species: Rabbit; Pump: 2001; Duration: 7 days

ALZET Comments: Cardiovascular; animal info (New Zealand white, 3-4 kg); peptides


Agents: Fluorouracil, 5-FU; peplomycin  
Vehicle: Saline, heparinized; Route: IA (abdominal aorta); Species: Rat; Pump: 2ML1; Duration: 7 days

ALZET Comments: Controls received mp w/ vehicle; cancer; chemotherapeutic agents; PE-10 and 60 used; tubing attached using a moment binding agent (alon-alfa); catheter schematic p. 3027; pump placed IP

Agents: Monocyte chemoattractant protein-1, recomb. human; leptin, recomb. human Vehicle: Not Stated; Route: IA (femoral); Species: Rabbit; Pump: 2ML1; Duration: 7 days;

ALZET Comments: Controls received mp w/ PBS; no stress (see pg. 359); cardiovascular; peptides; right femoral artery occlusion


Agents: Heparin Vehicle: Saline; Route: IA (carotid); IV (jugular); Species: Rat; Pump: 2001; Duration: 7 days;

ALZET Comments: Controls received mp w/ vehicle; post op. care (wounds treated with local anesthetics, lidocaine cream); PE-50 tubing was filled with rat serum and heparin and plugged with nylon fishing line until the pumps were attached; pumps were used only as a means of keeping vessel catheters patent.

P6370: P. S. Manoonkitiwongsa, et al. Neuroprotection of ischemic brain by vascular endothelial growth factor is critically dependent on proper dosage and may be compromised by angiogenesis. Journal of Cerebral Blood Flow and Metabolism 2004;24(6):693-702

Agents: Vascular endothelial growth factor Vehicle: Saline; Route: IA (carotid); Species: Rat; Pump: 2001; Duration: 7 days;

ALZET Comments: Controls received mp w/ vehicle; dose response (p. 697); stroke; ischemia (cerebral); biocompatible glue was used to secure catheter in artery


Agents: Mibefradil Vehicle: PBS; Route: IA (femoral); Species: Mice; Pump: 1007D; Duration: 7 days;

ALZET Comments: Controls received mp w/ vehicle; antihypertensive; mibefradil is a tetralol calcium channel blocking agent; PE-50 heat stretched to an O.D of 0.22 mm


Agents: Monocyte chemoattractant protein-1 Vehicle: PBS; Route: IA (femoral); Species: Rabbit; Pump: 2ML1; Duration: 1 week;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by residual volume; dose-response (p. 181, 183); cardiovascular; peptides; MCP-1


Agents: Monocyte chemotactic protein-1 Vehicle: Not Stated; Route: IA (femoral); Species: Mice; Pump: 1007D; Duration: 7 days;

ALZET Comments: Controls received mp w/ PBS; cardiovascular


Agents: Fibroblast growth factor, basic Vehicle: Sodium citrate; glycerol; PBS; Route: IA (iliac); Species: Rat; Pump: 2002; Duration: 14 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by residual volume p. H1192; antihypertensive; post op. care (topical antibiotic powder); “The pump was housed in a tunnel under the skin in the left groin area; this placement did not hamper hindlimb movement while rats were walking on the treadmill.” p. H1191; behavioral study; “There were no signs of ischemia or necrosis and no presence of infection or complications from the osmotic pumps...” p. H1192

Agents: Fibroblast growth factor; heparinase I
Vehicle: Not Stated; Route: IA (iliac); Species: Not Stated; Pump: Not Stated; Duration: 2 weeks;
ALZET Comments: Dose-response (p. 213); the heparinase I infusion group targeted the contralateral iliac vessel; pump or animal model not mentioned


Agents: Vascular endothelial growth factor; Vascular endothelial growth factor-E; Monocyte chemoattractant protein-1; Placental growth factor
Vehicle: Phosphate buffer; albumin; Route: IA (femoral); Species: Mice; Rabbit; Pump: Not Stated; Duration: 1 week;
ALZET Comments: Controls received mp w/ vehicle; dose-response (p.381); peptides; placenta growth factor (PIGF) is a VEGF homologue; VEGF-E is a chimera containing the heparin-binding domain of VEGF; MCP-1


Agents: Nicotine; fibroblast growth factor, basic
Vehicle: PBS; Route: IA (iliac); Species: Rabbit; Pump: 2ML2; Duration: 18 days;
ALZET Comments: Controls received mp w/ vehicle.


Agents: L-NAME; D-NAME; Phenylephrine
Vehicle: Saline; heparin; Route: IA (femoral); Species: Rabbit; Pump: Not Stated; Duration: 6 weeks;
ALZET Comments: Controls received mp w/ phenylephrine or D-NAME; enzyme inhibitor (Nitric oxide synthase); cardiovascular; peptides; L-NAME & D-NAME (no synthase inhibitors) were dissolved in heparinized saline (100 U/ml)


Agents: Monocyte chemoattractant protein-1; doxorubicin; transforming growth factor-B1
Vehicle: Saline; heparin; Route: IA (femoral); Species: Rabbit; Pump: 2ML1; Duration: 24 hours;
ALZET Comments: Cardiovascular


Agents: Monocyte chemoattractant protein-1; Transforming Growth Factor-B; Doxorubicin
Vehicle: Not Stated; Route: IA (femoral); Species: Rabbit; Pump: 2ML1; Duration: 24 hours;
ALZET Comments: Cardiovascular; peptides; MCP-1 is monocyte chemoattractant protein 1

**Agents:** Uridine, bromodeoxy- **Vehicle:** Not Stated; **Route:** IA (carotid); **Species:** Rabbit; **Pump:** 2ML2; **Duration:** 3.7 days; **ALZET Comments:** Study proliferation of collateral arteries and capillaries


**Agents:** Uridine 5-triphosphate **Vehicle:** Not Stated; **Route:** IA (carotid); **Species:** Rabbit; **Pump:** 2ML2; **Duration:** 3.14 days; **ALZET Comments:** Controls received mp w/ PBS; cardiovascular; post op. care (buprenorphine)


**Agents:** Fibroblast growth factor 2 **Vehicle:** PBS; **Route:** IA (femoral); **Species:** Mice; **Pump:** 1007D; **Duration:** Not Stated; **ALZET Comments:** Controls received mp w/ vehicle; peptides


**Agents:** MC-2 **Vehicle:** Saline; **Route:** IA (profunda femoris artery); **Species:** Rat; **Pump:** 2ML2; **Duration:** Not Stated; **ALZET Comments:** Controls received mp w/ vehicle; tissue perfusion (skin flap allograft); immunology; peptides; MC-2 is derived from mouse interferon gamma; transplant


**Agents:** Vascular endothelial growth factor 121; Fibroblast growth factor, basic **Vehicle:** PBS; Sodium citrate; Glycerol; **Route:** IA (iliac); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days; **ALZET Comments:** Controls received mp w/ vehicle; dose response; peptides, cardiovascular; recomb. human FGF used; sodium citrate used to maintain catheter patency; glycerol used to enhance protein stability


**Agents:** A-192621 **Vehicle:** Ethanol; Propylene glycol; Sodium hydroxide; **Route:** IA (carotid); **Species:** Rat (pregnant); **Pump:** Not Stated; **Duration:** 7 days; **ALZET Comments:** Controls received mp w/ vehicle; functionality of mp verified by plasma A-192621 levels; dose-response (fig 3. p. 242); peptides; A-192621 is an Endothelin-B receptor antagonist which blocks vasoconstriction; vehicle was 20% ethanol, 40% propylene glycol, 0.4 M sodium hydroxide.


**Agents:** Cytochalasin D **Vehicle:** Not Stated; **Route:** IA (left carotid artery); **Species:** Rabbit; **Duration:** 14 days; **ALZET Comments:** Dose (10-4 M, 10-5 M, 10-6 M, 10-7 M, 10-8 M); animal info (Male New Zealand white rabbits (2.5 ± 3.5 kg)); cardiovascular;


**Agents:** Fibroblast growth factor, basic **Vehicle:** Sodium citrate; Glycerol; PBS; **Route:** IA (iliac); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days; **ALZET Comments:** Controls received mp w/ vehicle; dose response; peptides, cardiovascular; recomb. human FGF used; sodium citrate used to maintain catheter patency; glycerol used to stabilize protein.
Agents: Angiotensin II Vehicle: Saline; Heparin; Route: IP; IA (renal artery); Species: Rat; Pump: 2ML4; Duration: 14.25 days; ALZET Comments: Controls received mp w/ vehicle; cardiovascular; vehicle contained 10 IU/ml of heparin

Agents: Cyclosporin A; FK506 Vehicle: Not Stated; Route: IA (brachial); Species: Rabbit; Pump: Not Stated; Duration: 6 days; ALZET Comments: Dose-response; review, see pg. 409

Agents: Lysine, L-N6-(1-imino-ethyl)- Vehicle: Saline; Polymyxin; Route: IA (left carotid); Species: Rabbit; Pump: 2ML2; Duration: 14 days; ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by immunostaining to verify iNOS activity; cardiovascular; enzyme inhibitor; Polymyxin B present in vehicle (2ug/ml) to bind all traces of lipopolysaccharides. L-NIL is a nitric oxide synthase inhibitor.

Agents: Cyclosporin A Vehicle: Sandimmune IV solution; Route: IA (brachial); IV (jugular); Species: Rabbit; Pump: 2ML1; Duration: 6 days; ALZET Comments: Good surgical methods (p. 1186); immunology; diagram of pump/catheter system (p. 1186); PE-60 tubing was glued to PE-10 tubing; Sandimmune (CSA) solution used;

Agents: FK506 Vehicle: Not Stated; Route: IA (brachial); Species: Rabbit; Pump: 2ML1; Duration: 6 days; ALZET Comments: Functionality of mp verified by FK-506 blood levels via ELISA; dose-response (p.1198); FK506 also known as tacrolimus; continuous systemic vs. local administration; immunology; transplantation

Agents: Cyclosporin A Vehicle: Cremophor; sandimmune IV solution; Route: IA (brachial); Species: Rabbit; Pump: 2ML1; Duration: 6 days; ALZET Comments: Dose-response (p. 1192-1194); immunology; sandimmune (CSA) solution used; intramedic PE-60/PE-10 infusion catheter used; to achieve highest dose; two pumps were implanted and catheters were joined via a Y-connector;

Agents: SC-69000; SC-65811 Vehicle: Not Stated; Route: IA (carotid, femoral); Species: Pig; Pump: 2ML2; Duration: 14 days; ALZET Comments: Controls received mp w/ vehicle; cardiovascular; peptides; agents are aVb3 receptor inhibitors; diagram of pump placement on p.1041

Agents: Fibroblast growth factor, basic Vehicle: PBS; Sodium azide; Glycerol; Heparin; Route: IA (iliac); Species: Rat; Pump: 2002; Duration: 2 weeks; ALZET Comments: Controls received mp w/vehicle; functionality of mp verified by residual volume; peptides; human. recomb fibroblast growth factor used
**Agents:** Vascular endothelial growth factor; Nitroglycerin  
**Vehicle:** Saline; Heparin;  
**Route:** IA (iliac); **Species:** Rabbit; **Pump:** 2ML4; **Duration:** 28 days;  
**ALZET Comments:** Pump diagram (p. 888); 22 g intravenous catheter was inserted into tygon tubing; “implantable osmotic pumps offer an alternative simple delivery method, providing a constant release of soluble agents in a steady-state fashion.” (p. 892); controls received mp w/vehicle; good methods (pp. 887-888); cardiovascular; peptides; ischemia

**Agents:** Cell culture supernatant factor; Antibody, anti-human interleukin 8  
**Vehicle:** PBS, sterile; Albumin, bovine serum;  
**Route:** IA (renal); **Species:** Rat; **Pump:** 2ML1; **Duration:** 5 days;  
**ALZET Comments:** controls received mp w/vehicle; functionality of mp verified by residual volume; heat-stretched PE-10 tubing used; immunology

P4637: K. E. Matthys, et al. Local application of LDL promotes intimal thickening in the collared carotid artery of the rabbit. Arteriosclerosis, Thrombosis, and Vascular Biology 1997;17(2423-2429)
**Agents:** Lipoprotein, low density-; lipoprotein, oxidized low density-  
**Vehicle:** PBS;  
**Route:** IA (carotid); **Species:** Rabbit; **Pump:** Not Stated; **Duration:** 14 days;  
**ALZET Comments:** Controls received mp w/ vehicle; pumps connected to silicone collars around carotid arteries; human LDL used.

**Agents:** Uridine, bromodeoxy-; Monocyte chemoattractant protein-1  
**Vehicle:** PBS;  
**Route:** IA (femoral); **Species:** Rabbit; **Pump:** 2ML2; **Duration:** Not Stated;  
**ALZET Comments:** Controls received mp w/PBS; functionality of mp verified by BrdU staining and residual volume; peptides; cardiovascular; MCP-1

**Agents:** Interleukin-8  
**Vehicle:** BSA;  
**Route:** IA (renal); **Species:** Rat; **Pump:** 2ML1; **Duration:** 5 days;  
**ALZET Comments:** Controls received mp w/BSA; good methods (pg. 275); peptides; used PE10 catheter stretched to further reduce its diameter

**Agents:** Proline, l-; Proline, nitric oxide-  
**Vehicle:** NaOH;  
**Route:** IA (femoral); **Species:** Dog; **Pump:** 2ML2; **Duration:** 7 days;  
**ALZET Comments:** Controls received mp w/proline to contralateral vessel; stability verified by in vitro assay; half-life (pg. 27); cardiovascular; constructed local infusion device and attached to mp via catheter

**Agents:** Growth hormone, recomb. human  
**Route:** IA (femoral); **Species:** Rat; **Pump:** 2002; **Duration:** 13 days;  
**ALZET Comments:** controls received mp w/vehicle; replacement therapy (hypophysectomy); no stress (see pg. 103); stress/adverse reaction (p. 103); PE10, PE50 and PE60 tubing used; PE10 tubing was stretched to fit into the vessel; peptides

**Agents:** Fibroblast Growth Factor, basic; Heparin  
**Vehicle:** Saline; Glycerol; Sodium azide;  
**Route:** IA (Femoral); **Species:** Rat; **Pump:** 2002; **Duration:** 1,2,4 weeks;  
**ALZET Comments:** Controls received mp w/ heparin; functionality of mp verified by residual volume; long-term study, pumps replaced at day 14; no stress (p. 63); good methods (p.63); peptides; cardiovascular
Agents: Fibroblast growth factor; saporin  Vehicle: Sodium citrate; NaCl; EDTA; Route: IA (carotid); Species: Dog; Pump: 2002; Duration: 14 days;
ALZET Comments: Controls received mp w/vehicle; stability verified for 14 days by cellular assay; peptides; Saporin- FGF2 conjugate was infused; pump placed externally; Saporin is a potent ribosome-inactivating protein.

Agents: Epinephrine; Angiotensin II  Vehicle: Ascorbic acid; Route: SC; IA (carotid); Species: Rat; Pump: 2ML4; 1007D; Duration: 6 days;
ALZET Comments: controls received saline infusion; functionality of mp verified by plasma levels; stability verified by analyzing residual solution

Agents: Antibody, monoclonal, OX-19  Vehicle: Saline; Route: IA (renal); IV (femoral); Species: Rat; Pump: Not Stated; Duration: 7 days;
ALZET Comments: immunology; arterial infusion proved more effective than venous infusion

Agents: Interleukin-4; Interleukin-10  Vehicle: Not Stated; Route: IA (brachiocephalic); Species: Rat; Pump: Not Stated; Duration: 14 days;
ALZET Comments: immunology; peptides; pump infused the brachiocephalic artery of a harvested heart, which was then implanted into a recipient; recomb. mouse IL-4 & IL-10 used

Agents: BW2258U89  Vehicle: Saline; Route: IA (celiac); Species: Rat; Pump: 2001; Duration: 6 days;
ALZET Comments: controls received laporotomy & subsequent anesthesia; catheter tips passed through gauze before placement in arteries; catheters were anchored w/polypropylene microsuture; gauze was sutured to arterial wall

Agents: Fibroblast growth factor; Heparin  Vehicle: 125I tracer; Radio-isotopes; Route: IA (carotid); Species: Rabbit; Pump: 2001D; Duration: 24 hours;
ALZET Comments: Functionality of mp verified by residual radioactivity analysis; no stress (see pg. M631); good methods (p. M631); peptides; tissue distribution

Agents: Cell cultures, supernatant fraction of P8M  Vehicle: Not Stated; Route: IA (renal); Species: Rat; Pump: 2ML1; Duration: 5 days;
ALZET Comments: controls received mp w/ BSA in Hank’s solution; idiopathic minimal lesion nephrotic syndrome; patient mononuclear cells used; pumps sutured to abdominal wall; "...chronic infusion allowed us to avoid the sudden increase in intravascular volume observed during the acute infusion studies..." (p.590)

**Agents:** MPTP HCl  
**Vehicle:** Not Stated  
**Route:** IA (carotid)  
**Species:** Sheep  
**Pump:** 2ML1  
**Duration:** 1.7 weeks  
**ALZET Comments:** Neurodegenerative (Parkinson's disease); comparison of acute injections vs. mp; no stress (see pg. 474); catheter placed in proximal occipital artery (w/ distal end of artery occluded); "...slow continuous infusion may be a useful alternative to repeated dosing in animal studies using MPTP..."


**Agents:** Cisplatin  
**Vehicle:** Not Stated  
**Route:** IV (saphenous); IA (saphenous)  
**Species:** Rat (nude)  
**Pump:** 2ML1  
**Duration:** 6 days  
**ALZET Comments:** tissue perfusion (tumor xenograft); cancer


**Agents:** Antibody, monoclonal  
**Vehicle:** Saline  
**Route:** IA (renal); IV (femoral)  
**Species:** Rat  
**Pump:** 2ML1  
**Duration:** 7 days  
**ALZET Comments:** tissue perfusion (kidney allograft); dose-response (table, p.364); immunology; comparison of single IV bolus, systemic IV infusion, or regional IA infusion


**Agents:** Defibrotide; Cyclosporin A  
**Vehicle:** PBS; Cremophor  
**Route:** IA (innominate); IV (lumbar)  
**Species:** Rat  
**Pump:** 2002; 2ML1  
**Duration:** Not Stated  
**ALZET Comments:** Controls were untreated; comparison of ip injections or oral gavage vs. mp; defibrotide infused into artery of graft or recipient vein; defibrotide is an immunosuppressant w/ antithrombotic and profibrinolytic activities


**Agents:** Human placental lactogen  
**Vehicle:** Not Stated  
**Route:** IA (iliac)  
**Species:** Rat  
**Pump:** 2001  
**Duration:** 7 days  
**ALZET Comments:** controls received mp w/vehicle; stability verified in vitro for 6 days; peptides


**Agents:** Antibody, anti-epidermal growth factor; Epidermal growth factor  
**Vehicle:** Water; Glycerol; Sodium nitrate; Heparin; Albumin  
**Route:** IA (renal)  
**Species:** Rat  
**Pump:** 2002  
**Duration:** 14 days  
**ALZET Comments:** tissue perfusion (fetal tissue transplants); peptides


**Agents:** Urudine, fluorodeoxy-  
**Vehicle:** Heparin; Saline  
**Route:** IA (hepatic); IV (hepatic portal)  
**Species:** Rat  
**Pump:** 2ML2  
**Duration:** 7 days  
**ALZET Comments:** Cancer; 5000 IU/kg of heparin dissolved in saline; animal info (SD, F, 120-150 g); tissue perfusion (tumor); cancer; hepatic artery accessed via gastroduodenal artery; portal vein via ileocolic vein;


**Agents:** Insulin-like growth factor I  
**Vehicle:** Albumin, bovine serum; Saline  
**Route:** IA (suprarenal)  
**Species:** Rat  
**Pump:** 2ML1  
**Duration:** 7 days  
**ALZET Comments:** Controls received mp with vehicle; tissue perfusion (kidney); dose-response; peptides; pumps infused into the artery and directly into renal parenchyma via a catheter sealed at the end and punctured along the sides; recomb. human IGF-1 used
Agents: Antibody, anti-IGF I; Insulin Vehicle: 125I tracer; Heparin; Radio-isotopes; Serum, rabbit; Route: IA (iliac); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: functionality of mp verified by RIA; dose-response; peptides

Agents: Rapamycin Vehicle: Dimethylacetamide; PEG 400; Tween 80; Route: IA (innominate); IV (lumbar); Species: Rat; Pump: 2002; Duration: 14 days;
ALZET Comments: tissue perfusion (cardiac allograft); immunology; pumps implanted IP

Agents: Prostaglandin E2 analogue Vehicle: Ethanol; Saline; Route: IA (innominate); IP; IV (lumbar); Species: Rat; Pump: 2ML1; 2ML2; Duration: 1, 2 weeks;
ALZET Comments: tissue perfusion (cardiac allograft); immunology; pumps implanted IP

Agents: Hippuric acid Vehicle: 125I tracer; Radio-isotopes; Route: IA (suprarenal); Species: Rat;
ALZET Comments: Tissue perfusion

P2594: D. E. Andersen, et al. Metabolic effects associated with chronically elevated cortisol in rainbow trout (Oncorhynchus mykiss). Canadian Journal of Fisheries and Aquatic Sciences 1991;48(9):1811-1817
Agents: Cortisol Vehicle: Cyclodextrin, B-; Route: IA (dorsal aorta); Species: Fish (rainbow trout); Pump: 2001; Duration: 10,14 days;
ALZET Comments: controls received mp w/ vehicle or sham operation; functionalty of mp verified by RIA of plasma levels; stress from surgery caused hyperglycemia (p.816) for 22 hours; "Mini-osmotic pumps. . .were an effective method for chronically elevating cortisol titers in trout.; Molecusol HBP is a beta-cyclodextrin

Agents: Antibody, anti-fibroblast growth factor Vehicle: Glycerol; Sodium azide; Route: IA (suprarenal); Species: Rat; Pump: 2002; Duration: 14 days;
ALZET Comments: tissue perfusion (graft); peptides

Agents: Antibody, anti-fibroblast growth factor; Fibroblast growth factor Vehicle: Glycerol; Heparin; Saline; Sodium azide; Sodium citrate; Route: IA (renal); Species: Rat; Pump: 2001; 2002; Duration: 6, 11 days;
ALZET Comments: tissue perfusion: tissue graft; good methods for FGF/pg. 1765; peptides; basic FGF used

Agents: Epidermal growth factor Vehicle: Saline; Route: IA (renal); Species: Rat; Pump: 2001; Duration: 8 days;
ALZET Comments: controls received mp w/saline; peptides; medical category: renal; skc

Agents: Atrial natriuretic factor; cholecystokinin; Granulocyte-colony stimulating factor.; glucagon; insulin; interleukin-2; interleukin-3; melatonin; nerve growth factor; neurotensin; prolactin; theophylline Vehicle: Not Stated; Route: CSF/CNS, IA (femoral); intrasplenic; IP; SC; Species: Not Stated; Pump: Not Stated; Duration: Not Stated;
ALZET Comments: Peptides; ALZA-authored, review of peptide delivery issues and applications; tissue perfusion (spleen)
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Bibliography

Agents: Cyclosporin Vehicle: Cremophor; Route: IA (innominate); IV; Species: Rat; Pump: 2002; Duration: 14 days;
ALZET Comments: dose-response; comparison of gavage vs. mp infusion; functionality of mp verified by blood levels; tissue perfusion (heart allograft)

Agents: Insulin-like growth factor I; Parathyroid hormone Vehicle: Glycerol; Heparin; Sodium azide; Tris buffer; Route: IA (iliac); Species: Rat; Pump: Not Stated; Duration: 7 days;
ALZET Comments: functionality of mp verified by residual volume; peptides

Agents: OKY-046 Vehicle: Saline; Route: IA (renal); Species: Rat; Pump: Not Stated; Duration: 4 days;
ALZET Comments: tissue perfusion; OKY-046 is a thromboxane synthetase inhibitor

Agents: Angiotensin II; Norepinephrine Vehicle: Water; Route: IA (renal); IP; IV (jugular); Species: Rat; Pump: 2002; Duration: 1, 2 weeks;
ALZET Comments: dose-response (graph); tissue perfusion; peptides

Agents: Glutamine, glycyl-l- Vehicle: Plasma, heat-inactivated cat; Water; Route: IA (abdominal aorta); Species: Rat; Pump: 2001; Duration: 2 days;
ALZET Comments: controls received IA catheter, w/ no pump; tissue perfusion

Agents: Azidothymidine Vehicle: Not Stated; Route: IA (carotid); Species: Rat; Pump: 2001; Duration: 3, 7 days;
ALZET Comments: Dose-response; blood levels; comparison of IV injections vs. mp; good methods; antiviral; alkaline pH of 11 increased solubility and stability of AZT; antiretroviral drug

Agents: OKY-046 Vehicle: Saline; Route: IA (renal); Species: Rat; Pump: Not Stated; Duration: 4 days;
ALZET Comments: schematic of OP ligated to aortic cuff of allograft; tissue perfusion; cancer/immunology

Agents: Budesonide Vehicle: Propanediol; Water; Route: IA (carotid); IV (jugular); Species: Rat; Pump: 2ML2; Duration: 14 days;
ALZET Comments: dose-response; schematic shows IA catheter w/ mp; functionality of mp verified by plasma levels; tissue perfusion (heart); cancer/immunology

Agents: Uridine, fluorodeoxy- Vehicle: Heparin; Saline; Route: IA (hepatic); Species: Rat; Pump: 2ML2; Duration: 7 days;
ALZET Comments: regional chemotherapy; comparison of IA injections vs. mp infusion; cancer/immunology; tissue perfusion

**Agents:** Antibody, fibroblast growth factor; Serum, rabbit; Fibroblast growth factor **Vehicle:** Glycerol; Heparin, porcine; Sodium azide; Sodium citrate; Water; **Route:** IA (renal); **Species:** Rat; **Pump:** 2001; 2002; **Duration:** 6, 10 days;

**ALZET Comments:** antibody, transplanted embryo in kidney was perfused using renal artery; peptides; tissue perfusion; basic FGF used


**Agents:** Acenocoumarol **Vehicle:** PBS; Water; **Route:** IA (renal); IA (suprarenal); IA (testicular); intratesticular; **Species:** Rat; **Pump:** 2001; **Duration:** 5 days;

**ALZET Comments:** mp connected to catheter; functionality of mp verified by plasma and tissue levels; tissue perfusion; dose-response (table)


**Agents:** Acenocoumarol; Edetic acid; Hippuric acid; Propranolol; Radio-isotopes **Vehicle:** 125I tracer; 51Cr tracer; **Route:** IA; **Species:** Rat; **Pump:** Not Stated; **Duration:** Not Stated;

**ALZET Comments:** Targeted delivery; tissue perfusion; antihypertensive


**Agents:** Prednisolone **Vehicle:** Saline; Water; **Route:** IA (suprarenal); IP; **Species:** Rat; **Pump:** 2ML2; **Duration:** 14 days;

**ALZET Comments:** controls received mp w/saline; immunology; tissue perfusion


**Agents:** Prednisolone **Vehicle:** Water; **Route:** IA (suprarenal); **Species:** Rat; **Pump:** 2ML2; **Duration:** 14 days;

**ALZET Comments:** functionality of mp verified by serum levels; tissue perfusion (kidney)


**Agents:** Antipyrine; bleomycin; dopamine HCl; melatonin; methotrexate, sodium; nicotine; prednisolone; radio-isotopes; valproic acid **Vehicle:** 14C tracer; 3H tracer; **Route:** IA; IP; SC; **Species:** Mice; Rabbit; Rat; **Pump:** Not Stated; **Duration:** Not Stated;

**ALZET Comments:** ALZA-authored; synoptic review of mp; post op. care (antibiotic); comparison of sc injections vs. mp infusion; pulsed delivery


**Agents:** Growth hormone, human; Insulin-like growth factor I; Prolactin, ovine **Vehicle:** Saline, heparinized; **Route:** IA (femoral); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;

**ALZET Comments:** controls were untreated; mp connected to catheter in femoral artery; replacement therapy (hypophysectomy); local IA infusion; peptides


**Agents:** Nicotine **Vehicle:** Saline; **Route:** IA (carotid); **Species:** Guinea pig; **Pump:** 2002; **Duration:** 10 days;

**ALZET Comments:** mp connected to indwelling catheter in carotid artery
Agents: Saline Vehicle: Not Stated; Route: IA (renal); Species: Rat; Pump: 2001; Duration: 2, 3 days;
ALZET Comments: mp attached to catheter in suprarenal artery; tissue perfusion

Agents: Growth hormone, rat; Somatomedin C, human; Serum, rabbit; Antiserum, human somatomedin C, rabbit Vehicle: Glycerol; Sodium azide; Water, double-distilled; Sodium heparin; Route: IA (right superior vesicle); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: replacement therapy (hypophysectomy); peptides; minipump and catheter were implanted in abdominal cavity; some rats received co-infusion of GH and rabbit serum or antiserum

Agents: Growth hormone, rat; Prolactin, ovine Vehicle: Glycerol; Sodium azide; Route: IA (superior vesicle); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: replacement therapy (hypophysectomy); mp connected to catheter in superior vesicle artery; detailed description and diagram of catheter apparatus; constant and pulsed delivery of GH; peptides

Agents: Prednisolone Vehicle: Saline; Water; Route: IA (suprarenal); IA (testicular); IP; IV (jugular); Species: Rat; Pump: 2ML2; Duration: 13 days;
ALZET Comments: mp connected to catheter in suprarenal or testicular artery or jugular vein; states pump rate as 6 ul/hr; dose-response (serum urea levels); kidney transplant; immunosuppression; half-life; mp infusion prolonged graft survival; tissue perfusion

Agents: Prednisolone Vehicle: Water; Route: IA (suprarenal); IP; Species: Rat; Pump: Not Stated; Duration: Not Stated;
ALZET Comments: Immunology; tissue perfusion

Agents: Growth hormone; Insulin Vehicle: Glutamic acid; Glycerin; HCl; Sodium hydroxide; Phenol; Saline; Water; Route: IA (renal); Species: Rat; Pump: 2001; Duration: 7 days;
ALZET Comments: controls received mp w/saline; mp conn. to catheter in renal artery; comparison of sc inject. vs. mp infusion; repl. therapy (hypophysectomy); peptides; tissue perfusion

Agents: Saline Vehicle: Not Stated; Route: IA (renal); Species: Rat; Pump: 2001; Duration: Not Stated;
ALZET Comments: Pump used only to flush catheter and keep it patent when not in use; tissue perfusion

Agents: Saline Vehicle: Not Stated; Route: IA (renal); Species: Rat; Pump: Not Stated; Duration: 3, 5 days;
ALZET Comments: mp used only to keep catheters open prior to second part of surgery & prior to drug infusion; tissue perfusion
**Agents:** Norepinephrine  
**Vehicle:** Saline;  
**Route:** IA (renal); IV (jugular);  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 5 days;  
**ALZET Comments:** comparison of acute infusion by Percidor pump vs. iv or ia mp infusion; dose-response data; 2 doses NE - 4 and 36 ug/kg/hr; tissue perfusion

**Agents:** Norepinephrine  
**Vehicle:** Ascorbic acid; Saline;  
**Route:** IA (renal); IV (jugular);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 5 days;  
**ALZET Comments:** Comparison of iv vs. ia mp infusion; dose-response data; tissue perfusion

**Agents:** Saline  
**Vehicle:** Not Stated;  
**Route:** IA (renal);  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 2, 14 days;  
**ALZET Comments:** Pumps replaced after days 2 and 7; tissue perfusion

**Agents:** Norepinephrine  
**Vehicle:** Ascorbic acid; Saline;  
**Route:** IA (renal); IV (jugular);  
**Species:** Rat;  
**Pump:** 2001;  
**Duration:** 5 days;  
**ALZET Comments:** comparison of i.v. vs. i.a. infusion; tissue perfusion

**Agents:** Norepinephrine  
**Vehicle:** Ascorbic acid; Saline;  
**Route:** IA (renal);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 5 days;  
**ALZET Comments:** dose-response data; tissue perfusion