



RESEARCH MODELS

Surgical Services - North America

At Charles River we offer a variety of surgical services on five species (rat, mouse, guinea pig, hamster, and gerbil) at four different AAALAC-accredited production facilities in the United States and multiple international sites. Our surgical services are conducted by highly skilled surgeons with vast experience in veterinary medicine and animal science and range from simple procedures (e.g., soft tissue/organ extractions) to highly complex catheterizations and cannulations. We now offer more than 80 surgical procedures, all of which meet exacting scientific and regulatory standards. We continue to expand our capabilities, reflecting our ongoing commitment to providing the surgically altered animal models that meet your research needs.

State-of-the-Art Facilities

Charles River currently offers full surgical capabilities in several AAALAC-accredited facilities in North America. The surgical suites at each site are composed of HEPA-filtered, positive-pressure barrier rooms with a series of entry locks. Each suite features individual functional areas used for surgical manipulations, animal husbandry support, preoperative holding, postoperative recovery, supply preparation, and clerical activities.

Biosecurity

To ensure strict adherence to biosecurity policies, animals are not transferred between barrier production facilities, nor are non-Charles River animals used. Additional biosecurity measures include barrier-type surgical suites, the use of dedicated laminar flow workstations by each surgeon, and housing of animals in filter-top caging systems during the animals' stay in surgery.

Animal Welfare

Charles River's animal care and use program is accredited by AAALAC International. The entire surgical process (i.e., personnel training, animal anesthesia, analgesia, aseptic preparation, surgery, and postoperative care and holding prior to shipment) is reviewed and approved by our Institutional Animal Care and Use Committee (IACUC).

North American Surgical Locations

- Hollister, California
- Kingston, New York
- Raleigh, North Carolina
- Wilmington, Massachusetts

Capabilities

- Vascular catheterizations
- Non-vascular catheterizations
- Cardiovascular procedures
- Neurological procedures
- Soft tissue procedures
- Device implants
- Customized procedures
- Biospecimens

Vascular Catheterizations

Species	Procedure	Common Applications	Description/Comments
Rat, Mouse, Guinea Pig	Carotid Artery Catheterization – Common	Blood sampling or compound dosing; available in extended length catheters	A catheter is inserted into the common carotid artery. The catheter tip terminates at the aortic arch.
Rat, Mouse	Carotid Artery Catheterization – Cranial Dosing Model	Dosing compounds directly to the brain	A catheter is inserted into the common carotid artery with the catheter tip directed towards the brain. The common carotid is not ligated and retains blood flow to carry compounds to the brain.
Rat	Femoral Artery Catheterization	Blood sampling or compound dosing; available in extended length catheters	A catheter is inserted into the femoral artery.
Rat	Femoral Vein Catheterization	Dosing compounds or blood sampling; available in extended length catheters	A catheter is inserted into the femoral vein.
Rat	Hepatic Artery Catheterization	Direct infusion into the liver	A catheter is inserted into the hepatic artery. Animal's body weight is 320 g or greater. <i>Rent-A-Surgeon only.</i>
Rat, Mouse, Guinea Pig, Hamster, Gerbil	Jugular Vein Catheterization	Blood sampling or compound dosing; available in extended length catheters	A catheter is inserted into the right jugular vein. The catheter tip terminates 2-3 mm in the right atria.
Rat, Guinea Pig	Jugular Vein Catheterization – Double	Blood sampling from the right jugular vein and compound dosing through the left jugular vein	Both jugular veins are catheterized. The external jugular vein is used to catheterize both sides, with the right side terminating 2-3 mm in the right atria and the left side terminating in the superior vena cava.
Rat	Portal Vein Catheterization T-Tubing	Intestinal drug absorption, portal vein sampling, or infusion	A specially designed catheter with a T-tip is inserted directly into the portal vein.
Rat	Portal Vein Catheterization via Mesenteric Vein	Intestinal drug absorption, recommended for portal vein sampling or infusion	A catheter is inserted into the portal vein via the mesenteric vein.
Rat	Vena Cava – Femoral Vein Approach	Dosing to or sampling from the vena cava	The vena cava is catheterized via the femoral vein. Best used for the generalized placement of the catheter tip.
Rat	Vena Cava – Jugular Vein Approach	Dosing to or sampling from the vena cava	The vena cava is catheterized via the jugular vein.

Non-Vascular Catheterizations

Rat, Mouse	Bile Duct Catheterization	Routine sampling of bile for pharmacokinetic studies	Continuous loop system: one end of catheter placed in the bile duct, the other in the duodenum. The catheter is looped over the animal's back subcutaneously, with catheter access in the scapular area where an approximately 16 +/-3 mm section is exteriorized.
Rat, Mouse	Colon Catheterization	Dosing compounds into colon	Catheter is inserted into the colon. For infusion only.
Rat, Mouse	Cecum Catheterization	Dosing compounds into cecum	Catheter is inserted into the cecum. For infusion only.

Non-Vascular Catheterizations, continued

Species	Procedure	Common Applications	Description/Comments
Rat, Mouse	Duodenal Catheterization	Dosing compounds into duodenum	Catheter is inserted into the duodenum. For infusion only.
Rat	Ileum Catheterization	Dosing compounds into ileum	Catheter is inserted into the ileum. For infusion only.
Rat, Mouse, Guinea Pig	Intraperitoneal Catheterization	Infusion into the peritoneal cavity	A catheter is implanted and secured to the abdominal wall allowing access to the peritoneal cavity for the infusion of compounds.
Rat, Mouse, Guinea Pig	Subcutaneous Catheterization	Infusion into the spaces beneath the skin	A catheter is implanted and secured, allowing access to the subcutaneous space for the infusion of compounds.
Rat	Intrathecal Catheterization-Lumbar Approach	Direct infusion into subdural space of the spine	A catheter is inserted into the subarachnoid space of the spine at the L3-L5 region. The catheter is exteriorized from the scapular region. For infusion only.
Rat, Mouse	Jejunum Catheterization	Dosing of compounds into jejunum	A catheter is inserted into the jejunum. For infusion only.
Rat	Mesenteric Lymph Duct Catheterization	Immunological studies, lymph fluid sampling/collection	A catheter is implanted in the mesenteric lymph duct. For optimum patency, it is best to use these animals the day after surgery. <i>Rent-A-Surgeon only.</i>
Rat, Mouse	Stomach Catheterization	Routine compound infusion	Catheter is inserted into the stomach. For infusion only.
Rat, Mouse	Urinary Bladder Catheterization	Study the effects of micturition on a normal or unstable bladder using cystometry	A catheter is implanted in the urinary bladder wall to allow for dosing compounds.

Soft Tissue Procedures

Rat, Mouse	Adrenal Demedullation	Studies of sympathetic or parasympathetic nervous system, epinephrine, or norepinephrine	The cortex of each adrenal gland is cut and the medulla removed.
Rat, Mouse	Adrenalectomy	Studies of steroidal hormone metabolism and obesity	Adrenal glands are removed bilaterally. Retired animals are not recommended. Saline (0.9%) supplementation of water is required after surgery.
Rat, Mouse	Bile Duct Ligation	Studies of hepatic fibrosis, cholestasis, and drug metabolism with compromised liver function	The bile duct is ligated.
Rat, Mouse	Castration	Behavior studies, prostatic hyperplasia, and cancer	Testes are removed.
Rat	Hypophysectomy	Endocrinology studies	The pituitary gland is removed using parapharyngeal methods (through the neck). 5% glucose, sucrose, or sugar supplementation in water is required after surgery. Animals require warm environments.
Rat, Mouse	Hysterectomy	Hormonal and reproductive physiology studies	The entire uterus is removed, leaving the ovaries intact.

Soft Tissue Procedures, continued

Species	Procedure	Common Applications	Description/Comments
Rat, Mouse	Nephrectomy	Studies of hypertension or renal impairment	The left kidney is removed.
Rat, Mouse	Nephrectomy – 5/6	Hypertension, renal failure, and drug metabolism with compromised renal function	This is a two-part surgery, with 5-7 days between surgeries. The first surgery removes 2/3 of one kidney. The second surgery removes the entire other kidney. Upon request, a 5/6 nephrectomy can be done in a single surgery. A renal artery ablation model is also available upon request.
Rat	Olfactory Bulbectomy	Behavioral studies involving an impaired sense of smell, depression studies	The olfactory bulb is removed.
Rat, Mouse, Guinea Pig, Hamster, Gerbil	Ovariectomy	Osteoporosis, bone metabolism, and calcium absorption	Both ovaries are removed.
Rat, Mouse	Ovariectomy & Hysterectomy	Osteoporosis, bone metabolism, and calcium absorption	Both ovaries and the uterus are removed.
Rat	Parathyroidectomy	Study of calcium and phosphorus deficiencies and metabolism	Only the parathyroid glands are removed, leaving the thyroid glands intact. 1% calcium (calcium chloride, calcium lactate, calcium gluconate) supplementation is required after surgery.
Rat	Pinealectomy	Circadian rhythms, melatonin function, and metabolism	The pineal gland is removed.
Rat	Portacaval Shunt (Eck Fistula)	Hepatic metabolism of compounds	The portal circulation is changed, bypassing the liver and redirecting to the vena cava.
Rat	Renal Artery Ablation (Nephrectomy – 5/6)	Hypertension, renal failure, and drug metabolism with compromised renal function	This procedure is performed as a single surgery. The anterior and medium branches of the right kidney's renal artery are ligated. Then the left kidney is removed, but the adrenal gland is left intact.
Rat, Mouse	Splenectomy	Studies of immunology and hematopoietic diseases	The spleen is removed.
Rat	Splenic Denervation	Research involving early immune response	A small section of the splenic nerve is removed.
Rat, Mouse	Thymectomy	Immunology studies and transplant research	Both lobes of the thymus gland are removed.
Rat	Thyroidectomy	Thyroid function studies	Thyroid gland is removed; parathyroid gland is re-implanted.
Rat, Mouse	Thyroid-Parathyroidectomy	Calcium metabolism and thyroid function studies	Both the thyroid and parathyroid glands are removed. 1% calcium (calcium chloride, calcium lactate, calcium gluconate) supplementation is required after surgery.
Rat, Mouse	Tubal Ligation – Bilateral	Studies of ovarian function	Both uterine horns are ligated just below the fallopian tubes.
Rat, Mouse	Tubal Ligation – Unilateral	Studies of ovarian function	One uterine horn is ligated just below the fallopian tube.

Soft Tissue Procedures, continued

Species	Procedure	Common Applications	Description/Comments
Rat, Mouse	Ureter Ligation	Studies of renal impairment	One ureter is ligated below the hilus of the kidney.
Rat	Vagotomy – Bilateral Subdiaphragmatic	Differentiate peripheral and centrally-mediated effects on autonomic nervous system of drugs or other therapies	A small section of the vagus nerve from both trunks below the diaphragm is removed.
Rat, Mouse	Vagotomy – Hepatic Branch	Studies involving liver function	A small section of nerve from each hepatic branch that originates from the vagus trunk is removed.
Rat	Vagotomy – Bilateral Stomach	Studies involving gastric function	A small section of nerve from gastric branch of the vagus trunk is removed.
Rat, Mouse	Vasectomy	Bred to produce pseudopregnant females	A section of each vas deferens is removed.

Cardiovascular Procedures

Rat	Abdominal Aortic Banding	Hypertension model	Stenosis is created by two ligations or a hemoclip between the renal arteries using suture.
Rat	Atherosclerosis – Endothelial Injury	Study of atherosclerosis and endothelial injury	An embolectomy catheter is inserted into the left carotid artery and inflated to create injury to the vessel.
Rat	Myocardial Infarction	Study of heart disease	The left anterior descending coronary artery is permanently ligated.
Rat	Thoracic Banding – Ascending Aorta	Studies of left ventricular hypertrophy	Stenosis is created by ligation in the ascending aorta, resulting in an acute/subacute model that develops cardiac hypertrophy in 10 to 14 days.
Rat	Thoracic Banding – Transverse Aorta	Studies of left ventricular hypertrophy	Stenosis is created by ligation in the transverse aorta, resulting in a chronic model that develops cardiac hypertrophy in 6-8 weeks.

Neurological Procedures

Rat, Mouse	Third Ventricular Cannulation	Routine infusion to ventricular system	A cannula is implanted in the third ventricle using standard coordinates.
Rat	Angiotensin Testing	Validation test for ventricle cannulation surgery (can be added to any ventricle cannulation)	Animals are given a dose of Angiotensin II and allowed free water from pre-weighted bottles for 30 minutes. A water consumption of 5 g or more in the allotted time frame indicates a successful ventricle cannulation.
Rat	Bennett Model	Studies of neuropathy dealing with peripheral nerve injury	Four loose ligatures are placed around the common sciatic nerve.
Rat, Mouse	Bilateral Brain Cannulation	Routine dosing into two areas of the brain simultaneously	Coordinates for insertion of brain cannula need to be specified by customer at time of order.
Rat	Chung Model	Studies of neuropathy dealing with peripheral nerve injury	A single tight ligature is placed around the spinal nerve at L5-L6.

Neurological Procedures, continued

Species	Procedure	Common Applications	Description/Comments
Rat	Epilepsy Model	Studies involving screens for anti-seizure medications	Pregnant mothers are dosed twice with methylazoxymethanol acetate on gestational day 15, resulting in disrupted neurogenesis in cortical development in offspring. Later in life, when exposed to doses of pilocarpine, these offspring develop neuropathology that mimics that which is seen in epilepsy patients.
Rat, Mouse	Ganglion Denervation – Superior Cervical	Study effects of sympathetic denervation on the function of other organ systems	A small piece of nerve at a point 1 mm beyond the caudal portion of the superior cervical ganglion is excised.
Rat	Intracisternal Cannulation	Cerebrospinal fluid (CSF) sampling and dosing	A cannula is implanted in the cisterna magna, between the caudal part of the cerebellum and the medulla oblongata.
Rat, Mouse	Intralateral Ventricular Cannulation	Routine infusion of dosing compounds into the brain	A cannula is implanted in the lateral ventricle of the brain using standard coordinates. For infusion only.
Rat, Mouse	Intralateral or Third Ventricular Cannulation for osmotic pump attachment	Continuous infusion into the brain	A cannula is implanted in the lateral ventricle of the brain. Tubing connected to the cannula is subcutaneously tunneled towards the scapular region to connect to an osmotic pump for continuous delivery of compound to the brain.
Rat	Intrathecal Catheterization	Direct infusion into subdural space of the spine	A catheter is inserted into the subarachnoid space of the spine at the L4-L5 region. The catheter is exteriorized from the scapular region. For infusion only.
Rat	Microdialysis Guide Cannula Implantation	Brain microdialysis	A microdialysis guide cannula is placed in a customer-specified target area of the brain.
Rat	Middle Cerebral Artery Occlusion	Ischemic stroke model	The middle cerebral artery is occluded to create an ischemic stroke model. <i>Rent-A-Surgeon only.</i>
Rat	Osteoarthritis Model Induced with MIA	Studies involving therapeutics used to treat inflammation and osteoarthritis	Monosodium iodoacetate is injected into the femorotibial joint, inducing osteoarthritis.
Rat	Parkinson's Model	Parkinson's drug screening	6-hydroxydopamine solution is injected into the substantia nigra or medial forebrain bundle of the brain. An apomorphine challenge is done 5-7 days after surgery to verify success. Only animals that pass this test are shipped.
Rat	Schizophrenia Model	Studies identifying drug candidates that would not be discovered through traditional screens for antipsychotics	Pregnant mothers are dosed with methylazoxymethanol acetate on gestational day 17, resulting in disrupted neurogenesis in offspring. Later in life, these offspring show subtle behavioral changes, cognitive defects, neurochemical changes, and neuropathology that mimics those seen in schizophrenia patients.
Rat, Mouse	Unilateral Brain Cannulation	Routine infusion to a target brain area	A cannula is implanted in the customer-specified target area on one side of the brain.

Device Implant Procedures

Species	Procedure	Common Applications	Description/Comments
Rat, Mouse, Guinea Pig	Blood Pressure Telemetry	Blood pressure monitoring	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Blood Pressure/ Electrocardiograph (ECG) Telemetry	Blood pressure, heart rate and ECG monitoring	Customer supplies the telemetry device in manufacturer packaging.
Rat, Guinea Pig	Blood Pressure/ Electroencephalograph (EEG) Telemetry	Blood pressure, heart rate, and EEG monitoring	Customer supplies the telemetry device in manufacturer packaging.
Rat, Guinea Pig	Blood Pressure/ Electromyograph (EMG) Telemetry	Blood pressure, heart rate, and EMG monitoring	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Button	Accessory to catheterization surgery that allows for tethering or easier access to the catheter; comes in many variations and material composition (vendors include SAI, Instech, Access Technologies, and others)	The button is placed in the scapular area (standard practice). The catheter is then fed from the subcutaneous space up through the button to be exteriorized. In some cases, a button with a septum is available so that no catheter is exposed.
Rat, Mouse, Guinea Pig	Device Implantation 1	Subcutaneous implantation of varied nature with minimal manipulation required; includes hormone pellets, etc.	A small device requiring limited manipulation is implanted subcutaneously. Customer supplies the device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Device Implantation 2	Subcutaneous implantation of varied nature with extensive manipulation required; includes vascular access ports (VAP), osmotic pumps, etc.	A device requiring surgical manipulation is implanted. Requires an additional code to indicate vessel of entry. Customer supplies the device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Electrocardiograph (ECG) Telemetry	Recording changes in electrical potential that occur as the heart beats	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Electrocardiograph (ECG) + Electroencephalograph (EEG) Telemetry	Cardiovascular studies for recording changes in electrical potential that occur as the heart beats and for recording brain wave activity in neurological studies	Customer supplies the telemetry device in manufacturer packaging.
Rat	Electroencephalograph (EEG) + Electroencephalograph (EEG) + Electromyograph (EMG)	Recording brain wave activity using two sets of biopotentials, as well as the electrical activity associated with skeletal muscle function	Customer supplies the telemetry device in manufacturer packaging.

Device Implant Procedures, continued

Species	Procedure	Common Applications	Description/Comments
Rat, Mouse, Guinea Pig	Electrocardiograph (ECG) + Electromyograph (EMG) Telemetry	Cardiovascular studies for recording changes in electrical potential that occur as the heart beats and for monitoring animal activity or studying neuromuscular disorders by recording electrical activity associated with skeletal muscle function	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Electroencephalograph (EEG) + Electromyograph (EMG)	Recording brain wave activity, as well as recording electrical activity associated with skeletal muscle function	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Electroencephalograph (EEG) Telemetry	Recording brain wave activity in neurological studies	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Electromyograph (EMG) Telemetry	Monitoring animal activity or studying neuromuscular disorders by recording electrical activity associated with skeletal muscle function	Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse, Guinea Pig	Harness/Jacket	Accessory to a catheterization surgery to allow for tethering or easier access to catheter (vendors include SAI, Instech, and others)	The catheter is attached to the harness allowing access via the harness septum. Customer supplies the harness in manufacturer packaging.
Rat, Mouse, Guinea Pig, Hamster	Telemetry Implant – Activity + Temperature Monitoring	Activity/temperature monitoring	The device is placed in abdominal cavity. Customer supplies the telemetry device in manufacturer packaging.
Rat, Mouse	Vascular Pump Implant – Osmotic	Osmotic infusion dosing studies	Osmotic pump implanted. The relevant vascular catheterization procedure must be specified.

Surgical Support

Rat, Mouse, Guinea Pig, Hamster, Gerbil	Rent-A-Surgeon	On-site surgical support for procedures	Full-day service only. Typically Thursdays and/or Fridays. Requires prior IACUC approval of procedures to be performed.
Rat, Mouse, Guinea Pig, Hamster, Gerbil	Rent-A-Trainer	On-site surgical training for procedures	Full-day service only. Typically Thursdays and/or Fridays. Requires prior IACUC approval of procedures to be performed.
Rat, Mouse, Guinea Pig, Hamster, Gerbil	Customized	Variable	Our surgical staff will work with clients to develop and validate a customized surgical model.