

# BP and Heart Rate by Telemetry

Version: 1

Modified from: Butz *et al.* *Physiol Genomics*. 2001 Mar 8;5(2):89-97.

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**Summary:** Utilizing this telemetry we have the ability to simultaneously measure a pressure signal and biopotential signal (ECG, EEG, EMG) in a single mouse. This can provide a more comprehensive physiological assessment of cardiovascular function, the presence of any damage to the heart, the effects of drugs, specific genes or interventions used to regulate the heart.

## Reagents and Materials:

Reagent/Material	Vendor	Stock Number
Isoflurane	Baxter	
Ophthalmic Ointment	Butler	007312
Electric shaver		
Surgical Scrub	Operand	82-217
Sterile Saline (0.9% NaCl)		
Sterile Field Drape		
Heating Pad	Gaymar	TP22B
sterile cotton swabs	Puritan	806-WC
5-O suture	Medical Resources	L0079B
4-O suture	George Tiemann	160-1215
Surgical scissors		
Mouse Surgery Instruments	Data Scientific International	276-0034-001
Hemostat		
Vannas spring micro-scissors	Fine Science Tools	15610-08
Vessel cannulation forceps	Fine Science Tools	00608-11
Blunt dissecting	Fine Science Tools	14018-14

25-guage needles	Monoject	20046
1cc syringe	Monoject	501400
3cc syringe	Monoject	513918
veterinary adhesive		
Buprenex (buprenorphine hydrochloride)		
Gel leading micro-pipette tip		
HD-X11 transmitter	Data Sciences International	
Dataquest ART data acquisition system	Data Sciences International	

## Protocol:

**WARNING**

*All blood components and biological materials should be handled as potentially hazardous. Follow universal precautions established by CDC when handling and disposing of infectious agents.*

### Surgical Preparation

1. Administer the appropriate concentration of Isoflurane anesthesia so animal is in deep anesthetic plane. Isoflurane will be administered throughout the duration of the procedure.
2. Remove the body hair from all intended incision sites by shaving.
3. Surgically scrub the incision sites.
4. Once the animal is prepped for surgery and a sterile field has been established, the surgery is ready to begin.

### Carotid Cannulation *(Tissue hydration should be maintained throughout the procedure by irrigations with saline (0.9% sodium chloride) to the tissues as needed.)*

1. Position the animal in dorsal recumbency on the surgery table with the head closest to the surgeon. Provide supplemental warmth during the surgery.
2. Loosely tape the animal's forelimbs to the table.
3. Establish a sterile surgical field and apply sterile draping material.
4. Using small surgical scissors make a 1.5 cm midline incision through the skin on the neck.
5. Carefully separate the mandibular glands using sterile cotton tip applicators.
6. Carefully retract the left mandibular gland using an elastic stay hook and tape the hook to the surgery table.
7. Locate the carotid artery along the left side of the trachea using sterile cotton tip applicators. Using fine tipped, curved forceps, carefully isolate the vessel from the surrounding tissue, making sure not to disturb the vagus nerve.
8. Pass three pieces of 5-0 or 6-0 non-absorbable suture underneath the isolated artery section. The furthest cranial suture will be used to permanently ligate the carotid artery while the suture closer to the heart will be used to temporarily occlude blood flow to allow for placement of the catheter. The middle suture will be used to hold the catheter in place after cannulation of the artery.
9. Position the ligation suture just proximal to the bifurcation of the interior and exterior carotid arteries. Tie a secure knot around the artery to ligate the vessel and tape the suture tails to the surgery table.

10. Make a loose knot in both the occlusion suture and the middle suture and position them as close to the clavicle as possible thus isolating at least 6 mm of the artery.
11. After making a loose knot in both pieces of suture, clamp a hemostat on one of the tails of the middle suture.
12. Remove the transmitter from the sterile package and transfer it to the sterile field. Do not handle the transmitter by grasping the catheter. This may cause damage to the catheter or the pressure sensor.
13. Turn the AM radio on and carefully remove the tip cover. Removal of the tip cover should be done by alternating gentle traction and release. Take care to prevent gel loss due to compression of the catheter or sudden release of the tip cover. Always examine the catheter under high magnification before implantation for gel loss or bubbles. If there is gel loss or bubbles, the catheter will need to be re-gelled.
14. Prepare a catheter introducer by bending the beveled tip of a 25-gauge syringe needle. Hold the syringe needle with the beveled side facing up. Grasp just the beveled area of the needle with a needle holder and bend the tip downward to an angle of approximately 90°. The syringe needle may be placed onto a 1 cc syringe to be used as a handle to hold onto the needle and allow for a clear view of the surgical area.
15. Gently apply tension to the occlusion suture closest to the clavicle using a hemostat. This will elevate the artery and occlude blood flow. Caution: Excessive tension can damage the artery.
16. Grasp the tip of the catheter just distal to the thin-walled section using a Vessel Cannulation Forceps.
17. Using the 25-gauge needle as an introducer, pierce the artery just proximal to the ligation suture and insert the catheter upstream toward the aorta. Once the catheter is inserted into the vessel, withdraw the catheter introducer.
18. Advance the catheter into the artery until it reaches the occlusion suture.
19. Position the middle suture around the artery and catheter. Secure the catheter by pulling the loose suture tail to tighten the knot. Releasing the catheter before it is secured may cause it to come out of the vessel.
20. Once the catheter is secured, release the tension on the occlusion suture and advance the catheter beyond the suture into the thoracic cavity.
21. Continue to advance the catheter so that at least 2 mm of the sensing region of the catheter is positioned in the aortic arch.
22. Tighten the occlusion suture and the middle suture around the artery and catheter to seal the artery wall around the catheter stem.
23. Release the tension on the ligation suture and tie the loose ends around the catheter stem to help anchor it in place.
24. Trim all suture tails as short as possible. A very small drop of Vetbond tissue adhesive may be applied only to the suture knots to ensure that they remain secure. A gel-loading micropipette tip is recommended to dispense the tissue adhesive.

**Subcutaneous Device Placement**

1. Insert small surgical scissors into the incision and form a subcutaneous pocket by using blunt dissection. If the pocket is not made large enough, the skin will be stretched too tightly across the contours of the transmitter and pressure necrosis may result.
2. Once the pocket is formed, irrigate the pocket with a 3 cc syringe filled with warm, sterile saline. The syringe should easily slide down the full length of the pocket. Insert the HD-X11 transmitter against the body.
3. After inserting the transmitter, a small drop of Vetbond tissue adhesive can be used to secure the transmitter in place. Draw the Vetbond up in a 1 cc syringe and insert the syringe into the pocket with the needle removed to dispense.
4. Secure the catheter to the surrounding tissue using a few small drops of Vetbond tissue adhesive. This will prevent the catheter from being accidentally incorporated into the closing suture. A gel-loading micropipette tip is recommended to dispense the tissue adhesive.

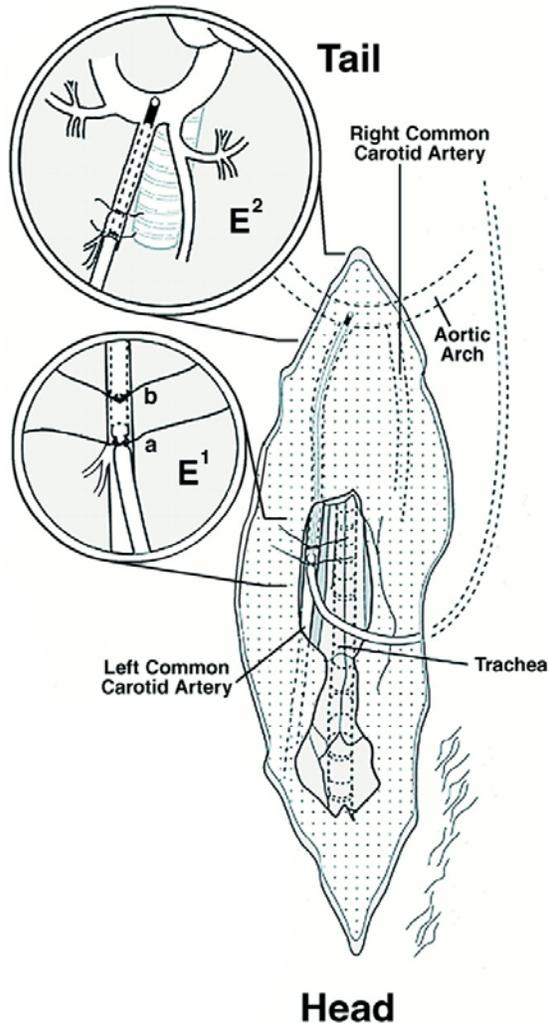
### **ECG Lead Placement with Subcutaneous Device Placement**

Once the transmitter is in place the leads will be tunneled subcutaneously to the desired ECG electrode locations.

1. Shorten the lead material to the appropriate length with a pair of scissors. A small amount of lead may be coiled under the skin to account for growth of the animal and re-use of the transmitter.
2. Cut around the silicone tubing at the tip of the lead using a sharp sterile scalpel blade and remove approximately 1 cm of the silicone tubing to expose the stainless steel wire.
3. Make tip covers by using the excess silicone tubing. After the silicone tubing is cut (Step 2), pull it to the end of the lead but do not remove it from the lead. Tie a piece of 5-0 or 6-0 non-absorbable suture around the silicone tubing and lead to secure the tubing in place. Cut off the excess silicone tubing that extends past the lead as this is not needed.
4. Place another suture around the silicone tubing just proximal to the exposed portion of the wire. This will inhibit fluids from migrating along the interior of the lead.
5. Ensure Steps 2 through 4 are completed for each lead.
6. Grasp the terminal end of the positive lead (red tubing) with a small hemostat and tunnel it subcutaneously from the neck incision to the left caudal rib region. This lead is positioned approximately 1 cm to the left of the xyphoid process.
7. Release the lead and withdraw the hemostat leaving the lead in place under the skin.
8. Grasp the terminal end of the negative lead (clear tubing) with a small hemostat and tunnel it subcutaneously from the neck incision to the right pectoral muscle.
9. Release the lead and withdraw the hemostat leaving the lead in place under the skin.
10. Ensure both leads are lying flat against the muscle for the whole length of the lead. This will avoid irritation of the tissue.
11. Secure both leads near the neck incision by placing a stay suture through the chest muscle and around the leads using 5-0 or 6-0 non-absorbable suture.
12. Close the skin incision using 5-0 or 6-0 absorbable or non-absorbable suture. Once closed, seal the incision with Vetbond tissue adhesive.

13. **Surgical Recovery**

14. Discontinue surgical anesthesia.
15. Maintain supplemental warmth throughout the anesthetic recovery.
16. The analgesic Buprenex is administered post-surgically.
17. Monitor animal closely for the return of normal postures and behaviors.



**Reagent Preparation:** *none*