

IACUC參考資料C

止痛、麻醉、術前與術後照顧

1 目的

These guidelines apply to all surgical procedures performed on rodents in which the animals are expected to recover from anesthesia. All staff working with animals is trained to recognize animal pain or distress, and know appropriate action to relieve pain or who to advise. 此規範的目的在確保術後的啮齒類實驗動物得以順利恢復。同時讓動物使用者可於疼痛發生時採取適當的措施。

2 名詞解釋

Survival Surgery procedures can be divided into:

存活性手術大致可分為兩類：

- 2.1 Minor Survival Surgery that is defined as any surgical intervention that does not penetrate a body cavity nor results in a permanent handicap in an animal that is expected to recover. Minor procedures are often performed under less stringent conditions than major procedures but still require aseptic technique and instruments and appropriate anesthesia. 次要存活性手術，指不侵入體腔或對身體機能、且不會造成永久性之損傷的手術。相較於主要存活性手術，次要存活性手術的操作條件較不嚴苛，但仍須符合無菌操作標準，並給予適當的麻醉。
- 2.2 Major Survival Surgery includes invasion of the cranial, abdominal or thoracic cavities. Any procedure that might leave the rodent with a permanent handicap, whether physical or physiological, would also be considered major surgery. The use of aseptic technique is mandatory in these surgeries to minimize the possibility of post-surgical infection. 主要存活性手術，指的是侵入頭顱、腹腔或胸腔的手術或對身體機能會造成永久性之損傷的手術。執行主要存活性手術，除了必須無菌操作，同時也需盡可能降低術後感染的機會。

3 PROCEDURES

3.1 Minor Surgery On Rodent 啮齒類實驗動物次要存活性手術

3.1.1 Instruments are sterilized prior to surgery. 所有器械應於手術前完成

消毒。

- 3.1.2 The surgical area should be disinfected with a 70% alcohol or quaternary ammonium compounds prior to surgery. 手術操作區需以70%酒精或四級胺類消毒劑進行消毒。
- 3.1.3 Animal should be free of clinical signs of disease. 動物必須沒有任何臨床症狀。
- 3.1.4 Prior to skin penetration, animal fur is shaved and skin cleaned and disinfected with 70% alcohol or surgical iodine. 手術區域的毛髮應於術前剃除乾淨，同時應清潔皮膚，並以70%酒精或手術專用碘液進行消毒。
- 3.1.5 The surgeon should wear sterile gloves and surgical masks. If performing batch surgeries, gloves should be changed. 手術操作人員應穿戴無菌手套及手術口罩。若連續進行多項手術，應於不同手術間更換手套。

3.2 Major Survival Surgery On Rodent 啮齒類實驗動物主要存活性手術

3.2.1 Animal Preparation 動物準備

- 3.2.1.1 Assess health status. Recommendations: 1-2 weeks of acclimation to animal facility, to overcome the stress of transportation. 評估健康狀態。建議動物應在手術前1-2週送達動物房，以讓動物有時間消除運送所造成的緊迫。
- 3.2.1.2 Should be free of clinical signs of disease. 動物必須沒有任何臨床症狀。
- 3.2.1.3 Normal intake of food and water. Fasting is generally unnecessary. Because rats and mice do not vomit, they do not have the risk of intra/post-op vomiting as in other species. If you will perform surgery on the gastrointestinal tract, you can fast the animals, but briefly (a few hours). 由於大鼠與小鼠無發生術間或術後嘔吐的危險，故無須禁食。但若是與消化道有關的手術，禁食幾個小時方可進行手術。

3.2.2 Pre-operative Preparation 術前準備

- 3.2.2.1 A separate facility for rodent surgery is not necessary. Surgery should be conducted in a low traffic, uncluttered area that promotes asepsis during surgery. 進行啮齒類實驗動物手術時不一定需要獨立的空間，但至少應為一個整齊的，且不是很多人往來經過的區域，以利無菌操作進行。
- 3.2.2.2 Surgical tables and equipment must be disinfected. 手術桌面與

器械必須徹底消毒。

3.2.2.3 Surgeon should use an appropriate anesthesia, in sufficient doses to block pain reflexes. Animal should be weighed for accurate anesthetic dosing. 手術操作人員應使用適當的麻醉以確實阻斷疼痛反射。動物必須秤重已估算正確的麻醉用量。

3.2.2.4 Examples 例如：

3.2.2.4.1 Ketamine-Xylazine, Intraperitoneally, 50-100mg/kg ketamine + 5-15mg/kg xylazine for procedures less than 30 minutes. Give 1/10 to 1/3 of original dose of ketamine only if additional anesthesia time is needed. 以50-100mg/kg ketamine + 5-15mg/kg xylazine的劑量進行腹腔注射，麻醉時間少於30分鐘。如果必須延長手術時間，可追加給予原劑量的1/10至1/3。

3.2.2.4.2 Gas anesthesia (isoflurane) requires appropriate scavenging system for safety of investigators. 氣體麻醉如 isoflurane 需要有適當的抽風排除系統，以確保研究人員的安全。

3.2.2.4.3 Sodium pentobarbital – 30-40 mg/kg intraperitoneally. Sodium pentobarbital以30-40 mg/kg的劑量進行腹腔注射。

3.2.2.4.4 常用的大小鼠麻醉劑與劑量如參考資料A。

3.2.2.5 Support normal body temperature during anesthesia. Rats and mice have high surface area and lose body heat rapidly. A major cause of surgical mortality is not the anesthesia or the surgery but hypothermia. Water-circulating blankets or heat lamps are recommended. 麻醉期間，應維持動物正常體溫。大鼠與小鼠有較高的體表面積，因此散熱較快。手術期間動物發生死亡的主要原因，常為體溫過低所致，不在麻醉或手術本身。建議可使用循環式溫水毯或保溫燈以保持動物體溫。

3.2.2.6 Prepare the animal by removing hair from the surgical site to prevent contamination with fur. But avoid taking off too much fur, because this will reduce the animal's ability to regulate his body temperature. 剃除手術區域周圍的毛髮，以避免毛髮造成污染。剃除過大範圍的毛髮會降低動物體溫調節的能力，應避免。

3.2.2.7 Prepare the surgical site at least 2 step solution preparation. First scrub with 70% alcohol swab followed by the iodine solution painted on the site. Minimize soaking the body of the rodent as

this could lead to hypothermia and possible death. 手術區域的消毒至少有2個步驟。建議先以70%酒精擦拭，接著以碘液塗佈於手術區域皮膚表面。避免將動物的全身皮膚都弄濕，否則可能造成動物體溫過低、甚至死亡。

3.2.2.8 It is recommended that a small amount of plain, sterile ophthalmic ointment be instilled in each eye of the anesthetized animal prior to surgery to prevent corneal drying. 術間建議塗抹無菌眼藥膏於動物雙眼，以避免手術過程中角膜乾燥受損。

3.2.2.9 Surgeons should wash hands with an antiseptic scrub preparation prior to surgery. The surgeon and any assistants working in the immediate surgical field must wear sterile gloves and a mask. Wearing a clean lab coat or clean scrub suit is mandatory. 執行手術的人員應於術前用抗菌劑刷手。術者與相關助手，均應穿戴無菌手套與口罩，並務必穿著乾淨的實驗衣或刷手服。

3.2.3 Surgery 手術

3.2.3.1 The animal should be maintained in a surgical plane of anesthesia throughout the procedure. Monitoring of anesthetic depth is critical. Periodic observation of respiration, color of mucous membranes and toe pinch reflex are recommended. 術間動物應維持在適合手術的麻醉狀態，並隨時監控麻醉深度，例如可定期觀察呼吸、黏膜顏色、及捏動物腳趾反射。

3.2.3.2 All instruments and materials used in the surgical procedure must be handled aseptically. 手術過程中所有用到的器械及材料均應滅菌。

3.2.3.3 Draping the surgical site with sterile drapes to avoid contamination of the incision, instruments and supplies is preferred. Drape should cover all exposed parts of rodent's body (tail, feet). 為了避免創口及手術器械受到污染，應在動物體表覆蓋創巾。創巾應覆蓋動物的所有暴露區域，包括尾巴及四肢。

3.2.3.4 Monitor and evaluate animal's vital signs during surgery every 10 minutes. 每10分鐘監控與評估動物的生命表徵。

3.2.3.5 Close surgical wounds using appropriate techniques and materials. Closure of the skin with non-capillary, non-absorbable material is essential to reduce the risk of post-operative infection. 選擇適用的方法與材料縫合創口。用於皮膚的縫線應使用無毛細現象、且為不可吸收性的材質，以降低術後感染的風險。

3.2.4 Post-Operative Care 術後照顧

- 3.2.4.1 Move the animal to a warm, dry area and monitor vital signs during recovery. 將動物移到溫暖、乾燥的場所，並持續觀察動物恢復時的生命表徵（例如呼吸與黏膜顏色）。
- 3.2.4.2 Give the animal fluids SQ (LRS 40-80 ml/kg/24hr), provide heat during recovery and offer moist foods on floor of cage. 可由皮下提供輸液（乳酸林格氏液 40-80 ml/kg/24hr），並提供保暖以利術後動物的恢復，也可在鼠籠內放置微濕的飼料。
- 3.2.4.3 Record your observations on the post-operative report form. 將術後觀察的結果記錄於術後觀察記錄表。手術記錄表與術後觀察記錄表可自行設計，但內容至少應包括：IACUC No.、手術日期、動物體重、麻醉劑使用、止痛劑使用、動物呼吸、活動力、傷口之觀察。
- 3.2.4.4 Provide analgesics as approved in your protocol. Record on post-operative report form. 依據實驗計畫書投予止痛藥，並記錄於術後觀察記錄表。建議術前投與止痛劑。大小鼠疼痛評估與常用止痛藥如附件。
- 3.2.4.5 Return the animal to its routine housing only after it has recovered from anesthesia and identify cage with blue tag so that the veterinary staff can perform the 2 day post-operative follow up of the animal. 在動物完全由麻醉狀態恢復後，才可以將動物送回原飼育房舍。該動物的鼠籠應明顯標示，以利獸醫師在術後2天內追蹤動物的健康狀況。
- 3.2.4.6 Examine animal at least daily for 3 days. Examine incision site for redness, discharge or swelling, and ensure animal is eating, drinking, urinating and defecating. 術後3天內，應至少每天檢查一次動物，檢查的項目包括縫合的創口紅腫的狀況，或是創口有無分泌物，動物的飲食、泌尿、排便狀況等。
- 3.2.4.7 If pre-op or post-op treatment with broad spectrum injectable antibiotic is required, consider one of the following: 若於術前或術後須使用廣效性的注射型抗生素藥物，可選用下列其一：
- 3.2.4.7.1 Baytril (enrofloxacin). Dose for rats is 2.5-5mg/kg IM or SC bid. Baytril(enrofloxacin)用於大鼠的劑量是以肌肉注射或皮下注射，每日兩次給予2.5-5mg/kg。
- 3.2.4.7.2 Cephalexin; rat dose is 15mg/kg SC bid. Cephalexin用於大鼠的劑量是以皮下注射，每日兩次給予15mg/kg。
- 3.2.4.7.3 trimethoprim/sulfadiazine; rat dose is 0.5ml/kg SC of a

240mg/ml solution. trimethoprim/sulfadiazine 用於大鼠的劑量是以皮下注射給予0.5ml/kg，240mg/ml（即120mg/kg）。

3.2.4.8 Remove skin sutures or staples 10-14 days following surgery. 術後10-14天，拆除皮膚的縫線或皮釘。

3.2.4.9 In the event of post-operative complication (infection, recovery) contact the veterinary staff immediately. 當發現術後併發症（如感染或恢復期拖長），應立即與獸醫師聯繫。

參考文獻：

University Animal Care Committee Standard Operating Procedure #10 (October 2005 version), McGill University

參考網址: <http://www.nlac.org.tw/n7/n7-2-1.asp>