EQUIPMENT FOR USE IN MONITORING ANESTHETIZED ANIMALS IN REMOTE GEOGRAPHIC LOCATIONS

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Abstract

Monitoring anesthetized animals in remote geographic locations with no electrical power source can be accomplished with the use of commercially available equipment or with modifications of available equipment. The use of portable solar panels to recharge batteries can supply adequate power to operate most equipment. Equipment for monitoring oxygenation, ventilation, cardiac rhythm and rate, blood pressure and core temperature have been successfully used in areas without an electrical grid or electrical generators.

Criteria for Choice of Equipment for Field Use

Size, weight, power requirements, durability and the ability to operate in harsh environmental conditions should be considered when choosing monitoring equipment for field use. Of concern are the power requirement and the source of the power, particularly in areas where there is no power grid or generator available.

Power Source

There are a number of types of rechargeable batteries on the market.[1] Nickel metal halide batteries (NiMH) were chosen for use in monitoring equipment in this study (MAHA Powerx 2100mAh, Thomas Distributing, 128 East Wood, Paris, IL 61944). NiMH batteries have several features that make them attractive for remote use.[1] They can be recharged 500 to 1000 times, have no memory, have a fairly steady discharge curve and have the least negative environmental impact when disposed of than other available batteries.[1] One disadvantage of NiMH batteries is that they have a self discharge rate of 2-3% per day when not in use. AA NiMH batteries produce 1.2 volts.

Battery energy output is measured in milliamp hours (mAh)[2]. A battery rated at 1700 mAh will produce 1700 mA for 1 hr. Different manufacturers produce batteries with different power outputs. AA NiMH batteries are rated at up to 2400 mAh. The higher the mAh, the greater the output of the battery.

Batteries are charged using fast, smart chargers attached to portable solar panels (iPowerUS fast smart charger, iPower corporation, CA, USA). A fast charger delivers the amount of current

necessary to recharge the battery in 1 hr or less. In general, a slower charge rate will extend the overall life of the battery.[3] To overcome the deleterious effects of rapidly charging a battery, a smart charger has a current-limiter built into it that reduce the current as the battery is charged, thereby preventing most of the deterioration.[3] The fast smart charger is attached to a portable solar panel (Sun Catcher Expedition solar charger, PowerQwest, Inc.3400 Corporate Way, Suite C Duluth, GA 30096 USA) via a 12 volt "cigarette lighter" type plug.

The panel produces 25 watts of power, which is more than enough power to charge 8 AA NiMH batteries at a time.

Equipment that uses AA or AAA batteries is preferred so that a large number of different sized rechargeable batteries are not required in the field.

Monitoring Equipment

Oxygenation is measured with a pulse oximeter or by arterial blood gas determination using a portable clinical analyzer. Several brands of pulse oximeters have been successfully used and recharged in the field. An Invacare model 3402NV (Sims BCI, Inc., Waukesha, WI 53186) is relatively small, light weight and operates on 6 AA batteries. This oximeter is durable and operates well on rechargeable AA NiMH batteries.

An I-Stat portable clinical analyzer (Heska Corp. 1613 Prospect Parkway, Fort Collins, CO 80525 USA) has been successfully used in the field using rechargeable 9-volt NiMH batteries. A challenge of using the I-Stat in the field is the analyzer's normal operating temperature of 16-30°C (61-86°F). The I-Stat has been kept in the proper operating temperature range by placing it in a 12-volt thermoelectric cooler (Coleman, Spirit Lake, IA 51360, USA). The thermoelectric cooler runs directly off of the solar panel.

Ventilation is measured using capnography or arterial blood gas determination. The criteria for choice of a capnograph include a waveform display, mainstream and sidestream capabilities and powered by rechargeable AA batteries. The Novametrix Tidal Wave model 615 (Novametrix Medical Systems, INC., Wallingford, and CT USA 06492) meets these criteria. The Tidal Wave comes standard with a rechargeable computer-type battery, but can be ordered with a battery tray, which holds 7 AA batteries. This instrument is durable and operates well on rechargeable NiMH batteries. The sidestream capability allows a large gauge needle to be placed in the lumen of a large endotracheal tube for sampling.

Cardiac rate and rhythm are monitored by use of an electrocardiograph (ECG). A compact ECG unit (Heska Vet/ECG 2000, Heska Corp., 1613 Prospect Parkway, Fort Collins, CO 80525 USA) that operates on 3 AAA rechargeable NiMH batteries is durable and dependable in the field.
Blood pressure is measured by a direct arterial line or by indirect methods. Of the indirect methods, automated oscillometry has been successfully used in the field. No automated

oscillometric blood pressure machine that runs on replaceable batteries could be found. A compact, durable instrument, Oscillomate 9300 (CAS Medical Systems, Inc., 44 East Industrial Blvd., Branford, CT 06405), was modified for field use. A transformer was manufactured which is inserted between the internal battery of the blood pressure monitor and the solar panel. This allows the internal battery of the blood pressure monitor to be recharged directly from the solar panel.

All monitoring equipment, battery chargers and rechargeable NiMH batteries are transported into the field in a backpack that is designed for photographic equipment (Lowepro Supertrecker AW II, Lowepro USA, P.O. Box 6189, Santa Rosa, CA 95406).

All of the above equipment has been dependably used to monitor immobilized elephants in a variety of remote habitats in Cameroon, including dry, hot habitat,[2] hot humid habitat.

LITERATURE CITED

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