

# KETAMINE IMMOBILIZATION OF SOUTHERN ELEPHANT SEALS BY A REMOTE INJECTION METHOD

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**ABSTRACT.** Ketamine hydrochloride in intramuscular doses of 4.5–13.6 mg per kg body weight was found to be a useful and satisfactory method of immobilizing male and female Southern elephant seals in order to obtain bacteriological specimens. A simple method of remote injection is described which avoids wastage of Ketamine in the event of the needle being displaced and which enables incremental doses to be given without re-inserting the needle.

Ketamine hydrochloride (Vetalar, Parke-Davis & Co., Pontypool) has previously been used with success to immobilize the Northern elephant seal *Mirounga angustirostris* although no adult males were included as subjects (Briggs and others, 1975). Ketamine is a very potent analgesic and dissociative sedative. Unlike other anaesthetics, it does not usually affect the pharyngeal muscles, so that the animal can breathe on its own without obstruction.

Bacteriological specimens were required from the eyes, nose, pharynx, skin and rectum of the Southern elephant seal *Mirounga leonina* as part of a project to isolate the organism responsible for the characteristic finger infections (seal-finger or Spekkfinger) contracted by seal handlers and hunters. Immobilization of the seals was necessary to enable uncontaminated swabs to be obtained in safety.

The sub-Antarctic island of South Georgia has a large population of Southern elephant seals and a history of seal-finger amongst seal hunters of the past. The specimens were taken between January and April 1979. At this time, the beaches were only sparsely populated by seals as the breeding season had terminated and many seals had completed the moult.

## MATERIALS AND METHODS

Five seals (three adult males, one adult female and a first year female pup) were immobilized by injection of Ketamine. The subjects selected were apparently in good health and somnolent. They were in locations facilitating approach, administration of the drug, and retreat, i.e. on a flat terrain of short grass or tussock away from mud wallows and the sea.

### *Dose estimation*

No method was available for direct weighing of the seals before or during immobilization, but regression equations exist that relate weight to body length in the Southern elephant seal (Ling and Bryden, 1981):

$$\text{Males: } W = 131.49 + 0.00002079 \times L^3$$

$$\text{Females: } W = 195.51 + 0.00000400 \times L^3$$

where  $W$  = body weight in kg, and  $L$  = the standard length in cm (measured in a straight line from the tip of the nose to the tip of the tail). The standard length was estimated roughly before immobilization without disturbing the seal. The approximate weight was obtained from the equations, and a total dose calculated. The dose/weight ratios were based on dose rates of 1.4–6.9 mg per kg known to immobilize the Northern elephant seal (Briggs and others, 1975). During immobilization, accurate measurements of standard length were made which could

then be used to re-estimate body weight and re-calculate a more accurate dose/weight ratio.

#### *Method of administration*

Intramuscular injection of Ketamine by hand-held syringe, although satisfactory for females and pups, was found to be impractical in the case of adult males. The aggressive reaction of a large seal on being disturbed was incompatible with the safety of the operator over the long injection time necessitated by the large dose volumes involved.

Use of a spring-loaded syringe was attempted so that retreat could be effected as soon as the needle had been inserted into the hip region. Invariably the seal reared, violently withdrew its hind quarters and often pursued the operator. If the syringe is displaced by these movements, the spring continues to operate and the Ketamine is lost onto the ground. The high cost of Ketamine was the major factor in rejecting this method.

The method finally adopted involved the use of a human spinal needle (Monojet  $3\frac{1}{2}'' \times 18$  gauge) without stylus which was connected and wired to a series of two lengths of transparent plastic intravenous drip tubing (Baxter Travenol) with reservoir chambers removed (Fig. 1). The tubing was filled with the dose of Ketamine ( $200 \text{ mg ml}^{-1}$  solution) and the operator end of the tubing was closed by a clamp to avoid loss until injection commenced. The needle was inserted into the dorsal hip area of the seal and retreat effected immediately, allowing the seal to become quiescent again. A long length of thin cord attached to the operator end of the tubing allowed that end to be drawn towards the operator without further approach to the seal. The column of Ketamine in the tubing could then be injected into the seal in safety from a distance of about 3 m by introducing air or water into the operator end.

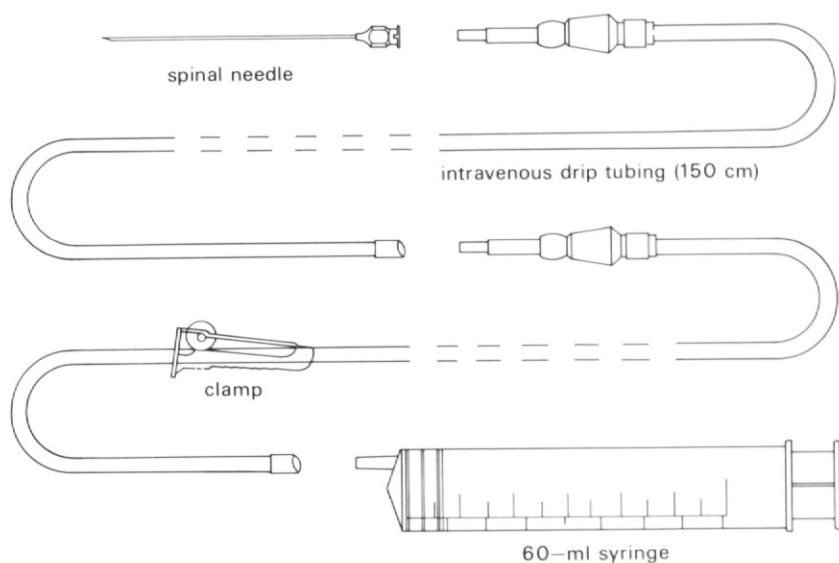


Fig. 1. Apparatus for remote injection.

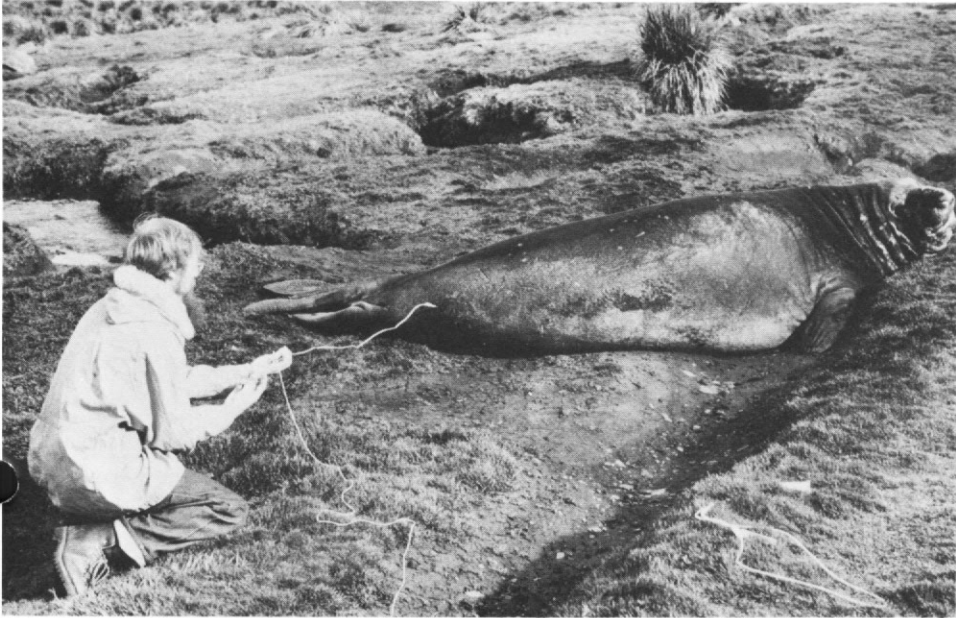


Fig. 2. Injection of Ketamine into a young male Southern elephant seal.

By this means the dose was not wasted in the event of the needle being displaced and incremental doses could be given without re-inserting the needle (Fig. 2).

#### *Measurement*

The seals were observed throughout the period of immobilization and recovery for degree of mobilization, state of muscle tone and reflex activity. Heart rate was measured by palpation or auscultation, respiratory rate by observation and core-temperature by rectal bi-metal thermometer. An attempt was made to measure the arterial blood pressure of the seal pup.

Induction time was measured from the start of the injection until the seal ceased to raise its head on approach.

'Duration of maximum immobilization' was defined as the time between induction and the onset of uncoordinated provoked voluntary movement.

'Total immobilization time' was measured from induction until the seal was able to raise its head when approached.

#### RESULTS

Table I shows the effect of intramuscular Ketamine on five Southern elephant seals.

Seals 1 and 3 were given initial doses of 4.48 and 4.63 mg per kg body weight respectively, but when after 20 min no signs of immobilization were apparent, additional Ketamine doses of 1.58 and 2.93 mg per kg respectively, were injected through a re-inserted needle to make total dose rates of 6.06 and 7.56 mg per kg. The induction times in these two cases are measured from the point at which these additional doses were given.

Table I. Effect of intramuscular Ketamine on Southern elephant seals.

<i>Seal no.</i>	<i>Sex</i>	<i>Standard length (m)</i>	<i>Calculated weight (kg)</i>	<i>Dose rate (mg per kg body weight)</i>	<i>Induction time (min)</i>	<i>Duration of maximum immobilization (min)</i>	<i>Total duration of immobilization (min)</i>	<i>Rectal temperature (°C)</i>	<i>Heart rate (beats per min)</i>	<i>Respiration rate (expir. per min)</i>
1	M	4.18	1650	4.48 + 1.58 total: 6.06	7	25	90	36.0-36.5	34-40	3.5
2	M	3.81	1281	4.6	12	42	61	35.8-36.6	54	4
3	M	3.60	1102	4.63 + 2.93 total: 7.56	11	38	67	35.7-36.3	38-45	4
4	F	2.76	279.6	13.6	7	45	120	36.0	72-76	4
5	F	1.60	211.9	4.85	9	63	88	36.5	72-76	5.5-7.0

In all seals except no. 4, immobilization was preceded by 30–60 s of generalized moderate tremor which did not recur. In all cases, some muscle tone was present throughout immobilization. The tongue protruded in all cases. No cyanosis of the mucous membranes was observed in any seal at any time. Salivation was thought to be increased in seal 2 but an increase in lacrimation observed in seals 2, 3 and 5 was thought to be of doubtful significance as eye swabs had been taken in all cases. At maximum immobilization in each case, corneal reflex was present and in seal 2 a minimal withdrawal reaction to painful stimuli was observed but all other movement was absent.

Ketamine in dose rates ranging from 4.6 to 13.6 mg per kg body weight provided deep immobilization for periods from 25 to 63 min and periods from 61 to 120 min when the seal could be handled relatively easily and safely.

All rectal temperatures varied by less than 1°C. There was little change in heart rate and respiratory rate during immobilization and no suggestion of pathological cardiac arrhythmia.

Measurement of arterial blood pressure was attempted on the first year pup (seal 1) during immobilization simply by using a medical sphygmomanometer on the front limb and arterial auscultation. Repeated estimations gave systolic pressures of 110–115 mmHg, and diastolic pressures of 60–85 mmHg. It was not possible to use this method on the larger seals.

All seals were marked with paint and examined 24 h post-immobilization. All were apparently in good health and exhibiting no signs of abnormal movement or behaviour.

#### DISCUSSION

Ketamine has previously been used intramuscularly in other pinnipeds with success. The results suggest that Ketamine can also be used to immobilize the Southern elephant seal (Geraci, 1973; Trillmich and Weisner, 1979).

The intramuscular route provides ease of administration and Ketamine requires no antagonist. Immobilization for periods up to 2 h had no apparent adverse effect. Inadvertent self-injection of Ketamine by the operator would not be expected to present the same potentially fatal consequences following for example Etorphine (Immobilon) injection (Firn, 1973).

There appears to be a wide individual tolerance. No adverse effects were noted using a dose rate as high as 13.6 mg per kg in one seal although a dose rate of 4.6 mg per kg provided deep immobilization in another. Seals 1 and 3 were unaffected by initial doses similar to that causing deep immobilization in Seal 2. But a relatively small additional dose through a replaced needle provided rapid immobilization. It is probable that part of the initial injections were misplaced outside the muscle mass. The placing of the needle is of necessity a hurried procedure.

The use of Bryden's regression equations for weight estimation has limitations. The weight of a seal varies considerably with the time of year due to fluctuations in the amounts of blubber and (to a lesser extent) muscle as proportions of the total body weight. Bryden's data for males were obtained at about breeding time or in winter whereas those for large females were secured during the moult, when blubber weight was low (Bryden, 1969; and personal communication). However, as the poorly vascularized blubber is minimally involved in the initial distribution of Ketamine and hence its concentration in the blood, this fluctuation may not be of great importance. Weights estimated in the field by visual assessment of standard

lengths and inspection of weight versus length curves, even if not physiologically very meaningful, could be used as a basis for calculating dose-rates. By having available an excess of anaesthetic solution in the syringe system the method described could be used to administer a further dose should the initial injection not prove effective.

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