

Performance of Ketamine as a General Anesthetic for Domestic Fowl
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ABSTRACT

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Ketamine hydrochloride was tested as a general anesthetic administered as a single intramuscular injection at doses of 20, 30, 60, 175 or 350 mg/kg to 40-day-old male White Leghorn chickens. Doses of 175 or 350 mg/kg are lethal to these birds. Toxicity of the drug was expressed by the formula $y = 0.984x + 1.72$ using probit analysis with LD50 and LD99 values at 49.07 and 98.86 mg/kg, respectively. The ED50 was 1.67 mg/kg. The therapeutic index (TI) was 29.38, indicating a wide margin of drug safety. The time for onset of anesthesia was 1-10.7 min depending upon dose levels with drug dose and response being negatively correlated ($y = -4.85x + 13.933$). Stable anesthesia was maintained for 20-60 min with mean recovery time of 43.6, 42.4 and 35 min in the groups treated at 20, 30 or 60 mg/kg, respectively. Differences between groups, however, were not significant ($p > 0.05$) when scores for individual birds were analyzed. No untoward effects were observed up to 3 weeks when the experiments were terminated. It is proposed that Ketamine, when given intramuscularly, has the potential to be used effectively and safely as a general anesthetic for domestic fowl.

INTRODUCTION

Ketamine is a [cyclohexanone](#) derivative with analgesic and anesthetic properties. It is administered intravenously or intramuscularly to both

mammalian and avian species. Several investigators have recommended ketamine hydrochloride as a suitable

injectable general anesthetic Mandelker, 1972; Boever and Wright, 1975; Paul-Murphy and Fialkowski, 2001). According to Sinn (1994), the drug is effective in various species of birds at doses of 5-75 mg/kg with a wide margin of safety in most of these species (Anon 2001). In most instances, however, ketamine is used in combination with other injectable agents such as xylazine, diazepam or midazolam to reduce or eliminate undesirable side effects if used alone (Maiti *et al*, 2006; Durrani *et al*, 2014). The present study was performed to assess the performance of this drug as a general anesthetic when administered to domestic fowl. Assessment was made in terms of drug basic toxicity, therapeutic efficacy, margin of safety, time for onset of anesthesia and recovery from of anesthesia.

Onset of Anesthesia: Birds treated at different dose levels were observed closely to determine the time for onset of anesthesia measured from the instant of injection of the anesthetic to the moment the bird fell permanently on its side. Mean time for different groups was considered when results were analyzed.

Recovery from Anesthesia: Recovery time was recorded for individual birds in groups treated with different doses starting from the time of onset of anesthesia until the bird was

agent for birds (Kittle, 1971;

MATERIALS AND METHODS

Treatment: Twenty 40-day-old clinically healthy White Leghorn chickens of body weight 842 – 1015 g, average 860 g, were randomly divided into 5 groups. They received single ketamine intramuscular (i.m.) injections (Ketamine hydrochloride, ROTEXMEDICA GmbH, Trittau, Germany) in the pectoral muscle at doses of 20, 30, 60, 175 or 350 mg/kg administered to 5,5,5,3 or 2 birds per group, respectively. Drug toxicity was assessed in terms of the median lethal dose (qualified as LD50 i.m.) and LD99 using probit analysis (Randhawa, 2009).

Therapeutic Efficacy and Drug Safety: The two criteria were evaluated in terms of the median effective dose (ED50) and Therapeutic Index (TI), respectively

fully awake showing normal physical responses.

RESULTS

Drug Toxicity: The i.m. administration of ketamine to chickens at doses of 20, 30 or 60 mg/kg was tolerated by birds. A dose of 350 mg/kg was instantly lethal to these birds. A single bird in the group treated at 175 mg/kg survived anesthetic treatment and eventually died after 2 hours. Probit analysis provided the formula $y = 0.984x + 1.72$ with $LD50 = 49.07$ mg/kg and $LD99, 98.86$ mg/kg (Figure 1).

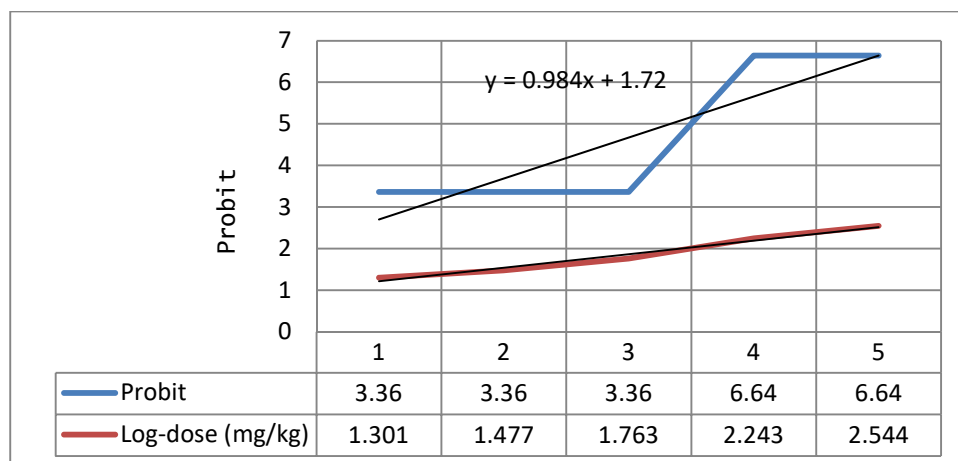


Figure 1: Toxicity of Ketamine hydrochloride administered intramuscularly to 40-day-old chickens: Quantal log - dose response relationship

Drug Safety: Linear interpolation (Microsoft Excel) provided the formula $y = 30x$ (Fig. 2) with ED50 equals 1.67 mg/kg. The Therapeutic Index (LD50/ ED50) equals 29.38.

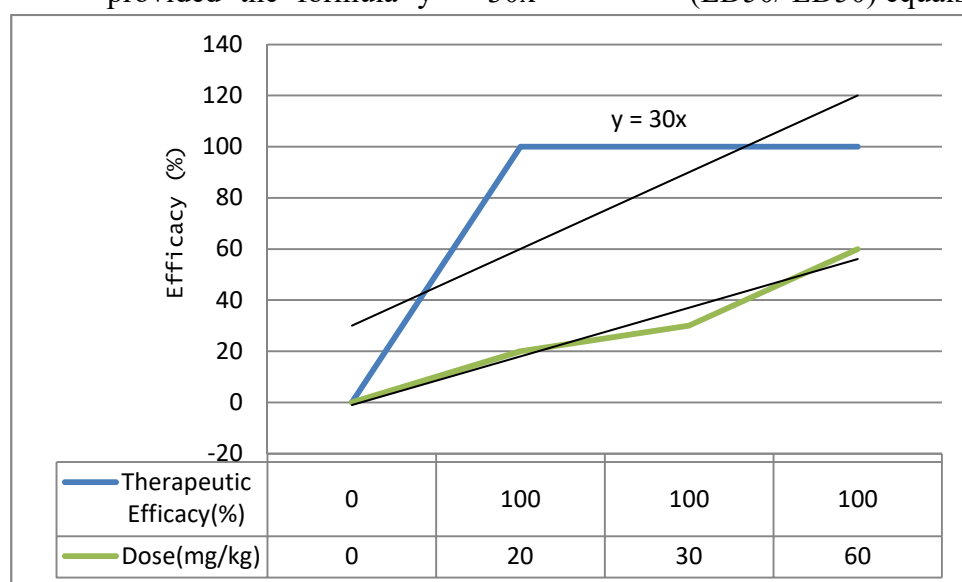


Figure 2: Therapeutic effect of ketamine administered to 40-day-old chickens

Onset of Anesthesia: The mean time for onset of anesthesia varied between different groups ranging between 1-10.7 min depending upon dose level (Figs 3. There is an inverse relationship between dose and response ($y = - 4.85x + 13.93$).

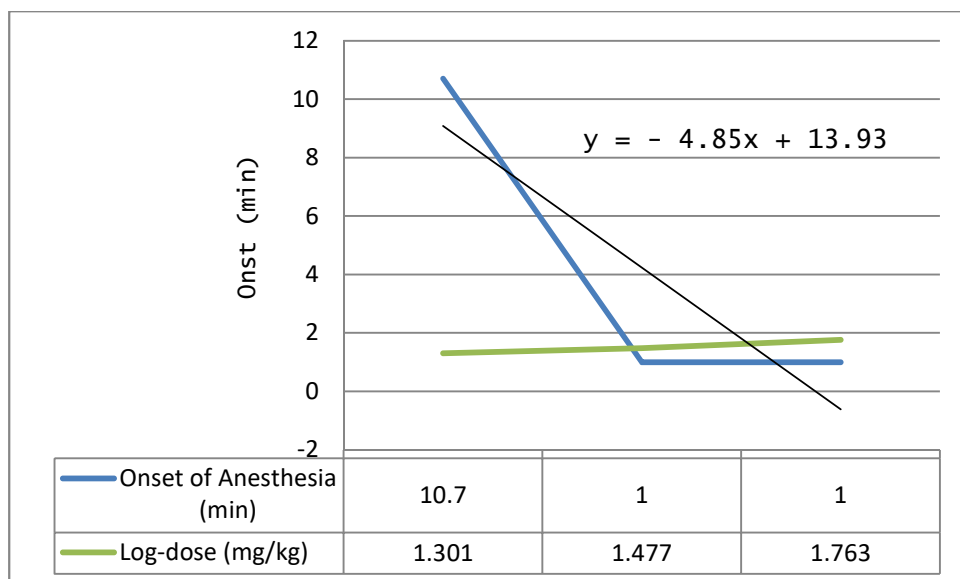


Figure 3: Onset of Ketamine –induced Anesthesia in 40-day-old chickens

Recovery from Anesthesia:

Stable anesthesia was maintained for 20-60 min with mean recovery time of 43.6, 42.4 and 35 min in the groups treated at 20, 30 or 60 mg/kg, respectively. Differences between groups, however, were not significant ($p > 0.05$) when scores for individual birds in these groups were compared ($n_1 = n_2 = n_3 = 5$; $T > 17$; Wilcoxon Rank Test).

DISCUSSION

Doses ranging from 20 – 60 mg/kg appeared to be well tolerated by birds. This conforms to results (Sinn, 1994) that Ketamine is effective at doses of 5-75 mg/kg in various species of birds. Results also indicate a wide margin of safety as judged by drug Therapeutic Index. Onset of anesthesia was within 60 seconds in birds treated with 30 or 60 mm/kg. Such a rapid mode of drug action may be considered an advantage. The finding that onset of anesthesia took a longer time (10.7 min) in the group given 20 mg/kg than in

those given either 30 or 60 mm/kg indicates an inverse relationship between dose and response ($y = -4.85x + 13.933$).

Following onset of anesthesia recovery lasted 35-43.6 min in birds treated with doses of 20, 30 or 60 mg/kg. Recovery was consistently smooth and no untoward clinical reactions were recorded for up to 3 weeks when the experiments were terminated. These results suggest that ketamine is a potential candidate for application as a general anesthetic for domestic fowl. Generally, ketamine has been shown to have a highly variable effect in different avian species with side effects such as cardiac and respiratory depression, increased blood pressure and prolonged physiological changes (Sin, 1994). The drug therefore is commonly used in combination with other injectable agents to reduce or eliminate side effects such as muscle rigidity and violent recoveries (Maiti *et al*, 2006; Durrani *et al*, 2014). The

results reported in the present study may be of value in situations where resources are limited and it is not feasible to perform anesthesia with drug combinations or use other methods such as inhalation anesthesia. Such a proposition may to be weighed against possible drug side effects.

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