INTRAMUSCULAR ANESTHESIA OF BELUGA (*HUSO HUSO*) WITH KETAMINE

SHAFIGH SHAFIEI[1*], MASOOMEH GHADAM[2], HOOMAN RAHMATI-HOLASOO[1], HOSSEINALI EBRAHIMZADEH MOUSAVI[1]

[1]Department of Aquatic Animal Health, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran, [2]Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran

[*]Corresponding author e-mail: Shafiei_sh@ut.ac.ir

INTRAMUSKULARNA ANESTEZIJA MORUNE (*HUSO HUSO*) SA KETAMINOM

Abstrakt

Sredstva za anesteziju se kod riba obično daju kupkama, sa IM, IV, IP injekcijama. Ketamin ima anestetičke i analgetičke osobine i široku primenu u humanoj i veterinarskoj medicini. U ovoj studiji posmatrano je 50 *Huso huso*, prosečne težine 550 $\pm$ 20 g. Tokom ispitivanja ribe su držane u bazenu (1000 l) koji je bio napunjen aerisanom bunarskom vodom koja recirkuliše jednu nedelju pre eksperimenta. Ribe su podeljene u 5 različitih koncentracija (70, 75, 80, 85 i 90 mg/kg). Stanja analgezije i anestezije su konstatovana. Oporavak se javljao kada su ribe stavljane u vodu bez anestetika i beleženo je vreme oporavka. Rezultati su pokazali da je prosečno indukciono vreme u obrnutom odnosu sa dozom ketamina. Sa povećanjem doze intramuskularnog ketamina smanjivalo se indukciono vreme, a vreme oporavka povećavalo. Vreme oporavka je bilo 25 minuta kada je *Huso huso* anestezirana sa 90 mg/kg. Povećano vreme oporavka može biti povoljno u nekim slučajevima, kao u hirurgiji, ali nije korisno za rutinsko korišćenje. U ispitivanjima, anestezija je davana *Huso huso* putem injekcija sa 30 mg/kg ketamina u dorzalnu ili kaudalnu arteriju. U poređenju sa našim ispitivanjima doza ketamina u onoj situaciji (30 mg/kg) bila je manja od naše minimalne doze (70 mg/kg), ali je oporavak bio duži nego u našim ispitivanjima, što je možda je zavisno od načina iniciranja (IM i IV) ili individualnih razlika kod riba. Uopšte, neki značajni faktori za procenu individualnog anestetika kod riba su brzo indukciono vreme anestezije (manje od 4 minuta) i kratko vreme oporavka (manje od 8 minuta). Tako ovi opšti faktori i dobijeni razultati naših ogleda pokazuju da je 80 mg/kg ketamina sa 2,4 ili 8,0 minuta za indukciju i vreme oporavka najpogodnija anestezija za *Huso huso*.

Ključne reči: *ketamin, Huso huso, anestezija, intramuskularno.*

INRODUCTION

Several different chemicals such as MS-222 and clove oil have been used as anesthetics in fish farms and fish biology researches to reduce handling stress on fish. Anesthetic agents are commonly administered by immersion, with IM, IV, and IP injection and oral administration are used less commonly. Ketamine (Vetalar) is available either as a white powder or as a readymade injectable solution in saline. It has anesthetic and analgesic properties and has been widely used in human and veterinary medicine. Ketamine is the major drug in current use with crocodilians. It is effective at intramuscular weight-related doses between 12 and 80 mg kg−1 in a range of species (Ross and Ross, 2008). Ketamine is a rapid-acting, nonnarcotic, nonbarbiturate anesthetic agent that induces a state of unconsciousness known as dissociative anesthesia (Graham and Iwama, 1990). It is thought to induce anesthesia and amnesia by functionally disrupting the CNS through over stimulation induction of a cataleptic state (Williams et al. 2004). The most common injection route of ketamine, IM, requires high doses when used alone (Fleming et al. 2003; Bruecker and Graham, 1993)**.** Ketamine, used alone or in combination with α2-agonists is effective for a number of species and has been shown to have minimal hematological effects in mammals and fish (Harms, 1999). Beluga (*Huso huso* (Linnaeus, 1758)) has a wide distribution. It is distributed in the Caspian Sea, Black Sea, and the Sea of Azov and many of the tributaries of these seas. Beluga is the largest species of Acipenseriformes reaching a length of six meters and a weight of more than one tone (Berg 1948; Sudagar et al 2010). The aim of this study was to determine the best dose of ketamine for anesthesia of Beluga (*Huso huso*) in intramuscular (IM) injection.

MATERIAL AND METHODS

For this study 50 *Huso huso* with average weight 550±20 g were chosen. During the study, the fish had been kept in a tank (1000-liters), containing aerated re-circulating well water for one week prior to experimentation. Water temperature ranged from 18 to 22^{0}C, pH ranged from 7.5 to 8.2, and minimum oxygen concentration was > 6 mg/L. After a period of one week, experiments were started with the Ketamine anesthesia. Fish were divided into five groups of 10 fish. Drug used in the study included ketamine (50 mg/ml) diluted with sterile saline [0.9% NaCl] solution and injections were performed with 2-mL Syringes and 22-gauge needles. Five groups anesthetize with IM injection method by ketamine in different concentration (70, 75, 80, 85, and 90 mg kg^{-1}). Stages of analgesia and anesthesia such as ataxia and reduced response to stimulation, ventilation decreased, erratic swimming, partial loss of equilibrium, and reduced activity and finally absent respiration were monitored and also ability of fish handling for injection (total loss of reaction to surgical stimulation) were assessed. Recoveries were occurred when the fish were placed in anesthetic-free water and recovery times were recorded.

RESULTS

Results showed that average of induction and recovery times were different in 5 groups. Result showed that average of induction time had a reverse relation with in-

crease in dose of ketamine. And recovery time had a direct relation with increasing in dose of ketamine. With increasing in dose of intramuscular ketamine, times of induction decreased and times of recovery increased. In first and last groups average of induction and recovery times were 6.45, 5.48 minutes (for 70 mg kg^{-1}) and 1.04, 25 minutes (for 90 mg kg^{-1}) respectively. Induction and recovery times of 5 groups have been showed in figure 1.

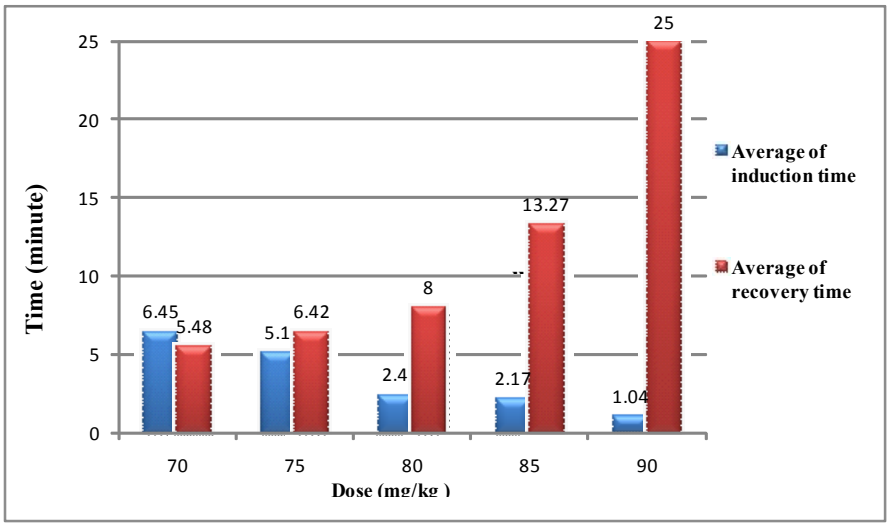

Figure 1. Average of induction and recovery times in 5 groups of *Huso huso*

DISCUSSION

Anesthesia with Ketamine at 30 mgL^{-1} in *Oncorhynchus mykiss* and *Oncorhynchus kisutch* was successfully used (Graham and Iwama, 1990). In another study rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were injected intra-muscularly with ketamine at 130 mg kg^{-1}, after that, anesthesia persisted for only 20 minutes, but anesthesia with 150 mg kg−1 (IM) persisted for 50–80 minutes. Recovery time was prolonged, taking up to 90 minutes, during which there was notable hyperactivity and ataxia (Oswald, 1978). In our study, recovery time was 25 minutes when *H. huso* was anesthetized with 90 mg kg^{-1}. In both studies, recovery was prolonged, it can be useful for some purposes such as surgery, but it is not useful for routine uses. Anesthesia in *Heros citrinellum* via injection of 30 mg kg^{-1} ketamine into the dorsal aorta or caudal vein was induced and was very fast with considerable reduction in ventilation after 1minute. Anesthesia lasted for up to 40 minutes and recovery required up to 4 hours (Bruecker and Graham, 1993). In comparison with our study dose of ketamine for anesthesia in that study (30 mg kg^{-1}) was less than our minimum dose (70 mg kg^{-1}), but recovery time was longer than in our study. It maybe dependant on method of injection (IM and IV) or on individual differences of fishes. Use of 12–20 mg kg^{-1} ketamine in combination with xylazine (Rompun) with grey nurse sharks, *Carcharias taurus* was successful (Smith, 1992). Induction took 10–20 minutes.

Ketamine was successfully used in combination with the analgesic and sedative medetomidine in bonitos (*Sarda chiliensis*) and Pacific mackerel (*Scomber japonica*) (Williams *et al.* 2004). These two studies show that ketamine can be used in combination with other sedative and analgesic drags. Maybe we can use ketamine with some other drugs such as xylazine or medetomidine in anesthesia of Acipenseridae such as *H. huso*. It need next studies to find that best form of anesthesia with ketamine is use alone or is in combination with other drags in *H.huso*. In general, the important factors for evaluating an ideal anesthetic in fish include rapid induction time of anesthesia (less than 4 minutes), short recovery time (less than 8 minutes), low toxicity for humans (at the concentrations used for fish), and availability and handler safety (Neiffer, 2007). So these general factors and the results that were obtained from our investigation, suggest that 80 mg kg^{-1} ketamine with 2.4 and 8.0 minutes respectively for induction and recovery times is the most suitable dosage for anesthetize of *Huso huso*.

CONCLUSION

In conclusion, results of our study showed that the longest and the shortest induction and recovery times were seen in 70 mg kg^{-1} ketamine (6.45 and 5.48 min) and 90 mg kg^{-1} (1.04 and 25 min). There were direct relations between increasing dose of ketamine and recovery time, so with increasing of anesthetic dose, recovery time was increased. But with increasing of anesthetic dose, induction time was decreased. So average dose (80 mg kg^{-1}) is the most suitable dosage for anesthetize of *Huso huso*.

ACKNOWLEDGMENT

Authors wish to thank specially to Mr. Mahmudi, technician of laboratory of Aquatic Animal Health, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.

REFERENCES

Berg, L. S. (1948): Freshwater fishes of the U.S.S.R. and adjacent countries. 4th edition, Akad. Nauk SSSR 2ool. Inst., Vol. 1, 493 pp.

Bruecker, P., Graham, M. (1993): The effects of the anesthetic ketamine hydrochloride on oxygen consumption rates and behavior in the fish *Heros* (*Cichlasoma*) *citrinellum (*Gunther, 1864). Journal of Comparative Biochemistry and Physiology 104C, 57-59.

Fleming, G.J., Heard, D.J., Floyd, R.F. and Riggs A. (2003): Evaluation of propofol and medetomidine-ketamine for short-term immobilization of Gulf of Mexico sturgeon (*Acipenser oxyrinchus de soti*). Journal of Zoology Wild Medicine 34, 153-158.

Graham, M.S, Iwama, G. (1990): The physiologic effects of the anesthetic ketamine hydrochloride on two Salmonid species. Aquaculture 90, 323-331.

Harms, C.A. (1999): Anesthesia in fish In: Fowler ME, Miller RE, eds. Zoo and Wild Animal Medicine, Current Therapy 4. Philadelphia: WB Saunders. 158-163 pp.

Neiffer, D.L. (2007): Boney fish (lungfish, sturgeon, and teleosts). In: West G,Heard D, Caulkett N, eds. Zoo Animal and Wildlife Immobilization and Anesthesia. Ames IA: Blackwell Publishing, 159-196 pp.

Oswald, R.L. (1978): Injection anesthesia for experimental studies in fish, Comparative Biochemical Physiology.60C, 19–26.

Ross, L.G., Ross, B. (2008): Anesthetic and Sedative Techniques for Aquatic Animals. 3rd edition. Blackwell publishing.185-187 pp.

Smith, M.F.L. (1992): Capture and transportation of elasmobranchs, with emphasis on the grey nurse shark (*Carcharias taurus*). Australian Journal of Marine Freshwater Research Special issue: Sharks: Biology and Fisheries 43, 325–343.

Sudagar, M., Hosseinpoor, Z., Hosseini, A. (2010): The use of citric acid as attractant in diet of grand sturgeon *Huso huso* fry and its effects on growing factors and survival rate. AACL Bioflux 3, 4, 311-316.

Williams, T.D., Rollins, M., Block, A. (2004): Intramuscular anesthesia of bonito and Pacific mackerel with ketamine and medetomidine and reversal of anesthesia with atipamezole. Journal of American Veterinary Medical Association 225,417-421.