Biochemical changes induced by general anesthesia with romifidine as a premedication, midazolam and ketamine induction and maintenance by infusion in donkeys

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Abstract

The objective of this study was to determine the effects of the general anesthesia on same biochemical changes in donkeys. The anesthesia was induced by intravenous (IV) injection of romifidine 0.1 mg/kg as a premedication, after 5 minutes induction of general anesthesia by (IV) of mixture midazolam 0.1 mg/kg and ketamine hydrochloride 2.2 mg/kg in the same syringe. The maintenance of anesthesia was performed by (IV) infusion of a mixture of the midazolam 0.065 mg/kg/hr. and ketamine 6.6 mg/kg/hr. The biochemical parameters changes in serum levels of Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) and Alkaline phosphate (ALP) activity as liver enzymes and serum glucose were estimated in zero, 15, 30, 60, 120, 240 and 480 minutes. The results revealed significant differences (P<0.05) in the means of AST (U/L) between zero 199.6 with 30 min 192.5 and 60 min 191.5. No significant differences (P>0.05) in mean enzyme activity of the ALT and ALP. Serum glucose results were shown no significant differences (P>0.05) in the (control, 15, 30 minutes) and (60, 120 and 240) respectively and significant differences in between and within 480 minutes. The general anesthesia in this protocol was good and had little effect on the liver function and showed increase in serum blood glucose in donkeys.

Keywords: general anesthesia, romifidine, midazolam, ketamine biochemical change.

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Introduction

The α-2-adrenoceptor agonist drugs have been recognized as worldwide use in veterinary medicine for their sedative, analgesic and muscle relaxation properties in large and small animals (1). The commonly α2-agonists which used in veterinary practice are xylazine, detomidine, medetomidine and romifidine. Romifidine is a recent α-2 adrenoceptor agonist marketed for use in horses (2). Romifidine has been available since 1985 (3). It has been used successfully for sedation, analgesia, and premedication in horses in several countries since 1988 (4) with effects similar to other α-2 adrenoreceptor agonists (5). Midazolam is a short-acting benzodiazepine with hypnotic, anticonvulsant, muscle-relaxant and anxiolytic properties. In clinical practice, it was used for the induction of anesthesia (6). The midazolam metabolites are conjugated and then excreted as glucuronides in the urine (7,8). Ketamine is a phenacyclidine derivative that produces a dissociative state of anesthesia. Dissociative anaesthesia was characterized by dissociation between the thalamocortical and limbic system on the electroencephalogram (EEG) (9,10). Ketamine has been used as an anesthetic agent in equine medicine since the mid-70s (11). Initially, ketamine was applied just as an induction agent, producing amnesia, loss of consciousness, analgesia and immobility. In later years, based on these properties, the application of ketamine in equine anaesthesia was extended by using in different total intravenous anaesthesia protocols (12,13).

Blood plasma contains three major protein fractions: albumin, globulin, and fibrinogen. In humans, sheep, goat, rabbits and rat there are mostly albumins, while in horse, pig and cattle the ratio of albumins and globulins is almost equal, or globulins prevail (14). Aspartate aminotransferase (AST) is a widely distribute enzyme, which is found in many tissues and organs, with high activity in the liver (15). Isoenzymes of ALP are recognized, including hepatic, osseous, intestinal, and placental forms; the relative proportions of these isoenzymes in plasma vary with species (19). The plasma and urinary glucose act as broad indicators of the severity of any disturbance to carbohydrate metabolism, the homeostatic mechanisms for maintaining blood glucose are influenced by intestinal absorption and both hepatic and tissue metabolism. The balance is influence by several hormones in addition to insulin and glucagon, and these other hormones include corticosteroids, growth hormones, adrenocorticotrophic hormone, and biogenic amines (19). Plasma or serum should be rapidly separated after collection to avoid the effects of erythrocyte glycolysis.

Materials and methods

Ten clinically healthy female donkeys weighing between 70-100 kg aged 8-12 months have been used in this study. Romifidine was used as a premedication drug (Sedivet® 1.0% Boehringer Ingelheim Vetmedica, Inc., Spain). Midazolam (15 mg in 3 ml, Alsaad pharmaceuticals, Syria) and ketamine (kepro pharmaceuticals, 100 mg/ml Holland), was used for induction and maintain the general anesthesia. The regime of general anesthesia was made by administration of romifidine at a dose of 0.1 mg/kg B.W. injected intravenously in the jugular vein as a premedication, then after five minutes, midazolam at a dose of 0.1 mg/kg B.W. and Ketamine at a dose of 2.2 mg/kg B.W. mixed in the same syringe (20) have been injected intravenously.

Fifteen minutes later an infusion of midazolam 10 mg (2 ml) mixed with ketamine 1000 mg (10 ml) in 500 ml normal saline was administrated to maintain the anesthesia, the rate of dripping was 100-110 drops per minute (20 drops equal to 1 ml). 5 ml of blood samples were collected via jugular vein puncturing with 23 G needle, the blood in the plain tubes was allowed to form serum at room temperature and centrifuged to harvest serum. Serum was stored at -20°C until analysis by using diagnostic kits and spectrophotometer. The biochemical changes of this regime are evaluated by liver enzyme (AST, ALP and ALP) U/L and serum blood glucose (mg/dl). The (ALT) and (AST) enzyme kits were manufactured by RANDOX laboratories Antrim, United Kingdom. While the (ALP) kit manufactured by BIOLABO SA, Maizy, Frances. Serum blood glucose, kit manufactured by SPINREACT, S.A., Girona, Spain. The results were expressed as means (M) stander error (SE). Parametric data were analyzed by one ways analysis of variance (ANOVA) continued with Least Significant Difference (L.S.D.), and P<0.05 was considered to be significant. Statistical Package for Social Sciences (SPSS) was used (21).

Results

Aspartate aminotransferase (U/L) activity showed decreased in level of enzyme assay through induction and maintenance of anesthesia and increased after recovery but still below the base line of the study (Table). The statistical
Table: Effect of general anesthetic regime on some liver enzyme and serum blood glucose in (10) donkeys.

| Parameter          | Time minutes |
|--------------------|--------------|
|                    | Zero | 15 | 30 | 60 | 120 | 240 | 480 |
| AST enzyme U/L     |       |    |    |    |     |     |     |
| A                  | 199.6±1.783 | 194.8±1.982 | 192.5±1.579 | 191.5±1.771 | 195.1±2.024 | 195.1±1.048 | 197.3±1.453 |
| B                  | 25.5±0.450 | 25.7±0.512 | 24.7±0.265 | 25.2±0.668 | 25.2±0.747 | 25.7±0.580 | 25.2±0.612 |
| ALP enzyme U/L     | 519.2±4.378 | 514.9±5.728 | 511.7±6.119 | 508.6±5.406 | 513.2±5.278 | 514.4±5.200 | 513.9±4.789 |
| Serum blood glucose Mg/dl | 96.1±0.737 | 95.0±1.229 | 94.6±1.212 | 93.7±1.075 | 93.9±1.075 | 96.3±1.155 | 96.0±0.714 |

Value is expressed as M ± SE. Different in the capital latters refer significant differences (P<0.05) between time.

Discussion

The increase in the serum glucose during the anesthesia time agreed with Khan et al., (23) and Almarsoumy, (24) whom used α-2 adrenoceptor similar to romifidine in their effect, cause hyperglycemic effect by inhibition of insulin released by the stimulus of the pancreatic β cells and to an increased glucose production in the liver. Thakur et al. (25) exposed that ketamine hydrochloride generally increases norepinephrine blood levels and turnover, since norepinephrine affects gluconeogenesis and glycogenolysis and also decreases insulin production, enhanced hyperglycemic effects after ketamine administration are obvious. The continuously increase of the serum glucose after the end of anesthesia may be feeding and watering of the animals after fasting and continues effects of romifidine and ketamine. In the enzyme assay there are two main isoenzymes: mitochondrial and cytosolic, AST prevails in the total concentration in the blood plasma because it has a longer half-life (17). Activity of AST in horses is much higher than in other animals (18). In addition to species, breed and age, AST activity was influence by muscle activity (26). The AST enzyme is present in most tissue and increases with muscle injury especially cardiac muscle, as well as hepatocellular injury, also present in kidney, pancreas and erythrocytes. Thus AST assays should be run in conjunction with other enzymes assays, especially ALT when evaluating liver function. Increase ALT with normal to mildly elevated AST may indicate reversible liver damage. Marked elevation in ALT and AST indicate hepatocellular necrosis. Increased AST with normal ALT may indicate that the source of AST is not the liver (27,28). Thus AST has also been used as a cardiac marker (29).

Result of the AST assay agreed with Hall et al., (30) revealed that midazolam was substrate competition which causes inhibitors to the enzyme this factor effects lead to decrease the AST level in the time of anesthesia. Lemma and Moges, (31) shown that working donkeys have higher activity of the AST enzyme 288 U/L than donkeys which are at rest for several days 223 U/L. The AST enzyme assay in study was within the normal which ranged on 223.30±32.78 U/L (22). The ALT enzyme assay is using to detect liver injuries and long-term liver disease. Highly elevated levels may indicate active hepatitis from any cause, including virus, drug or toxin. Some prescription and over-the-counter medications can cause an increase in ALT levels, can be dramatically affected by shock, low blood pressure or any other condition that deprives the liver of blood and oxygen. The result of this study agrees with the other studies that the ALT enzyme is not present in enough amounts in liver cells of horse, ruminants and pig (27). ALT level of this study were in accordance with Gul et al., (22) who reported a normal value of ALT 27.25±0.91U/L activity in healthy donkeys.

The result of the ALP enzyme assay agreed with Thakur et al. (25) that revealed ALP value in horses is wide that a change in its value is of no clinical relevance. Serum ALP activities usually increase in animals with biliary stasis,
steroid hepatopathy and occasionally bone lesions. In addition to that ALP is found in much tissue, including liver, bone, intestine, placenta and kidneys (32). Hepatic and bony metastasis can also cause elevated levels of alkaline phosphatase. Results of enzyme assay were in accordance with Gul et al. (22) who reported a normal value of ALP 485.46±98.74 U/L activity in healthy donkeys.

According to these results, the general anesthesia by this protocol has minimal effect on the liver and the value of enzyme still within normal value while the serum glucose was affected by this protocol and causes elevation in the value.

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