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Cumulative Clinical Evaluation of Transcutaneous Blood Laser Irradiation on Hemodynamic Changes in Anesthesia of Dogs

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Abstract

Objectives-The aims of this study were evaluation the effects of blood laser irradiation on hemodynamic parameters, the amount of anesthetic drugs in maintenance of anesthesia and duration of recovery.
Animals- Fifteen mixed breed dogs
Procedures- dogs (25.0 ± 3.6 kg) were divided into three groups (n=5). The group I was acted as control and received only cold laser. The group II was premedicated with neuroleptanalgesics including Midazolam (0.2 mg/kg/iv/bw) plus Fentanyl (0.05 mg/kg/i.v/bw), and induction of anesthesia was done by Propofol (5 mg /kg/i.v/bw), then dogs were intubated for maintenance of anesthesia by Isoflurane 1% In addition to neuroleptanalgesics combined with Isoflurane, group III received Trans-cutaneous Blood Laser Irradiation (Trans-cut BLI) through the cephalic venous line by a portable laser probe designed by Canadian optic &laser center immediately after intubation.The changes in cardiac rhythm, hemodynamic parameters including heart rate, blood pressure, SpO_2 and the level of blood cortisol were measured before and after the induction of anesthesia on 5, 10 ,15,45, and 60 minutes.
Results- No complication from anesthesia and blood laser radiation was noticed, and despite of some variation observed in collective data but there was no significant difference between homodynamic parameters, blood cortisol level, SpO_2 and the doses of Isoflurane. However all of dogs in group III had smooth recovery and attained full conscious after end of anesthesia.
Conclusions and clinical relevance- This study showed that transcutaneous blood laser irradiation is a safe method without any side effect to add anesthetic procedure.There was no deterioration effect on hemodynamic parameters and consumption amount of Isoflurane.
Key words- Transcutaneous blood laser irradiation, Anesthesia, Hemodynamic changes, Dog.

Introduction

The intravenous laser blood irradiation is a biological therapeutic methods that seems suitable to intervene in the system of basis regulation by a connection to the CNS and the endocrine (hypothalamus) .this treatment usually connected out with low power of 1-3 mw and exposure time of 20-60 minutes, applying on big vein having a wide lumen to catch a great volume of blood in the period of time. Originally this method was developed for the treatment of cardiovascular diseases improved of rheological properties of the blood as well as improvement of microcirculation and reduction of the area infarction had been proved further reduction of dysrhythmia and sudden cardiac death occurred.[4,17,21] A despite of the successes of surgery are closely related to adrenals in anesthesiology and intensive care in general and the methods of protecting patients against surgical trauma in particular. As due to breed variation and uneven complication usually occur during anesthesia to reduce the dose effect of anesthetic drugs, the technique of low intensity laser irradiation (i.v.LILI) was tried for cardiovascular change.[1]

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Materials and Methods

All dogs were anesthetized in the same way the standard technique and calculated dose of neuroleptanalgesia was used. After the institutional animal investigation and ethical committee's approval of Tehran University was obtained. 15 dogs (25.0 ± 3.6 kg) were divided into three groups (n=5). The group I was acted as control and received only cold laser,

whereas group II were premedicated with neuroleptanalgesics including Midazolam (0.2mg/kg/iv/bw) plus Fentanyl (0.05, mg/kg/i.v/bw), and induction of anesthesia was done by Propofol (5 mg /kg/i.v/bw), then dogs were intubated for maintenance of anesthesia by Isoflurane 1% .In addition to neuroleptanalgesic combined with Isoflurane, group III received trans-cutaneous blood laser radiation through the cephalic venous line by a portable laser probe designed by Canadian optic &laser center (P= 100 mW, WL= 650 nm, A = 1cm ^{2}, T= 20 min) immediately after intubation (Fig.1). Transcutaneous Blood Laser Irradiation (Trans-cut BLI) was through the cephalic vein in each dog. During anesthesia the following parameters of the each dog "homeostasis were controlled: The changes in cardiac rhythm, hemodynamic parameters including heart rate, blood pressure, SpO_2 and the level of blood cortisol were measured before and after the induction of anesthesia on 5, 10 ,15, 45, and 60 minutes. Dogs' behavior and the level of consciousness were evaluated after the end of anesthesia and in recovery room. The results were analyzed by spss-16 program including means of repeated measure, ANOVA for quantitative changes between two groups p>%5, Exact Fisher test used for qualitative clinical vital reflexes and paired sample T test for time dependent for hematological changes.

Figure 1- trans-cutaneous blood laser radiation through the cephalic venous line by a portable laser probe

Results

The results of the current study clearly demonstrate the feasibility, safety and efficacy of laser –assisted anesthesia. No complication from anesthesia and IVBLI (Trans-cut BLI) treatment were noted. It's well established that in each patient, intraoperative homeostasis depends mainly upon adequacy of anesthesia ,however to date there is no objective method by which it would be possible to estimate the adequacy of anesthestetic case during surgical stress. Despite of some variation observed in collective data but there was no significant difference between hemodynamic parameters (Fig.2,3), blood cortisol level, SpO_2 and the doses of Isoflurane. However all of dogs in group III (Trans-cut BLI) had smooth recovery and attained full conscious after end of anesthesia .No agitation, noisy sound, aggressive movement and behavior were observed in this group. All of dogs in this group had shorter recovery time compare to last two groups.

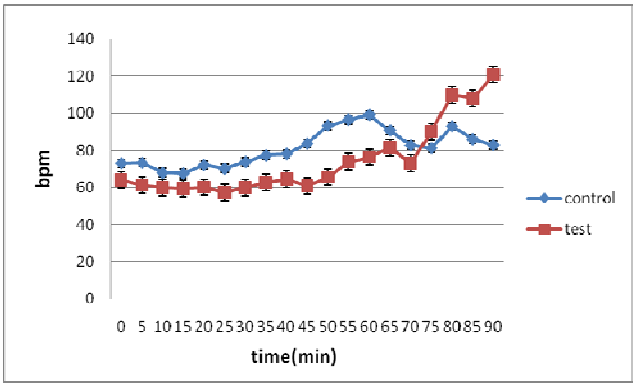

Figure 2- Line graph shows effect of laser blood irradiation on pulse. Values are mean ±SE; P<0.05, no significant difference between test & control group.

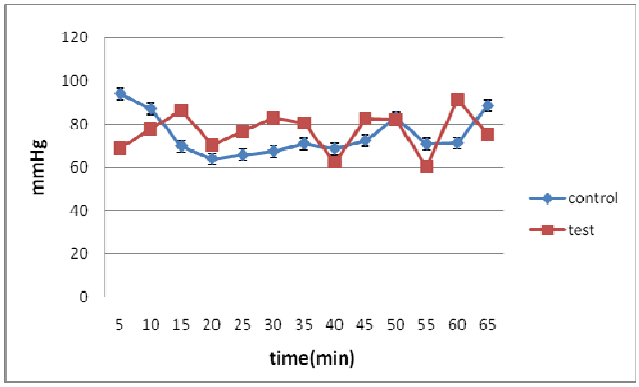

Figure 3 - Line graph shows the effect of laser blood irradiation on Blood pressure. Values are mean ±SE; P<0.05, no significant difference between test & control group.

Discussion

The method of intravenous laser blood irradiation was first introduced into therapy by the Soviet Scientists E.N.Meschalkin and V.S.Sergiewski in 1981.[4] Indeed the intravenous laser blood, irradiation is a biological therapeutic method that seems suitable to intervene in the system of basis – regulation.[3] Originally this method was developed for the treatment of cardiovascular diseases, improvement of rheological properties of the blood as well as improvement of microcirculation and reduction of the area of infarction had been proved. Under laser blood irradiation anti-inflammatory effects were observed. The successes of surgery are closely related to advances in anesthesiology and intensive care in general and the methods of protecting patients against surgical trauma in particular.[1] In the last decade there has been significantly increased interest in using low–intensity He-Ne laser in various fields of medicine .That is why we sought to apply this technique to the complex of anesthetic protocol of selected model of animal

like dogs highly referred cases to the small animal hospital ,during normal anesthetic procedures.[1,2] The intravenous laser exposure of blood (ILEB) holds a special position among the variety of laser biostimulation methods due to the fact that blood is a biological component, which determines the functioning of the whole of the organism.[5] Blood is the liquid that provides the exchange of all the nutrients and gases. The laser influences upon blood is apparently one the most important aspects among the whole variety of laser–biostimulation effects. A fundamental finding was the positive influences on rheological properties of the blood which is the greatest interest to surgery, angiology and cardiology in particular.[6] A diminishing tendency of aggregation of thrombocytes and of forming property of erythrocytes results in an improved oxygen supply and with that to decrease of partial which is particularly relevant to wound healing.[7,8] Because of the described effects the intravenous blood irradiation is used in Russian surgical university clinics pre-operative, to avoid thromboembolic complications, and post-operative for a faster wound healing .

It was proved that IV BLI reduces aggregation ability of thrombocytes, activates fibrinolysis which results in peripheral blood flow velocity increasing and tissues oxygenation enriching. The improvement of microcirculation and utilization of oxygen in tissues as results of IV BLI in intimately linked with positive influence on metabolism: higher level of oxidation of energy-carrying molecules of glucose, pyruvate, and other substances.[5]

The improvement in microcirculation system is also stipulated by vasodilatation and change in rheological properties of blood as a result of drop of its viscosity, decrease of aggregation activity of erythrocytes due to changes of their physicochemical properties in particular rising of negative electric charge, finally the activation of microcirculation, unlocking of capillaries and collaterals. Improvement of tissue tropical activity, normalization of a nervous excitability take place[13] IV BLI is recommended to apply before surgical operations as preparation for intervention as well as in the postoperative stage because the laser irradiation of blood has not only analgesic effect but also spasmolytic and sedative activity.

Multimodal administration of analgesic drugs improves pain relief through the use of drugs with different pharmacological mechanisms. Intraoperatively these combinations reduce the required amount of inhalant anesthetics and thus the cardio respiratory depression related to their use.[9] In this experiment reduction of total dose and amount of Isoflurane was highly under consideration .Clinically valuable method to determine the analgesic potency of opioids in the intraoperative period is to determine the reduction of an inhalant anesthetic in the minimum alveolar concentration (MAC).[10] Several studies have evaluated how the use different doses of lidocaine, morphine or ketamine can reduce the concentration of inhalant anesthetic in dogs.[11.12] Preoperarive intravenous low intensity He-Ne laser irradiation improves the quality of anesthetic care during invasive surgery and decreases the neurovegetative strain [1] and P_{50} appears to increase ,the index of tissue oxygen extraction does not change and the data of the acid-base balance tend to improve and low level of 11 oxycorticosteriods and the plasma content of serotonin and histamine as well as moderate changes of plasma enzyme activity confirm the efficacy of protecting patients from surgical trauma by application of He-Ne laser irradiation as a component of complex anesthetic care [1].

As different doses of opioids analgesic drugs with or without sedative or hypnotic supplements frequently used for anesthesia in patients undergoing difficult operation [14] As to explore the effect of intravenous blood irradiation on overall quality of anesthesia induce by administration of Fentanyl ,Midazolam , Propofol and Isoflurane, the results of this study indicated that ,the feasibility, safety and efficacy of laser – assisted anesthesia without having any complication from anesthesia using intravenous blood irradiation were noted. The doses of the drugs used and the volumes of intravenous infusion were accepted by each dog. Despite of some variation observed in collective data but there was no significant difference between hemodynamic parameters, blood cortisol level, SpO_2 and the doses of Isoflurane , but all of dogs in group III (Trans-cut BLI) had smooth recovery and attained full conscious after end of anesthesia .No agitation, noisy sound, aggressive movement and behavior were observed in this group. All of dogs in this group (Trans-cut BLI) had shorter recovery time compare to last two groups. The major clinical noted signs immediate after administration of Fentany and Midazolam respiratory depression which is good evidence of similarity with other reports with all doses of opioids.[14] Recent publications have suggested that some of the effects of Fentanyl may be mediated by mechanisms other than opioid receptors- associated actions [15.19.20.21] and that the anesthetic action of Fentanyl can be dissociated from its analgesic effect [16] non specific possibly membrane mediated effects on the other. Attempts to define the anesthetic capabilities of Fentanyl in terms of its analgesic and /or receptor–mediated effects alone may not be fully appropriate.[16] This experiment shows even Trans-cut BLI being a safe method without any side effect to add to general even to local anesthetic procedure. Despite minutes variation in almost all parameters, there was no deterioration effect on hemodynamic parameters and consumption amount of Isoflurane. Improvement in smooth recovering symptoms after anesthesia in all of dogs in laser group had higher level of consciousness after anesthesia and shorter recovery time.[18.19] Dynamic characteristics of hemodynamic parameters after intravenous blood irradiation immediate after induction using opioids and inhalation anesthetic drugs provided there are no drastic vital organs acute or chronic pathological disorders entail such conclusions that the intravenous blood laser irradiation in contrast to the drug intervention positively influences the entire blood parameters. It and dynamics of postoperative fluctuations of blood parameters is significantly improved, what indicates the faster return of patient to the homeostasis and the intravenous blood laser irradiation is compatible with pharmacological and other procedures of the general anesthesia and does not cause the suppression of any vital systems[5] and this suggested direct intravenous blood laser irradiation and even according our finding in this

experiment in form of Trans-cut BLI method ,promise for the future an abundance of additional facts.[3]

Conclusion

This study showed that transcutaneous blood laser radiation (Trans-cut BLI) is a safe method without any side effect to add anesthetic procedure. There was no deterioration effect on hemodynamic parameters and consumption amount of Isoflurane; in other side, it improved recovering symptoms after anesthesia. All of dogs in laser group had higher level of consciousness after anesthesia and recovery too. The results indicated application of laser during anesthesia will have qualitative effect on depth of anesthesia and prepared ground for smooth recovery without post-anesthetic complications.

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چکیده

بررسی بالینی تابش لیزر جلدی خونی بر تغییرات همودینامیکی سگ‌های بیهوش

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هدف- بررسی اثرات تابش لیزر جلدی- خونی بر پارامترهای همودینامیکی، میزان داروی مورد نیاز جهت حفظ بیهوشی و مدت زمان ریکاوری در سگهای بیهوش می‌باشد.

حیوانات- پانزده قلاده سگ نژاد مخلوط

روش کار- سگ‌ها بصورت تصادفی به سه گروه ۵ تایی تقسیم شدند. در پنج سگ گروه اول تنها از تابش لیزر سرد و در سگهای گروه دوم و سوم بعنوان پیش بیهوشی از داروی میدازولام ۰/۵درصد با دوز ۰/۲ میلی گرم به ازای هر کیلوگرم وفنتانیل سیترات به مقدار ۰/۰۵ میلی گرم به ازای هر کیلوگرم استفاده شد. پس از القای بیهوشی با دوز ۵ میلی گرم به ازای هر کیلوگرم پروپوفول ، بمنظور تداوم بیهوشی ازغلظت کافی ایزوفلوران به همراه اکسیژن استفاده گردید. در گروه سه پس از تثبیت وضعیت بالینی حیوان و رسیدن به عمق بیهوشی مناسب تابش اشعه لیزر خونی جلدی با پراب پورتال(قدرت=۱۰۰ میلی وات، طول موج=۶۵۰ نانومتر، سطح =۱ سانتی متر مربع، زمان= ۲۰ دقیقه) در ناحیه ساعد و ورید سفالیک بلافاصله پس از لوله گذاری نایی انجام پذیرفت. در گروه دوم تمامی مراحل به غیر از تابش لیزر صورت پذیرفت و تمامی فاکتورهای مد نظر شامل تعداد ضربان قلب ، فشار خون، درصد اشباع بودن گلبولهای قرمز از اکسیژن و سطح کورتیزول خون قبل و پس از بیهوشی در دقایق ۵ ،۱۰، ۱۵، ۴۵ و ۶۰ دقیقه ثبت گردید.

نتایج- بیهوشی و کاربرد لیزر جلدی- خونی هیچگونه عارضه ای را در پی نداشته و علارغم وجود تفاوتهایی در یافته‌های بدست آمده هیچگونه اختلاف معنی‌داری در پارامترهای همودینامیکی، درصد اشباع بودن گلبولهای قرمز از اکسیژن، سطح کورتیزول خون و دوز مصرفی ایزوفلوران بین گروه‌ها مشاهده نگردید.

نتیجه گیری و کاربرد بالینی- کاربرد لیزر حین بیهوشی علاوه بر ارتقاء کیفیت عمق بیهوشی، زمینه یک ریکاوری آرام و مناسب را فراهم می‌آورد.

کلیدواژگان- تابش لیزر جلدی خونی، بیهوشی، تغییرات همودینامیک، سگ.