INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com Volume-3, Issue-3, July-Sept-2012 Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

Received:06th June-2012 *Revised: 10th June-2012* *Accepted: 12th June-2012*

Research article

COMPARISON OF COMMON CLINICALLY USED LOCAL ANESTHETICS ON ANIMAL MODELS

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ABSTRACT: The animal models used in this study were Plexus anesthesia in frogs, Infiltration anesthesia in guinea pigs, Surface anesthesia in rabbits. The drugs were diluted with normal saline. Lignocaine2%: xylocaine hydrochloride injection IP, Bupivacaine 0.5%: Bupivacaine hydrochloride injections IP were prepared. Plexus anesthesia: Frog was pithed and spinal cord was destroyed up to the 3 vertebra. The abdominal pouch was filled with local anesthetic solution. Reflex activity was tested by immersing both feet of the frog every two minutes for not longer than 10 seconds into N/10 Hydrochloric acid. The time was noted. Surface anesthesia: Albino rabbits of either sex weighing 2.5 – 3.0kg ware selected. The conjunctival sac of one eye was held open, thus formed a pouch. 0.5ml of solution of the anesthetic was applied into the conjunctival sac for 30 sec. Infiltration anesthesia: Preparation of guinea pig: Guinea pigs (either sex) weighing 250-300grams were used. Lignocaine produced rapid onset of plexus anesthesia in Frogs in comparison to the bupivacaine at concentration of 0.1% & 0.2% which is statistically significant. Bupivacaine is more potent than the lignocaine as a surface anesthetic agent in the Rabbit, where as lignocaine could produce surface anesthesia at concentration of 0.5% or 0.1% or both. Both bupivacaine and lignocaine produced infiltration anesthesia on intradermal injection in guinea pigs but the duration of infiltration anesthesia produced by bupivacaine is more prolonged which is statistically significant in comparison to the lignocaine at all the three concentrations tested i.e. 0.05%, 0.1% & 0.2%.
Keywords: Local anesthesia, Lignocaine, Bupivacaine, Surface, Infiltration anesthesia.

INTRODUCTION

Local anesthetics are used whenever a clinical procedure causes pain that could be eliminated by their use. These are the most commonly used drug group in dentistry. Some 9000 practitioners in Australia conservatively give 10 or more local analgesic doses per day which equates to between 15 and 20 million doses per annum. (Benowitz NL 1993). Against this backdrop of common usage an in-depth understanding of the biology and pharmacology of local analgesia is often lost in the volumes of other information required for quality dental practice and other miner surgeries.(Kalow W 1952)

Local anesthesia is useful in a wide variety of clinical situations. It increases patient comfort and facilitates patient cooperation during procedures. As a diagnostic aid, it helps to localize or identify the source of pain.(Katz J et al 2000). Several local anesthetic drugs are available. It is important to become thoroughly familiar with the commonly used ones. Lignocaine is now one of the most popular local anaesthetic agents. (Setnikar I 1990). Bupivacaine is used when more prolonged anesthesia is required. Levobupivacaine and ropivacaine are recently introduced drugs with similar properties to bupivacaine but less toxic.

Amethocaine is also useful and available in many countries. Their effectiveness is influenced by many factors; particularly the choice of agent and the technique of administration. Information regarding the relative potency, efficacy and duration of the different clinically used local anesthetics with the same concentration by different techniques of administration are not available. (Rose, Shackell Bulbring & Wajda,1945) This work is an attempt to throw light in this regard on different laboratory animals, which may be interpolated, to human beings.

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MATERIAL AND METHODS

The animals were kept under standard condition of illumination with a 12 - h light-dark cycle at 25 ± 1° C. They were provided with tap water and balanced diet ad libitum. The study was approved by the Institutional Animal Ethics Committee (IAEC) and it followed the Committee for Purpose Controlling and Supervision on Experimental Animals (CPCSEA) rules on animal protection. The animal models used in this study were

a)Plexus anesthesia in frogs

b)Infiltration anesthesia in guinea pigs

c) Surface anesthesia in rabbits. (Bavoux E et al.,2000)

Three different procedures have been extensively used in this work. However no other test known provides all the information required, so that one must be prepared to apply several different tests, each useful because of the information it provides. (Bedder MD 2000)

Plexus anesthesia is used to indicate relative speed of onset of anesthesia, rather than duration, since such a preparation presumably undergoes constant deterioration. (Benlabed M et al 1990). In some respects the intra dermal wheal test offers distinct advantages over either of those mentioned above, although it gives little information about local anesthetic potency on topical application. (Capogna G et al1995) Corneal anesthesia is an indication not only of anesthetic potentiality, but also of the ability of the agent to penetrate the outermost layers of cells. (Capogna G et al 1995) Penetration on topical application depends on the presence of significant proportion of undissociated molecules. The concentrations of drugs were chosen as that the reflex was not blocked in less than 2 minutes but blocked in less then 20 minutes. Even with no local anesthetic present the reflex may not persist for much longer than 25 minutes. (Chestnut DH 1989)Then the same concentrations were applied in the experimental models made in India by Astrazenca Pharma India limited; Bangalore. The drugs were diluted with normal saline. Lignocaine2%: xylocaine hydrochloride injection IP; made in India by Astrazenca Pharma India limited; Bangalore. Bupivacaine 0.5%: bupivacaine hydrochloride injection IP.

PLEXUS ANESTHESIA:

Animal was pithed and spinal cord was destroyed up to the 3 vertebra. After nailing the fore limbs on the frog board A transverse incision was made on the abdominal wall just below the sternum. Through this opening the viscera was removed carefully and exposed the lumbar plexus without damaging the plexus. The plexus was seen as yellow trunk, running down the both sides of spinal column. Then frog board was fixed to the stand in such a way that the lower limbs are freely hanged vertically. The abdominal pouch was filled with local anesthetic solution. Reflex activity was tested by immersing both feet of the frog every two minutes for not longer than 10 seconds into N/10 Hydrochloric acid. Later immersed the legs in saline to wash off the Hydrochloric acid each time. The time was noted for the disappearance of the reflex activity and the time of onset of anesthesia was calculated. (Chow M 1998)

SURFACE ANESTHESIA:

Albino rabbits of either sex weighing 2.5 – 3.0kg ware selected, upper and lower eyelashes were carefully trimmed. The conjunctival sac of one eye was held open, thus formed a pouch. 0.5ml of solution of the anesthetic was applied into the conjunctival sac for 30 sec. with the help of dropper. Then the procedure was repeated, so that 1.0ml is applied within 2min same procedure was repeated in other eye taking it as control. Corneal reflexes in both the eyes were tested for every 5min with wet cotton plug. (. De Nicola A, Sucre MJ 2000)

INFILTRATION ANESTHESIA:

Preparation of guinea pig: Guinea pigs (either sex) weighing 250-300grams were used. They were prepared at least 24hrs before the experiment by shaving the hair on either side of the lower back. A sterile sharp 26gx 3/8inch needle was used for each injection.

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Lower back of the guinea pig was stretched taut by holding the animal with the hand placed around the abdomen and by pulling the skin taut with the thumb and forefinger. The drug was injected (0.1ml) enough to rise the wheal Then outlined the wheal with marker pen. Five minutes after the injection the sensitivity of the area was tested by pricking with a needle, injected in the same direction as that in which the skin was being held and the needle is inserted intradermally. six times lightly at the site of injection and control area. Six squeaking were noted on control and test side. Responses at the site of the injection will indicate the degree of anesthesia. Failure to squeek (out of six) 6/6 indicates maximum anesthesia 0/6 indicates no anesthesia. (Coventry DM, Todd JG 1989)

RESULTS AND DISCUSSION

A comparative study of local anesthetic activity of two clinically used local anesthetic agents bupivacaine and lignocaine was none in three species of animals i.e. Frogs, rabbits, and guinea pigs by utilizing the experimental models of local anesthesia, testing i.e. plexus anesthesia in frogs, surface anesthesia in rabbit eye and infiltration anesthesia in guinea pigs. Both bupivacaine and lignocaine produced concentration dependent rapid local anesthesia when they are exposed to frog lumber plexus. But in the concentration of 0.1%and 0.2% Lignocaine produced statistically significant rapid on set of plexus anesthesia compared to similar concentration of bupivacaine. Rosers et al. (1993) mentioned that onset of local anesthesia with lignocaine is fast while with bupivacaine the onset is moderate. So my results in the plexus anesthesia experiment is like the observations mentioned by Rosers et al.
Both bupivacaine and lignocaine produced surface anesthesia in the rabbit eye but bupivacaine produced surface anesthesia at 0.05% concentration. Whereas lignocaine produced surface anesthesia in the rabbit eye at 0.5% concentration, suggesting bupivacaine is more potent than lignocaine.

In the literature mentioned that bupivacaine is a potent local anesthetic agent. So my results in the surface anesthesia experiments are also correlating with the facts mentioned in the literature. Both bupivacaine and lignocaine produced infiltration anesthesia when injected intradermally in the guinea pigs. However the duration of infiltration anesthesia with bupivacaine is more prolong, which is statistically significant in comparison to the duration of infiltration anesthesia after intradermal injection of lignocaine.

CONCLUSION

Lignocaine produced rapid onset of plexus anesthesia in Frogs in comparison to the bupivacaine at concentration of 0.1% & 0.2% which is statistically significant. Bupivacaine is more potent than the lignocaine as a surface anesthetic agent in the Rabbit eye because bupivacaine could produced surface anesthesia in the Rabbit eye at 0.05% concentration onwards, where as lignocaine could produce surface anesthesia at concentration of 0.5% or 0.1% or both. Both bupivacaine and lignocaine produced infiltration anesthesia on intradermal injection in guinea pigs but the duration of infiltration anesthesia in guinea pigs produced by bupivacaine is more prolonged which is statistically significant in comparison to the lignocaine at all the three concentrations tested i.e. 0.05%, 0.1% & 0.2%.

Table: 1 Comparison of 0.05%, 0.1% and 0.2% concentrations of Bupivacaine and lignocaine on Lumbar plexus anesthesia in Frogs.

	Onset of plexus anesthesia in frogs mean+/-S.E (min)		
Concentration (%)	0.05	0.1	0.2
Bupivacaine	11.17±0.31	7.67±0.42	4.67±0.33
Lignocaine	10.33±0.42	6.5±0.22	3.33±0.21
"t" value	1.16	2.47	3.47
"P" value	-	<0.05	<0.01

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Table. 2: Comparison of 0.05%, 0.1%, 0.2% & 0.5% concentrations of Bupivacaine and lignocaine on surface anesthesia in rabbit eye.

	Onset Surface anesthesia in rabbit eye mean ± S.E (min)			Duration of Surface anesthesia in rabbit eye mean ± S.E (min)		
Concentration (%)	0.05	0.1	0.2	0.05	0.1	0.2
Bupivacaine	5±0	5±0	5±0	13.33±1.05	22.5±1.12	32.5±1.12
Lignocaine	0	0	0	0	0	0
"t" value	5	5	5	12.7	20.09	29.02
"P" value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table.3: Effect of 0.05%, 0.1%, & 0.2% Bupivacaine on infiltration anesthesia in guinea pigs.

	Onset of Infiltration anesthesiain G.Pig mean ±S.E (min)			Duration Infiltration anesthesiain G.Pig mean±S.E (min)		
Concentration (%)	0.05	0.1	0.2	0.05	0.1	0.2
Bupivacaine	2.67±0.61	2.33±0.42	1±0	26.67±1.67	44.17±1.54	62.5±1.12
Lignocaine	1±0	1±0	1±0	13.33±1.67	17.5±1.12	27.5±1.12
"t" value	2.73	3.1	1	5.65	14.01	22.1
"P" value	<0.025	<0.025	-	<0.001	<0.001	<0.001

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