ESTIMATION OF RECTAL TEMPERATURE AND BODY WEIGHT OF RAT AGAINST TYPHOID

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Abstract

Typhoid fever (TF) is an important communicable disease in many developing countries. Salmonella, a gram negative bacilli, and can survive during certain stages of host parasite interaction. Nitric oxide (NO) is a versatile molecule produced in a biological system; previous studies have suggested that exogenous administration of L-arginine results in increased NO production, indicating that endogenous substrate is insufficient for maximal NO production. Taking these facts into consideration, it was thought pertinent to see the effect of oral administration of NO donors i.e. L-arginine. In this study have evaluated rectal temperature and body weight in Wistar rat before and after treatment of NO donor i.e., L-arginine and low doses of ciprofloxacin.

Keywords: Typhoid, Rectal temperature, Body weight

1. Introduction

Salmonella typhi infection is still a major health problem in tropical and developing countries. TF is an important cause of morbidity and mortality in many regions of the world, with an estimated 1233 million cases leading to 216,000 - 600,000 deaths annually.\(^1,2\) The treatment against this disease was antibiotics and vaccination. A major impediment to the effective chemotherapy of typhoid is the ever increasing numbers of resistant strains of S. typhi.\(^3-5\) Carl Reinhold August Wunderlich was the first to conduct extensive study on body temperature, and published his opus magnus in 1868. The rectum is the site of the highest temperature measurement in the body. Rectal temperature is a reliable approximation of core temperature only if the patient is in thermal balance. Although generally safe, such measurements are associated with a small risk of rectal perforation, especially in neonates and very young infants. The rectal temperature responded slowly to changes in blood temperature.\(^6\)

This finding was probably related to the heat sink effect of stool in rectum. Even at steady state, rectal temperature has been shown to differ significantly from pulmonary artery temperature. It was concluded that the accuracy of rectal temperature measurement is poor at extremes of temperature, because it is slow to measure change.

Fever is basically the rise of the regulated set-point temperature by the effect of pyrogens. Pyrogens are classified into two groups: exogenous and endogenous. Exogenous pyrogens include: micro-organisms (primarily cell wall components), microbial toxins (usually Gram-positive organisms), antigen-antibody complexes, drugs, and polynucleic acids. They can induce the host cells (primarily macrophages) to produce endogenous...
pyrogens. Some endogenous molecules can also induce endogenous pyrogens; these include antigen-antibody complexes, certain androgenic steroid metabolites, inflammatory bile acids, complement components, and some lymphocyte products.

Endogenous pyrogens include: interleukins (ILs)-1, 2, 6, and 8, tumour necrosis factor (TNF)-α, and prostaglandin E, which is a component of the final common pathway of action on the thermoregulatory centre. The pyrogens disturb the balance in firing of warm- and cold-sensitive neurons in the hypothalamus, leading to elevation of the set-point temperature.

In both vertebrates and invertebrates (few exceptions) manifest fever in response to challenge with microorganisms or other known pyrogens. This has been viewed as one of the strongest pieces of evidence that fever is an adaptive response: it is held that the metabolically expensive increase in body temperature that accompanies the febrile response would not have evolved, and been so faithfully preserved within the animal kingdom, unless fever had some net benefit to the host. Fever has been shown to enhance monocytic elimination of *Leishmania* and neutrophilic elimination of pneumococci, *Candida*, *Escherichia coli*, *Salmonella typhimurium*, *Listeria monocytogenes*, and *Staphylococcus aureus*. Fever also has been shown to decrease bacterial and viral growth rates.

2. Materials and Methods:

2.1 Dose and Dosage

2.1.1 Animals: *Wistar* rat of 6-8 weeks old were obtained from the central animal house of Hamdard University, New Delhi, India. The animals were kept in Polypropylene cages in an air-conditioned room at 22°/25°C and maintained on a standard laboratory feed (Amrut Laboratory, rat and mice feed, Navmaharashtra Chakan Oil Mills Ltd, Pune) and water *ad libitum*. Animals were allowed to acclimatize for one week before the experiments under controlled light/dark cycle (14/10h). The studies were conducted according to ethical guidelines of the “Committee for the purpose of control and supervision of Experiments on Animals (CPCSEA)” on the use of animals for scientific research.

2.1.2 Bacteria:

In this experiment only *Salmonella typhimurium* (wild) was used. The standard strain of this pathogen was obtained from the National Salmonella Phage Typing Centre, Lady Harding Medical College, New Delhi, India. This bacterial strain was further confirmed by the Department of Microbiology, Majeedia Hospital, New Delhi, India. The drug was administered orally and *S. typhimurium* intraperitoneally.

Animals were divided into six groups. Each group comprised of six animals. The study comprised of following treatment schedule. *(Table -1)*

Effects of above drugs on infected mice by *S. typhimurium* were analyzed. Post-treatment of drugs were done at above dose orally to the experimental animals, first group was considered as control that receive only saline, second group considered as positive control which was challenged with sub lethal dose of *S. typhimurium* (0.6xLD50) along with saline. Third group was challenged with sub lethal dose of *S. typhimurium* and given only full dose of ciprofloxacin. Fourth group was challenged with sub lethal dose of *S. typhimurium* and then mice were treated with full dose of Arginine only. In
fifth and sixth group animals were challenged with *S. typhimurium* and then half and one fourth dose of Arginine was administered along with half dose of Ciprofloxacin respectively.

**2.1.3 Record of rectal temperature**

Temperature was recorded using Liquid-in-glass thermometers (mercury or spirit) in the anus. Clinical thermometers differ from laboratory thermometers by virtue of a small constriction just below the scale, which prevents the indicator liquid from flowing back into the bulb as the thermometer cools. Its advantages include low cost and good accuracy.

**2.1.4 Record of body weight:** Body weight was recorded using digital weighing balance.

**2.1.5 Statistical analysis.** All data are expressed as means ± standard errors of the means (SEM). The statistical difference was determined by the two-tailed unpaired *t* test. A *P* of <0.05 was considered statistically significant.

**3. Result**

**3.1. Effect of drugs on rectal temperature and body weight of rat:**

The therapeutic effect of above dose of drugs in pre-infected rat of rectal temperature was analyzed. There was increase in rectal temperature by 20.58% in *S. typhimurium* pre-infected rat. Drugs (ciprofloxacin (0.04 gm per kg body weight); L-Arginine (1 gm per kg body weight); 1/2 L-Arg+1/2 Cip (0.5+0.02 gm/kg b. wt); 1/4 L-Arg+1/2 Cip (0.25+0.02 gm/kg b. wt)) were administered in pre-infected rat and the percent decrease in temperature was observed by (1.94, 1.29, 1.31 and 0.45%). Result has been summarized in **Figure 1.** The above drugs have shown more or less clinically non-significant changes in rectal temperature. The curative effect of drugs was not pronounced well in reversal of temperature. Similarly when the animals were infected with *S. typhimurium* which causes decrease in body weight by 3.4% and slight increase were found in drugs treated rat by 5.01, 3.60, 3.70 and 0.62% respectively Figure 2.

**Discussion:**

**Rectal temperature:** The effect of drugs in rat challenged with sub lethal dose of *S. typhimurium* [Ciprofloxacin alone (0.04gm/kg b. wt), Arginine alone (1gm/kg b. wt), 1/2 Arg+1/2 Cip (0.50g/kg b. wt)+Cip (0.02 gm/kg b. wt), 1/4Arg+1/2Cip; Arginine (0.25g/kg b. wt)+Cip (0.02 gm /kg b. wt)] was seen, and the increase in rectal temperature by 20.58% in *S. typhimurium* pre-infected rat where as decrease in temperature was observed by and it was found 1.94, 1.29, 1.31 and 0.45% in drugs treated rat respectively (Figure 1). It is concluded that the drugs does not directly decreases the temperature. Similarly when the animals were infected with *S. typhimurium* it cause decrease in body weight by 3.4% and slight increase were found in drugs treated rat by 5.01, 3.60, 3.70 and 0.62% respectively (Figure 2). It is now concluded that in case of typhoid rise in temperature or decrease in body weight not due to Salmonella infection itself.

**Conclusion**

Due to lack of specific clinical signs complicates the diagnosis of typhoid fever, which must be distinguished from other endemic acute and sub acute febrile
illnesses. A fever lasting more than one week without evident cause should be considered typhoid until proven otherwise and typhoid should always be considered when suspected malaria has not been confirmed or has not responded to antimalarial therapy.

It is now concluded that rise of temperature during the course of Salmonella infections is due to elimination of neutrophils.

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Table 1. Treatment schedule

| Groups  | Treatments                                                                 |
|---------|-----------------------------------------------------------------------------|
| Group1  | Negative control (Normal Saline)                                           |
| Group2  | Positive control (S. typhimurium(0.6xLD50) + Saline                        |
| Group3  | S. typhimurium (0.6xLD50)+Ciprofloxacin (400 mg/kg b. wt)                   |
| Group4  | S. typhimurium (0.6xLD50) +Arginine (1000 mg/Kg b. wt)                      |
| Group5  | S. typhimurium (0.6xLD50) +Arginine (500mg per kg b. wt)                    |
|         | +Ciprofloxacin (200mg per kg b. wt)                                         |
| Group6  | S. typhimurium (0.6xLD50) +Arginine(250mgper kg b. wt)                      |
|         | +Ciprofloxacin(200 mg per kg b. wt)                                          |
Figure 1. Rectal temperature of rats: drugs were given for seven days

S=Saline, B+S=S. typhimurium+Saline, B+Cip=S. typhimurium+400mg per kg b. wt Ciprofloxacin, B+Arg=S. typhimurium+1 000mg per kg b. wt L-Arginine, B+1/2Arg+1/2Cip=S. typhimurium+500mg per kg b. wt Arginine+200 mg per kg b. wt ciprofloxacin, B+1/4Arg+1/2Cip=S. typhimurium+250mg per kg b. wt Arginine+200mg per kg b. wt Ciprofloxacin.

Figure 2. Effect on body weight of rat: drugs were given for seven days.

S=Saline, B+S=S. typhimurium+Saline, B+Cip=S. typhimurium+400mg per kg b. wt Ciprofloxacin, B+Arg=S. typhimurium+1 000mg per kg b. wt L-Arginine, B+1/2Arg+1/2Cip=S. typhimurium+500mg per kg b. wt Arginine+200 mg per kg b. wt ciprofloxacin, B+1/4Arg+1/2Cip=S. typhimurium+250mg per kg b. wt Arginine+200mg per kg b. wt Ciprofloxacin.