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# Probable cause of tragic death and akward incident happened with Ringer Lactate Solution at Karnataka and in WestBengal which was manufactured by Pharmaceutical company in West Bengal Ltd - a case study

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**ABSTRACT:**

An intravenous fluid called Ringer's Lactate is mostly used for electrolyte balance and rehydration. Lactate, calcium chloride, potassium chloride, and sodium chloride make up this isotonic mixture. IV fluids are essential for preserving the body's electrolyte balance and hydration. About 60% of human bodies are made of water. Dehydration can affect important organs like the heart and kidneys and cause serious health problems. The Ringer's Lactate scandal highlights how important it is for medical suppliers to have strict quality control. Patients rely on IV fluids' effectiveness and safety. The factors that might affect the ringer lactate solution are :PH ,microbial load ,temperature ,counterfeit drugs ,storage condition and others .These factors may have some affect on the solution and it mostly reacted when given on a pregnant lady .The pharmaceutical company might be unknown by these factors which hampered the solution and ultimately cause death to the patient .

**Keywords**: Spurious, Electrolyte, Dehydration, Effectiveness, Concerns.

## Introduction:

The main purposes of Ringer's Lactate, an intravenous fluid, are electrolyte balance and rehydration. It is made up of lactate, calcium chloride, potassium chloride, and sodium chloride. When a patient is dehydrated after surgery, burns, accidents, or delivery, medical personnel frequently give them RL. Since it is categorized as a crystalloid solution, it includes tiny molecules that are easily able to cross cell membranes. Ballari District Hospital reported a sharp increase in maternal fatalities between November 9 and November 11. According to reports, the fatalities happened after a caesarean section that was performed in the hospital's maternity operating room throughout these three days. According to the Minister, seven women experienced problems from the 34 caesarean surgeries performed over the course of these three days, including acute renal damage that necessitated haemodialysis and multi-organ failure. “Of the seven, four women died, including one death on November 26. A confidential review of the deaths by a team of specialists constituted by the Rajiv Gandhi University of Health Sciences has revealed that there is no negligence or dereliction of duty by the doctors at the hospital. The report said that all protocols and patient care guidelines have been followed,” he said. Two of the remaining three women have been discharged from the hospital and one patient is recovering at VIMS Ballari. The Minister said the onset of complications following caesarean operations is being suspected to the ringer lactate solution supplied by M/S Paschim Banga Pharmaceutical Ltd to Karnataka State Medical Supplies Corporation Ltd. (KSMSCL).

## Instrument or Equipment –

Equipment Needed for Microbial Load Testing: Both aerobic/anaerobic microbial enumeration and sterility testing are required for determining the microbial load in Ringer's lactate solution.

- **Laminar Flow Hood (Class II):** To keep tests as sterile as possible.
- **Incubators:** Used to maintain microbial cultures at particular temperatures, usually between 20 and 25°C for fungus and between 30 and 35°C for bacteria. For plating the samples, use sterile petri dishes.
- **Membrane Filtration Equipment:** Usually used for sterile solutions, this equipment filters vast amounts of the fluid. Microorganisms are concentrated from a sample using membrane filters.
- **Sterile dilution bottles and vials:** Used to dilute the sample in order to achieve controllable microbial concentrations. Transferring test samples or diluted solutions is done with sterile pipettes.
- **Sterile Sampling Equipment:** Pipette tips, syringes, and needles that have already been sanitized.

- **Bacterial Culture Media:** Nutrient Agar or Tryptic Soy Agar (TSA) for bacterial growth. Use Sabouraud Dextrose Agar (SDA) to cultivate fungi.
- Bacterial growth indicators, such as turbidity in the broth or a change in colour in a differential media, are used to verify the growth of microorganisms.

## THE FACTORS THAT CAN AFFECT THE RINGER LACTATE SOLUTION ARE:

### *1. pH-*

It is a quantitative measure of the acidity or basicity of aqueous or other liquid solutions. It is a logarithmic scale that ranges from 0 to 14. A pH greater than 7 indicates basicity, a pH less than 7 indicates acidity, and a pH of 7 represents neutrality.

- ✓ The pH scale indicates a solution's acidity or alkalinity (basicity). The scale has a range of 0 to 14, where:

Pure water has a pH of 7, which is regarded as neutral, indicating that the solution is neither acidic nor alkaline. An acidic solution has a pH below 7. The acidity increases as the pH decreases. For instance, vinegar or lemon juice has a pH of about 2-3, making it acidic. A solution that has a pH higher than 7 is said to be alkaline, or basic. The strength of the alkalinity increases with pH. For instance, solutions of baking soda or household ammonia have an alkaline pH of around 9 to 11.

The pH of Ringer's lactate (RL) solution is normally between 6.0 and 7.5. Several problems may occur if the pH is not kept within this range:

**Increased pH (Alkaline Conditions):**

Ringer's lactate gets more alkaline as its pH goes over the normal range, which is around 6.0 to 6.5.

- ***Calcium Precipitation:*** The Ringer's lactate's ability to maintain appropriate electrolyte balance may be diminished if the calcium in it precipitates (forms solid calcium ions).
- ***Irritation:*** When administered intravenously, an alkaline solution may cause irritation to the veins and surrounding tissues.
- ***Electrolyte Imbalance:*** High pH can change how ions dissociate, which may have an impact on how the body receives and uses electrolytes (such as calcium, potassium, and sodium).

***Decreased pH (Acidic Conditions):***

A number of problems may occur when the pH falls below the typical range, making the solution more acidic:

• ***Metabolic Acidosis Risk:*** If Ringer's lactate is excessively acidic, it might cause the blood to become more acidic, which could result in metabolic acidosis, particularly if large amounts are given.

• ***Impaired Lactate Metabolism:*** The liver breaks down lactate, which aids in maintaining the body's acid-base equilibrium. Lactate's capacity to adequately buffer the blood may be impacted by changes in its processing caused by a more acidic solution.

• ***Tissue Irritation***: An acidic solution raises the possibility of negative responses by irritating the tissues at the infusion site.

***Impact on Efficacy:***

- ***Electrolyte Imbalance:*** The solution's ability to restore fluid and electrolyte balance in the body may be hampered by pH variations that affect the balance of electrolytes (sodium, potassium, calcium, and lactate).
- ***Metabolic Disturbances:*** Ringer's lactate is made to keep the pH balance just right, which is in harmony with the body's regular metabolic processes. The intended therapeutic benefits may be jeopardized if this range is exceeded.

### *2. Microbial load:*

Ringer's lactate solution (or any parenteral solution) must undergo microbial load testing in order to be sterile and safe for usage. The procedure necessitates following certain tools, methods, and legal requirements. These consist of the following:

Regulatory Guidelines: The World Health Organization (WHO), European Pharmacopoeia (EP), and United States Pharmacopoeia (USP) are among the regulatory organizations that offer guidelines for assessing the microbiological load of sterile goods, such as Ringer's lactate solution.

Some guidelines may be:

- USP Chapter <61> - Microbiological Analysis of Nonsterile Products: Check for Specific Microorganisms (if any) and Check for Total Aerobic Microbial Count. But for sterile formulations, you have to consult:
- USP Chapter <71> Tests for sterility (for parenteral solutions).
- Microbiological Analysis of Non-Sterile Products (EP 2.6.1).
- The Guide to Good Manufacturing Practices (GMP) for Parenteral Products is a set of WHO recommendations for sterile preparations.

Increases in Ringer's lactate solution's microbial load can cause a number of major problems, particularly if the solution is utilized for medical procedures like intravenous infusion. The possible outcomes are:

***Infections:***

- Pathogen Introduction: If a patient receives an infusion of a solution tainted with bacteria, fungus, or other microorganisms, the pathogens may enter their circulation directly. Sepsis, bloodstream infections (bacteremia), and other potentially fatal systemic infections can result from this.
- Local Infections: At the infusion site, microbial contamination may also result in local infections that might cause cellulitis or abscesses (a confined pocket of pus that collects in tissues ,organs or spaces inside the body ). The illness might get worse if it spreads.

***Immune System Response Impairment:***

- Weakened Immune Protection: Patients with compromised immune systems—such as those suffering from diabetes, cancer, or chronic illnesses—are more susceptible to infection from microbial contamination. Their immune system may be overloaded by even a tiny quantity of microorganisms in the solution, resulting in more serious diseases.

***Hazardous Reactions:***

- Endotoxins: When certain bacteria, particularly gram-negative bacteria, die, they produce endotoxins, which are poisons present in their cell walls. These poisons can be dangerous and cause the body to react toxically, resulting in symptoms including fever, hypotension (low blood pressure), and shock, which in certain situations can be lethal.

- Systemic Inflammatory Response: If certain bacteria or their metabolites are present in the blood, it may cause a systemic inflammatory response that, if left untreated, might lead to organ failure and death.

***Delayed Healing or Worsening of Conditions:***

- Treatment Compromise: Ringer's lactate is frequently used for electrolyte balance and fluid replenishment when conditions worsen or take longer to heal. By introducing germs, contaminated fluids might impede the desired course of therapy, postpone recovery, and exacerbate the patient's condition.

- Antibiotic Resistance: Treating an illness becomes considerably more challenging and may call for more potent, specialized therapies if the microbial load include germs that are resistant to antibiotics. Complication risks rise as a result.

***Negative Impacts of Contaminants:***

- Growth of Fungi or Mold: In addition to bacteria, there may be fungal or mold contamination. Failure to maintain the appropriate storage conditions (sterile, cold, and dry) might allow these bacteria to multiply in the solution. Fungemia, a condition that is sometimes more difficult to cure than bacterial infections, can result from fungal contamination.

***Reduced Treatment Quality:***

- Modified Composition: A higher microbial load may also have an impact on the solution's physical properties, perhaps changing its flavour, smell, or clarity. This may be a sign of contamination or deterioration that reduces the overall efficacy of the solution.

***Contamination Risk in Medical Environments:***

- Cross-Contamination: If tainted Ringer's lactate is used in a medical facility, there is a chance that it will infect additional patients or equipment, particularly if appropriate hygienic and sterilization procedures are not followed. The facility may experience an infection outbreak as a result of this.

***Avoiding a Higher Microbial Load:***

In order to stop microbiological contamination, it is essential to:

- Make sure that all manufacturing facilities, packaging, and equipment are properly sterilized.
- To preserve their sterility, keep Ringer's lactate solutions out of direct sunlight and under regulated conditions with the right humidity and temperature.
- In hospital settings, adhere to stringent handling and cleanliness guidelines, making sure that IV bags and infusion equipment are only utilized for their designated purpose.
  To lower the chance of microbial development, keep an eye on expiry dates and utilize the solution within the suggested time range.

### *3. Temperature:*

The stability and sterility of Ringer's lactate solution are significantly influenced by temperature. Extreme temperatures or improper storage can alter the solution's sterility, composition, and general efficacy, which could have negative effects if applied in a medical setting. Extremes in temperature can have the following effects on the solution:

- **High Temperatures (above recommended storage range) Solution Degradation:**

Ringer's lactate solution should normally be kept at room temperature, which is between 20 and 25°C (68 and 77°F), or as the manufacturer instructs [2,3]. If the solution is exposed to temperatures above 30°C (86°F) for prolonged periods of time, the chemical components may begin to degrade, affecting the solution's buffering capacity. This could result in an imbalance in the body's acid-base status, which could have potentially harmful effects like metabolic acidosis.

High temperatures can cause the water in the solution to evaporate, which could result in a concentration of electrolytes (e.g., sodium, potassium, calcium), which could be harmful to the patient.

Microbial development: If the container is unsealed or the solution is over its expiration date, exposure to high temperatures may also encourage the development of microorganisms in the solution. This may result in infections (like septicaemia), which may be fatal if left untreated.

Toxic Reactions: Endotoxins or other toxic byproducts may be released into the solution if the solution becomes contaminated or if certain chemicals degrade as a result of high temperatures. This increases the risk of toxic shock or a systemic inflammatory response, both of which could be lethal if treatment is delayed.

- **Low temperatures (below the recommended range for storage):**

***Crystallization of Electrolytes***: Calcium chloride and other electrolytes in the solution may precipitate or crystallize if exposed to extremely low temperatures (below 0°C or 32°F). These crystals have the potential to clot blood arteries or induce circulatory collapse if they are infused into the circulation. This could prove to be lethal or fatal [2,3].

***Increased Contamination Risk***: Improper thawing(solid to liquid phase ) of Ringer's lactate solution after freezing might compromise the container's integrity or introduce pollutants. There is a greater chance of contamination during the thawing phase since the freezing process may weaken the packaging's sterile barrier.

- **Extreme Temperature Changes (Rapid Flactuations):**

***Container Integrity***: The material of the container may be stressed by abrupt temperature changes, such as freezing and thawing or exposure to hot and cold conditions, which might result in leaks or cracks. Contamination may occur if the solution seeps out and is exposed to the atmosphere [3,4].

***Loss of Sterility:*** Variations in temperature can also impact the solution's sterility, raising the possibility of microbial infection. Particularly in susceptible people, the solution can cause sepsis or other severe illnesses that might be lethal if it is tainted and given.

**Suggestions for Safe Storage:**

- ✓ Ringer's lactate solution should be kept at room temperature (20–25°C or 68–77°F) to minimize these risks;
- ✓ away from sunlight or direct heat sources;
- ✓ in a cool, dry location to prevent contamination from high humidity;
- ✓ and away from frozen storage to avoid electrolyte crystallization.

### *4. Storage condition :*

If Ringer's lactate solution is not stored under proper conditions, several negative effects can arise, compromising the safety, sterility, and effectiveness of the solution. These effects can range from chemical degradation to microbial contamination, potentially leading to serious health risks when the solution is administered to patients. Here's a breakdown of what can happen if the storage conditions are not maintained:

**Chemical Degradation:**

- Altered Electrolyte Composition: Ringer's lactate contains sodium chloride, potassium chloride, calcium chloride, and lactate. If the solution is stored in inappropriate conditions, such as high temperatures, these chemicals could degrade or become imbalanced, leading to changes in the concentration of electrolytes. This can affect the solution's ability to properly rehydrate and restore electrolyte balance in the body [5].
- Lactate Breakdown: The lactate in Ringer's lactate serves as a buffer and is involved in maintaining the body's acid-base balance. Improper storage conditions, particularly high temperatures, can cause lactate to break down into lactic acid, leading to an increase in the acidity (lower pH) of the solution. This can cause metabolic acidosis when administered, which can be dangerous, especially for patients with compromised health.

- Precipitation of Electrolytes: If the solution is exposed to extremely low temperatures (below 0°C/32°F), electrolytes like calcium or sodium may precipitate out of solution, forming crystals. If infused into the patient, these crystals can block blood vessels, leading to vascular damage or other cardiovascular complications [1.3].

**Microbial Contamination:**

- Growth of Bacteria or Fungi: Storing the solution outside of recommended conditions, especially at higher temperatures or improperly sealed containers, can provide a breeding ground for bacteria, fungi, and other microorganisms. Once contamination occurs, the solution can introduce pathogens into the bloodstream when administered, leading to infections such as sepsis or bacteraemia [3].
- Endotoxin Production: Certain types of bacteria, especially gram-negative bacteria, can release endotoxins when they break down, which are toxic to the body. If the solution is contaminated with these bacteria and administered, it can lead to systemic inflammatory response syndrome (SIRS) or toxic shock, which can be fatal if untreated.

**Loss of Sterility:**

- Compromised Packaging: If Ringer's lactate is stored improperly or the packaging is compromised (e.g., punctured, cracked, or poorly sealed), bacteria or other contaminants may enter the solution. Even in sealed containers, exposure to moisture, light, or extreme conditions could compromise the sterile barrier and cause contamination [1,2].
- Increased Risk of Cross-Contamination: If Ringer's lactate is stored in environments that are not clean or where cross-contamination can occur, the likelihood of microbial contamination increases [4]. Improper handling of open containers (e.g., not using sterile techniques when opening or using the solution) can introduce harmful microorganisms into the solution.

**Physical Changes:**

- Cloudiness or Discoloration: Improper storage, such as exposure to excessive light or high temperatures, could cause the solution to change in appearance. It may become cloudy or discoloured, which indicates that chemical degradation or microbial growth may have occurred. A cloudy or discoloured solution should never be used, as it is likely to be contaminated or compromised.
- Leaking Containers: If storage conditions lead to damaged containers, such as overheating or freezing, there is a risk of leakage. This can compromise the sterility of the solution and increase the likelihood of contamination.

**Shortened Shelf Life:**

- Reduced Effectiveness: Ringer's lactate, like many other medical solutions, has a shelf life that is dependent on proper storage[3,4]. Exposure to extreme conditions can shorten the shelf life of the solution, meaning it may become ineffective or unsafe to use even before the expiration date. If the solution has been stored improperly, it's essential to check for visible signs of deterioration and consult with healthcare professionals before use.

**Toxic Reactions:**

- Endotoxins and Toxins from Bacteria: If microbial contamination occurs, especially with gram-negative bacteria, toxins can be released into the solution. These toxins can cause a toxic shock reaction, leading to fever, hypotension, and organ failure. Without immediate medical intervention, this can lead to death.

**To ensure the safety and effectiveness of Ringer's lactate solution, it should be stored under the following conditions:**

- Room temperature (20-25°C or 68-77°F).
- Protected from light to prevent degradation of components.
- Sealed tightly to maintain sterility and avoid contamination.
- Avoid freezing or exposing to temperatures below 0°C (32°F).
- Used before the expiration date and kept in clean, controlled environments.

### *5. Counterfeit Drugs*

Combining Ringer's lactate solution, a common intravenous fluid used for hydration, with counterfeit drugs can be extremely dangerous for patients. Ringer's lactate is frequently used to maintain fluid and electrolyte balance, however depending on the kind and makeup of the counterfeit drugs, the effects of combining it with them might vary greatly.

The following are potential risks and consequences:

- **Toxic Reactions**: Toxic reactions can be brought on by unsafe chemicals or incorrect dosages in fake pharmaceuticals [5,6]. These substances have the potential to cause major adverse effects including allergy, shock, or organ failure when coupled with Ringer's lactate solution.
- **Infection:** The production of counterfeit medications frequently takes place in unhygienic settings, raising the possibility of bacterial infection. These medications raise the possibility of causing sepsis, which can result in potentially fatal infections, when used with intravenous fluids.
- **Inaccurate Dosage:** Fake medications may have uneven doses or the wrong active component. Overdosing or low medication levels might occur from this, which could have negative side effects or no therapeutic benefit at all.
- **Decreased Treatment Effectiveness**: Combining Ringer's lactate with fake medications may change the fluid's and the medication's anticipated effects. The counterfeit medication may not function as planned and the body may not absorb the required nutrients and fluids as intended, which might aggravate health results[2].
- **Long-term Health Impact**: Depending on the type of substance involved, prolonged use of counterfeit drugs combined with intravenous fluids may cause chronic problems, such as damage to vital organs, neurological disorders, or cardiovascular issues.

- **Incompatibility**: Some counterfeit drugs may contain substances that react negatively with the components of Ringer's lactate (such as sodium, potassium, or calcium), potentially causing dangerous chemical reactions in the body.

**Ringer lactate affects the organs mostly and cause death :**

- Heart: Due to electrolyte imbalances, fluid overload, or acidosis.
- Lungs: In cases of fluid overload, pulmonary edema can impair breathing and gas exchange.
- Kidneys: In cases of fluid imbalance or acidosis, renal function can fail.
- Liver: Dysfunction in lactate metabolism can worsen acidosis, especially in liver-impaired individuals.

## Conclusion:

It is concluded that ringer lactate solution which is an isotonic mixture mostly used for electrolyte balance and it consists of Lactate, calcium chloride, potassium chloride, and sodium chloride. It is mostly used after burns, accidents or after delivery. The death of the women after delivery that cause a great chaos in the medical field. There are some factors that may affect the ringer lactate solution unknowingly. First factor can be PH. It is a quantitative measure of the acidity or basicity of aqueous or other liquid solutions. It is a logarithmic scale that ranges from 0 to 14. Increasing of the PH in the ringer lactate solution cause calcium precipitation ,irritation and electrolyte imbalance and decreasing of the PH in the ringer lactate solution cause metabolic acidosis and tissue irritation .Second Factor can be microbial load which causes infections like sepsis ,bacterial infections and cellulitis .Microbial load also hazardous reaction and lower the immune system of the body .Third factor can be room or storage temperature .Increasing temperature causes microbial development and toxic reactions and decreasing temperature causes Crystallization of Electrolytes that Calcium chloride and other electrolytes in the solution may precipitate or crystallize if exposed to extremely low temperatures (below 0°C or 32°F). These crystals have the potential to clot blood arteries or induce circulatory collapse if they are infused into the circulation. Fourth factor can be storage condition. Improper storage condition causes chemical degradation, microbial contamination, physical changes and shortened shelf life. These are the factors that can affect the solution and cause death to the patients.

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