



## A prospective approach on Scarlet fever

Balasubramanian J<sup>1,2&4\*</sup>, Vijayakumar N<sup>3</sup>

1. Dr. Mohans Diabetes specialities Centre, Chennai- 86, India
2. Madras Clinical Research, Chennai-86, India
3. Sai Bio Sciences Pvt. Ltd, Chennai, Tamil Nadu, India
4. Periyar maniammai University, Thanjavur-613403, Tamilnadu, India

\*Corresponding Author: Dr. Mohans Diabetes specialities Centre, Chennai- 86, India, E-mail: jvbalpharm@yahoo.co.in

### Publication History

Received: 07 November 2012  
 Accepted: 02 December 2012  
 Published: 1 January 2013

### Citation

Balasubramanian J, Vijayakumar N. A prospective approach on Scarlet fever. *Discovery*, 2013, 3(7), 2-4

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### General Note

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### ABSTRACT

Scarlet fever is caused by an infection with group A *Streptococcus* bacteria. The bacteria make a toxin (poison) that can cause the scarlet-colored rash from which this illness gets its name. Not all streptococci bacteria make this toxin and not all kids are sensitive to it. Two kids in the same family may both have strep infections, but one child (who is sensitive to the toxin) may develop the rash of scarlet fever while the other may not. Usually, if a child has this scarlet rash and other symptoms of strep throat, it can be treated with antibiotics. So if your child has these symptoms, it's important to call your doctor.

### 1. INTRODUCTION

While "flesh-eating infections" caused by the group A streptococcus (*Streptococcus pyogenes*) may grab more headlines today, one hundred and fifty years ago, the best known and most dreaded form of streptococcal infection was scarlet fever. Simply hearing the name of this disease, and knowing that it was present in the community, was enough to strike fear into the hearts of those living in Victorian-era United States and Europe. This disease, even when not deadly, caused large amounts of suffering to those infected. In the worst cases, all of a family's children were killed in a matter of a week or two. Indeed, up until early in the 20th century, scarlet fever was a common condition among children. The disease was so common that it was a central part of the popular children's tale, *The Velveteen Rabbit*, written by Margery Williams in 1922.

Luckily, scarlet fever is much more uncommon today in developed countries than it was when Williams' story was written, despite the fact that we still lack a vaccine for *S. pyogenes*. Is it gone for good, or is the current outbreak in Hong Kong and mainland China a harbinger of things to come? More below...

First, what are the symptoms of scarlet fever? Most often, this manifestation occurs during or following strep pharyngitis ("strep throat"). Rarely, scarlet fever occurs after the skin infection, impetigo. Children with scarlet fever develop chills, body aches, loss of appetite, nausea, and vomiting; these are symptoms that may occur at the same time as or shortly following the onset of pharyngitis. When the rash emerges, it typically seems like an itchy sunburn with tiny bumps. After first becoming visible on the neck and face, it spreads to the chest and back, later spreading to the arms and the remainder of the body. Though initially consisting of separate bumps, these bumps tend to merge together, giving the entire torso a red appearance. Generally, the rash begins to fade by about the sixth day; and similarly to sunburn, the skin may peel afterwards. The tongue, typically very red and bumpy ("strawberry tongue") may also peel.

Scarlet fever is nothing new to humanity, though the earliest case definition of scarlet fever is a matter of contention. Some researchers attest that descriptions of disease which match scarlet fever date back almost 2,500 years, to Hippocrates. Others believe the first conclusive diagnosis is found in the tenth century writings of Rhazes, who also worked to distinguish measles and smallpox as separate diseases. It is generally agreed upon that the first sufficiently detailed paper identifying scarlet fever as a disease distinct from other rashes appears in 1553. In that paper, the Italian physician Giovanni Ingrassia describes the disease and refers to it as "rossalia." The term "febris scarlatina" appears in a 1676 publication by the British physician, Thomas Sydenham. Historical data suggest at least three epidemiologic phases for scarlet fever. In the first, which appears to have begun in ancient times and lasted until the late eighteenth century, scarlet fever was either endemic (always present at a low level) or occurred in relatively benign outbreaks separated by long intervals. In the second phase (~1825-1885), scarlet fever suddenly began to recur in cyclic and often highly fatal urban epidemics. In the third phase (~1885 to the present), scarlet fever began to manifest as a milder disease in developed countries, with fatalities becoming quite rare by the middle of the 20th century. In both England and the United States, mortality from scarlet fever decreased beginning in the mid-1880s. By the middle of the twentieth century, the mortality rate from scarlet fever again fell to around 1%.

Severe streptococcal infections in historical perspective. Depicted in the insert are the recorded deaths in the United States from 1900 to 1960. From Krause RM, citation below.

During Sydenham's life (1624-1689) and for more than a century afterwards, scarlet fever was considered by both parents and physicians to be a relatively mild childhood disease. Although several European cities experienced fatal epidemics of the disease, these epidemics were often short-lived, and it does not appear they were widespread.

In the early nineteenth century, the clinical presentation of the disease appears to have changed for the worse. Lethal epidemics were seen in Tours, France, in 1824; in Dublin, Ireland, in 1831; and in Augusta, Georgia, during 1832-33. Similarly, in Great Britain, the fatality rate from scarlet fever increased from between 1 and 2 % to more than 15% in 1834.

From 1840 until 1883, scarlet fever became one of the most common infectious childhood disease to cause death in most of the major metropolitan centers of Europe and the United States, with case fatality rates that reached or exceeded 30% in some areas—eclipsing even measles, diphtheria, and pertussis.

Scarlet fever pandemics of this and other eras also had a profound effect on history, in addition to providing a plot device for a beloved children's story. Charles Darwin lost two of his children to scarlet fever. The first, his beloved daughter Annie, died at the age of 10 in 1851 (two sisters, also infected, recovered from this bout). In July 1858, Darwin also lost his 18-month-old son, Charles Waring, to scarlet fever. It is believed that a bout of scarlet fever at the age of 19 months caused Helen Keller to lose her senses of vision and hearing. Scarlet fever also led to the founding of The Rockefeller University by the world's first billionaire and the founder of Standard Oil, John D. Rockefeller, whose 3-year-old grandson died of scarlet fever. Rockefeller remains a leader in biomedical research today, including research investigating various aspects of the biology of the group A streptococcus.

In 1825 January 1<sup>st</sup> A new epidemical eruptive fever is called as scarlet fever identified in pediatrics. The rash is the most striking sign of scarlet fever. It usually begins looking like bad sunburn with tiny bumps and it may itch. The rash usually appears first on the neck and face, often leaving a clear unaffected area around the mouth. It spreads to the chest and back, then to the rest of the body. In body creases, especially around the underarms and elbows, the rash forms classic red streaks. Areas of rash usually turn white when you press on them. By the sixth day of the infection the rash usually fades, but the affected skin may begin to peel.

Aside from the rash, there are usually other symptoms that help to confirm a diagnosis of scarlet fever, including a reddened sore throat, a fever above 101°F (38.3°C), and swollen glands in the neck. The tonsils and back of the throat may be covered with a whitish coating, or appear red, swollen, and dotted with whitish or yellowish specks of pus. Early in the infection, the tongue may have a whitish or yellowish coating. A child with scarlet fever also may have chills, body aches, nausea, vomiting, and loss of appetite.

When scarlet fever occurs because of a throat infection, the fever typically stops within 3 to 5 days, and the sore throat passes soon afterward. The scarlet fever rash usually fades on the sixth day after sore throat symptoms began, but skin that was covered by rash may begin to peel. This peeling may last 10 days. With antibiotic treatment, the infection itself is usually cured with a 10-day course of antibiotics, but it may take a few weeks for tonsils and swollen glands to return to normal. In rare cases, scarlet fever may develop from a streptococcal skin infection like impetigo. In these cases, the child may not get a sore throat.

## 2. EPIDEMIOLOGY

### *Incidence and prevalence:*

- Up to 10% of streptococcal pharyngitis infections are complicated by scarlet fever
- Streptococcal infections with or without scarlet fever may occur in cluster outbreaks, particularly in child care or school settings

### *Demographics:*

- Ninety percent of cases occur in children 3 to 8 years old
- Rarely occurs before age 2 years due to the presence of maternal anti-exotoxin antibodies and lack of prior sensitization
- Rarely occurs after the age of 15 years
- By age 10 years, 80% of children have developed toxin-specific antibodies
- Boys and girls are equally commonly affected
- Geographically ubiquitous
- Occurs most frequently in late autumn, winter, and spring in temperate climates
- May be higher incidences associated with crowded living conditions, which is sometimes seen in socioeconomically disadvantaged populations
- Close contact in schools, daycare centers, and military installations can facilitate transmission

## 3. THE PATHOPHYSIOLOGICAL EFFECT OF SCARLET FEVER TOXIN

The intravenous injection of scarlet fever toxin leads to acute changes in the white blood picture. The changes are correlated to the dose; a small dose causes lymphopenia and granulocytosis, while higher doses are followed by initial granulocytopenia. Tolerant rabbits do not have granulocytopenia, but lymphopenia persists. Tolerance to the leucopenic effect of the toxin probably develops somewhat sooner and lasts longer than tolerance to its pyrogenic effect. The blood picture of a cortisone-treated rabbit after the intravenous injection of scarlet fever toxin resembles the blood picture of a tolerant rabbit.

## 4. SYMPTOMS

Scarlet fever begins with a rash that shows up as tiny red bumps. It most often begins on the chest and stomach but can then spread all over the body. It looks like a sunburn and feels like a rough piece of sandpaper. Most of the time it is redder in the creases of the elbows, arm pits, and groin areas. The rash lasts about 2-7 days. After the rash is gone, the skin on the tips of the fingers and toes begins to peel. Some other common signs of scarlet fever are:

- A flush face with a pale area around the lips.
- A red and sore throat that can have white or yellow patches.
- A fever of 101 degrees Fahrenheit (38.3 degrees Celsius) or higher.
- Swollen glands in the neck.

- A whitish coating can appear on the surface of the tongue. The tongue itself looks like a strawberry because the normal bumps on the tongue look bigger.

Other less common signs of illness include:

- Feeling sick to your stomach (nausea) and throwing up (vomiting).
- Having a headache.
- Having body aches.

## 5. DIAGNOSIS

To diagnose the cause of your child's rash or sore throat, your doctor or healthcare provider will examine the child and swab the back of the throat with a cotton swab. The swab will be then used for a throat culture or a rapid antigen test (sometimes called a "rapid strep test") to see if there is a group A strep infection.

## 6. CONCLUSION

Scarlet fever still remains a threat today, particularly in developing countries, but nowhere today is it as severe a disease as it was during that frightening time in the middle of the nineteenth century. However, the current outbreak in China shows how quickly this situation can change, as they've seen a quadrupling in the number of cases in 2011 compared to previous years and several fatalities. News stories have suggested this is some kind of "mutant" strain and has increased resistance to antibiotics, though still of relatively low mortality compared to Victorian era, the resurgence of this disease, and the potential for the emergence of a new strain shows how quickly this disease can make a comeback. Additionally, at least one article notes a simultaneous outbreak of chickenpox—and strep plus varicella zoster (the chickenpox virus) are a can be a nasty combination.

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