Salmonella infections of the Penis, testes, penis and Scrotal Contents: A Review and Update

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ABSTRACT
Salmonella infection of the penis, testis, or scrotal contents tends to be encountered on very rare occasions. Salmonella infection of the testis, penis or scrotal contents can affect neonates, children, or adults. The manifestation of this infection is non-specific which does simulate more common non-specific infections of the penis, testis, and scrotal contents. There may or may not be an antecedent history of diarrhoea or gastrointestinal Salmonella infection. Some of the presentations include fever, pain, swelling of the penis/testis/scrotum, and there may be or may not be a history of lose stool/diarrhoea and at times there might be redness of the penis, scrotum as well as clinical evidence of tenderness, redness, or an abscess of the affected organ. In the case of an infected penile prosthesis, there could be extrusion of the penile prosthesis associated with a discharge. In cases of an associated Salmonella gastrointestinal infections stool culture could demonstrate salmonella species but quite often there tends to be no diarrhoea. Nevertheless, Widal test results would raised and indicate Salmonella infection. Urine culture and blood culture could also grow Salmonella. Culture of an extruded prosthesis may also grow Salmonella species. If there is an abscess culture of the abscess fluid would grow Salmonella species. Treatment of this infection does entail utilization of anti-Salmonella medicaments and analgesia and cases of abscess do require drainage of the abscess. In the case of an infected penile prosthesis does require removal of the prosthesis plus anti-Salmonella medicaments. When a diagnosis of Salmonella infection of the penis, testis, and scrotal content is confirmed treatment with anti-Salmonella medicament does tend to emanate in resolution of the infection.

Key Word: Salmonella; penis; testis; scrotum; penile prosthesis; Widal test; antibiotic treatment, orchidectomy;


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INTRODUCTION
Urinary tract infection that had been caused by non-typhoidal Salmonella was stated to be first reported in 1946 [1-2]. [2] It has been iterated that urinary tract infection due to Salmonella is an uncommon phenomenon, that accounts for 0.01 to 0.07% of cases of UTIs that had been reported in various studies but there has been a notable increase with regard to the incidence of NTS infections over recent years [2] [3]. Jehangir et al. [1] iterated that urinary tract infection that is caused by Salmonella infection is most commonly encountered in infants and patients who are older than 60 years old. [4] In a retrospective analysis of 799 isolates of NTS from urine, serotypes of groups C1 and E were more commonly associated with UTIs, in contrast to group D Salmonella UTI, as described in their case. [5] The modes of urinary tract infection from NTS include hematogenous spread from gastroenteritis or contamination from faecal flora via direct urethral invasion, which is more common in women [6]. It usually manifests as typical symptoms of urinary tract infection, even though cases of asymptomatic bacteriuria have been reported. UTI from NTS is usually encountered in patients with predisposing factors, including severe immune deficiency, occult urologic problems, chronic diseases (e.g., diabetes mellitus), or exposure to reptiles,
such as the common green iguana. [7] Hence an episode of NTS urinary infection must be considered as a surrogate marker of underlying predisposing factor(s), namely, heretofore unrecognized immune system suppression or compromise of genitourinary anatomy. Such patients should also be evaluated for occult diabetes or recent exposure to reptiles. [6,8] Evaluation did not suggest any evidence of immunosuppression or diabetes in their patient. Genitourinary tract abnormalities commonly reported in the literature that predispose to NTS UTI include nephrolithiasis, chronic pyelonephritis, retro-vesicular fistula, urethrectal fistula, hydrocele, and post-TURP; their patient was conceivably predisposed to non-typhoidal *Salmonella* by his history of benign prostatic hyperplasia, as partial urinary obstruction is a major risk factor. [2,9] Nonetheless, it is imperative to remember that these urinary infections can also occur in apparently healthy and immunocompetent individuals and there is data suggesting that the relationship of NTS UTI with genitourinary abnormalities and immunosuppression is likely an overestimation as a result of bias. [10] Thus, it is important to keep NTS in the differential of potential pathogens causing UTIs, including patients without any overt predisposing factors [5-6] NTS urine infection may be difficult to treat, but early institution of antibiotics is associated with a favourable outcome. [7-8] Antibiotics with high intracellular concentrations such as ciprofloxacin should be used as *Salmonella* has the tendency to grow intracellularly. [8] Abuhasna et al. stated that high frequency of complications due to *Salmonella* UTI like pyelonephritis, renal insufficiency, nephrotic syndrome, nephrolithiasis, genitourinary abscesses, recurrence, and chronic bacteriuria warrants prolonged treatment, even though recurrences may still be seen [3,9] In view of the fact that *Salmonella* infection of the urinary tract organs are not common, there might be difficulties in diagnosing the disease in that clinicians may not have a high index of suspicion for the infection. The ensuing article on *Salmonella* infections of the urinary tract is divided into two parts (A) Overview and (B) Miscellaneous narrations and discussions from case reports, case series, and studies related to *salmonella* infections in general and *salmonella* urinary tract infections.

**Aim**

To review and update the literature on *Salmonella* urinary tract infections

**Methods**

Internet Data bases were searched including: Google, Google Scholar, Yahoo, Bing, and PUBMED. The search words that were used included: *Salmonella* infections; *Salmonella* typhoid infections, *Salmonella* infections of the urinary tract, *Salmonellosis* of penis, *Salmonella* infections of testis, *Salmonella* infections of scrotum, *Salmonella* infections of the testis, non-typhoidal *salmonella* infections of the penis, *Salmonella* typhi infections in general, non-typhoidal *salmonella* infections in general. Twenty two references were identified which were used to write the article which was divided into two parts: (A) Overview and (B) Miscellaneous narrations and discussions from Case Reports, Case Series, and studies related to *salmonella* infections in general and *salmonella* infections of the penis, testis, and scrotum.

**Review and Update of the Literature on Salmonella Infections in General and** *Salmonella* Infections of the penis, testis, and scrotum

**Overview**

It has been stated that the disease which is caused by *Salmonella* species infection is referred to as *Salmonellosis* or *Salmonella* infection. It has also been iterated even though overlap does exist with regard to *Salmonella* infection, species of *Salmonella* that cause typhoid fever as well as non-typhoidal species of *Salmonella* are quite often while overlap exists, species causing typhoid fever and nontyphoidal species often tend to be categorized separately. It has been stated that *Salmonellosis* or *Salmonella* infection is regarded to be a food borne disease and that summations related to typhoid fever and infections that are caused by non-typhoidal disease are as follows: [11]

Typhoid fever- It has been iterated that typhoid fever which at times is referred to as enteric fever relates to a life threatening illness which is caused by *Salmonella* typhi which at times is referred to *Salmonella* enterica serotype or *Salmonella* (S). Para-typhi. It has been stated that Salmonella typhi does infect between 20 million and 30 million individuals annually and this infection tends to occur within the developing areas of the world. It has also been stated that the occurrence of typhoid fever within industrialized countries does usually tend to be associated with travellers. [11]

Non-typhoid species- Non-typhoid species usually tend to cause self-limited gastroenteritis.
The Centres for Disease Control and Prevention (CDC) has estimated that one million cases, 19,000 hospital admissions, and 450 deaths do occur each year within the United States of America. Tens of millions of cases do occur globally annually which cause an estimated 100,000 deaths. The disease tends to spread via ingestion of contaminated food or water and very often in a sporadic fashion but at times, via food-borne outbreaks which often tend to be associated with sub-optimal sanitary practices or food preparation.

**Pathophysiology**

The pathophysiology of Salmonella infection has been summated as follows: [11] Salmonella does possess cellular mechanisms which enable bacterial proteins to be transferred to enterocytes and M cells with subsequent growth within endosomes. Subsequent events do include an inflammatory response with neutrophil recruitment and mucosal damage. The host immune response typically does control non-typhoidal infection; nevertheless, very young individuals, the elderly, the debilitated and immunosuppressed individuals could lack the response that is necessary to control infection. More commonly, Salmonella typhi tends to invade M cells. The Bacteria tend to be phagocytosed by histiocytes within the underlying lymphoid tissue. The bacteria do proliferate and they widely disseminate via the blood vessels and lymphatic channels.

**Aetiology**

Documented summations related to the aetiology of Salmonella infection do include: [11]

- Salmonella are gram negative bacilli.
- Salmonella typhi tends to be encountered only in human beings
- Non-typhoidal species of Salmonella tend to be encountered in human beings, domestic animals, as well as in wild animals
- Generally, Salmonella infection does occur via the ingestion of contaminated food or water via the faecal-oral route.
- Non-typhoidal Salmonella are commonly found within food and companion animals that include poultry, cattle, swine, parrots, cats, dogs as well as turtles
- Eggs, milk, meat, poultry as well as contaminated vegetables commonly tend to be implicated in cases of Salmonellosis
- Direct transmission of Salmonella from person to person and transmission from pets might occur.
- Within the setting of Salmonellosis, the source of the transmission may not appear.

**Clinical features of Salmonella infection**

The clinical features of Salmonella infection have been summarized as follows: [11]

- Symptoms of nontyphoidal salmonellosis generally start 12 - 36 hours after ingestion of bacteria but may occur after 6 - 72 hours
- Ingestion of very few organisms may cause disease
- Typically patients suffer self-limited illness characterized by diarrhoea, abdominal pain, fever, nausea and occasionally vomiting that is unpleasant but rarely life threatening
- May be life threatening in infants, elderly, immunocompromised or debilitated patients, due to dehydration or dissemination of bacteria
- Very rarely, toxic megacolon may complicate infection
- Individuals with achlorhydria or hypochlorhydria from drugs, chronic Helicobacter pylori infection or other causes are at higher risk of infection
- Some patients develop a reactive arthritis that may last for months and lead to chronic arthritis
- Typhoid fever causes symptoms shortly after bacteria are ingested
- Patients suffer from severe abdominal pain, bloody diarrhoea, bloating, anorexia, nausea, vomitting, headache
- A brief asymptomatic period is followed by bacteraemia with fever and flu-like illness
- Blood cultures are almost always positive at this time and antibiotic therapy may be lifesaving
- With disease progression in untreated patients, high fever and abdominal pain occurs that may mimic appendicitis; lasts for about two weeks
- If patients survive, symptoms slowly abate
- Possible extraintestinal complications include CNS disease, endocarditis, myocarditis, pneumonia, cholecystitis, osteomyelitis (patients with sickle cell disease are particularly prone to osteomyelitis)
- Disease relapses may occur
Diagnosis
Some of the summations related to the diagnosis of Salmonella infection do include: [11]
• Diagnosis of Non-typhoidal salmonellosis had traditionally been made based upon stool culture
  although many of the patients had tended not to seek medical attention
• Not long ago, a PCR based assay has been introduced which, in addition to Salmonella species bacteria,
  also does detect Campylobacter group, Shigella species, Vibrio group, Yersinia enterocolitica, Shiga toxin 1
  and 2, Norovirus G1 / GII, Rotavirus A as well as Aeromonas species
• Serotyping of Salmonella tends to be undertaken in order to characterize outbreaks of Salmonella
disease.
• Typhoid fever tends to be diagnosed by means of blood culture or stool culture
• Within the developing counties of the world where laboratory facilities may not be readily available,
  clinicians have tended to treat suspected Salmonella infection empirically without the results of positive
  microbiology or PCR serology results based upon a high index of suspicion.

Factors of prognostication
The factors of prognostication of Salmonellosis have been summed as follows: [11]
• Non-typhoidal salmonellosis almost always tends to be a self-limited infection, with the exception of
  Salmonella infection in infants, the elderly, immunocompromised as well as in debilitated patients
• Antibiotic treatment usually tends to be effective in patients who have salmonella infection, even
  though antibiotic resistance has been stated to have become a growing problem
• If typhoid fever is not treated this may become lethal even with regard to healthy individuals but the
  prognosis tends to be worse with regard to infants, the elderly, immunocompromised and debilitated
  patients
• Prompt commencements of antibiotic treatment greatly does improve the outcome of the patient and
  despite this it is important to note that antibiotic resistance is a growing problem

Typhoid perforation of the ileum and intussusception of the ileum does require resuscitation and early
appropriate surgical operation plus antibiotic treatment as treatment of curative intent. Haemorrhage
that emanates from a bleeding typhoid infection of the ileum may be severe enough to require blood
transfusion.

Treatment
Salient points related to the treatment of Salmonella infection have been summed as follows: [11]
The treatments of Non-typhoidal Salmonella most often:
  o Only do require supportive care, and in particular hydration of the patient.
  o Utilization of antibiotics are required for severe disease patients and vulnerable patients
  o Utilization of Ceftriaxone and ciprofloxacin have at the moment been recommended by the CDC
  o Resistance of Salmonella to antibiotics that are used in the treatment of Salmonella infection is a
growing global problem
Utilization of Antibiotic treatment for typhoid fever is obligatory and this should not be delayed for
confirmatory laboratory testing
  o In the past, chloramphenicol, trimethoprim-sulfamethoxazole, cephalosporins and first generation
  fluoroquinolones were utilized in the treatment of typhoid fever; nevertheless, antibiotic resistance had
developed.
  o At the moment, third generation fluoroquinolones have been recommended; however, resistance to
  these medicaments has been reported
  o The undertaking of surgical operations could be necessitated for intestinal perforation or gallbladder
disease
  o An effective vaccine for Salmonella. Typhi does exist

WHO recommendations for the public as well as travellers do include:
  o Individuals should ensure that their food is properly cooked and hot when they are served
  o Individuals should avoid drinking of raw milk and products that are made from raw milk
  o Individuals should avoid ice unless the ice is made from safe water
  o Individuals should utilize disinfecting tablets for water unless they are certain of the purity of the
  water.
  o Individuals should wash their hands thoroughly with soap and water following having had contact with
  pets or farm animals and after they had used the toilet
his urinalysis was essentially normal. There was no growth in this urine culture. He had ultrasound scan of white blood cell (WBC) count was 15,000/mm³, erythrocyte sedimentation rate was 15 mm/h,

The right testis was swollen as well as cystic; nevertheless, it was non-tender and it was not warm. His white blood cell (WBC) count was 15,300 mm³ with 79% neutrophils. His urinalysis revealed a PH of 6.0, 1 to 2 WBC per high power field, no red blood cell (RBC), and no bacteria, leucocytes esterase that meant his urinalysis was essentially normal. There was no growth in his urine culture. He had ultrasound scan of

Recommendations for food handlers and producers do include:
- Food handlers and food producers should maintain a clean workspace
- Food handlers and food producers should separate raw and cooked food
- Food handlers and food producers should cook food thoroughly
- Food handlers and food producers should keep food at safe temperatures
- Food handlers and food producers should use safe water and raw materials
- Food handlers and food producers should practice good personal hygiene
- Food handlers and food producers should work if they have fever, diarrhoea, vomiting or infected skin lesions
- Food handlers and food producers should protect fields from animal contamination

Miscellaneous narrations and discussions from some case reports, case series, and studies related to salmonella in general and Salmonella infections of the penis, testis, and scrotal contents.

Bansal et al. [12] reported a 63-year-old man who had manifested with a 1-week history of progressive swelling of his right testis that was associated with localized pain, mild dysuria, as well as low-grade fever. He was asymptomatic otherwise. His general and systematic examinations were normal. His scrotal examination demonstrated an enlarged, hot, erythematous, as well as tender right testis. A clinical diagnosis of right epididymoorchitis was made. The results of full blood count test was reported follows: Haemoglobin (HB) 10.89/DL, white blood cell (WBC) count 8,900 / microlitre with 57% polymorphs, 41% lymphocytes, 1% monocytes, 1% eosinophils, and a normal platelet count. The results of his blood glucose and routine biochemistry blood tests were normal. His urine examination was normal. His urine examination was normal. He was commenced on ciprofloxacin 500 mg orally twice per day. He underwent surgical incision and drainage of pus from his right hemi-scrotum which was submitted for culture and sensitivity. He had blood and urine specimens sent for culture and sensitivity and which did not grow any organism. His pus grew Salmonella Para-typhi A that was sensitive to Ceftazidime, Ceftriaxone, chloramphenicol, Amikacin, Ciprofloxacin, and cotrimoxazole, but which was resistant to ampicillin and nalidixic acid. His Widal test was positive for Salmonella Para-typhi A/O and H antigens in titres of 1:100 and 1:320 respectively. He received intravenous 1 gram Ceftriazone for one week and after improvement in his symptoms his treatment was changed to Ofloxacin for 4 weeks. He was well and asymptomatic at his 6 months follow-up.

Al-Obeid et al. [13] reported the finding of epididymo-orchitis that was caused by Salmonella spp in 2 patients who were immunocompromised as follows:

Case 1
A 56-year-old man who was known to have systemic lupus erythematosus who was on azathioprine and prednisolone treatment, who did develop urinary tract infection that was ensued by bacteraemia as well as epididymoorchitis. There was a growth of salmonella enteritidis strains within his urine and blood culture that were demonstrated based upon pulsed-field gel electrophoresis typing method to be genotypically similar to genotypically similar.

Case 2
The second patient was a 55-year-old man who was known to have type II diabetes mellitus who had manifested with a testicular abscess from which Salmonella enteritidis was cultured. He was treated with intravenous piperacillin and amikacin that was ensued by oral ciprofloxacin. He was asymptomatic at his follow-up.

Nawaz et al. [14] reported a 5-year-old boy who had presented with a right testicular swelling of 2 weeks duration which had gradually enlarged in size and which was associated with testicular discomfort. He was asymptomatic otherwise. His general and systematic examinations were normal. Examination of his scrotum demonstrated a fully developed scrotum with both testes having descended into the scrotum. The right testis was swollen as well as cystic; nevertheless, it was non-tender and it was not warm. His white blood cell (WBC) count was 15,300 mm³ with 79% neutrophils. His urinalysis revealed a PH of 6.0, 1 to 2 WBC per high power field, no red blood cell (RBC), and no bacteria, leucocytes esterase that meant his urinalysis was essentially normal. There was no growth in his urine culture. He had ultrasound scan of
tests which showed a solid hypoechoic lesion that measured 1.7 cm x 1.5 cm with multiple calcifications as well as peripheral vascularity within the mid and lower pole of his right testis that was indicative of teratoma of the right testis. The results of his blood tumour marker levels were normal including: Alpha fetoprotein (AFP) 0.82 IU/ML, Beta Human Chorionic Gonadotrophin (hCG) less than 1.2 MU/ML. He was scheduled to undergo right trans-inguinal radical orchidectomy and during the procedure, upon delivery of the right testis, there was exudation of purulent fluid. A large, thick, loculated, abscess cavity was found along the inferior and middle pole of the right testis was found. Frozen section pathology examination of the testis demonstrated absence of malignancy, in that it did demonstrate acute on chronic inflammation (see figures 1A to 1D). There was a growth of Salmonella Para-typi A from the pus. He was successfully treated with utilization of Cefixime at a dose of 16 mg / kg/day for 14 days. He had Doppler ultrasound scan of his scrotal contents at his 6 weeks post-operative follow-up which demonstrated normal vascularity of the testes. Nawaz et al. [14] stated that it is important to take into consideration Salmonella infection in the differential diagnosis of inflammatory and tender testis in immunocompromised patients and to remember to include Salmonella infection in the differential diagnosis of inflammatory and tender testis in immunocompromised patients and to remember to include blood, urine, and stool cultures as part of the assessment of all cases. A lesson learnt from this summation is the fact that Salmonella infection of the testis could simulate testicular abscess as well as teratoma of the testis and with a high index of suspicion the undertaking of radical orchidectomy would be avoided and adequate treatment with anti-Salmonella antibiotics would lead to resolution of the infection.

Arshed et al. [15] reported a 46-year-old Caucasian man who had manifested with right hemi-scrotal swelling and pain as well as a sensation of fever over the preceding 2 days. He was noted to be a homosexual and he had recently been diagnosed as having Human Immunodeficiency Virus (HIV) and he had been commenced on Atipra 2 weeks preceding his manifestation. It was noted that he had been treated for with oral cefuroxime 500 mg twice daily for 5 days for Salmonella urinary tract infection (UTI) one week preceding his admission. His temperature on examination was 98.7 °F and his pulse rate was 87 per minute. His blood pressure was 116/77 and his respiratory rate was 20/minute. His right hemiscrotum was found to be oedematous with erythema that was very tender. The results of his haematology and biochemistry blood tests were reported as follows: White blood cell count 5.7, haemoglobin 11.2, platelets 272, CD 246, creatinine 1.4, BUN 29, ALT 14, AST 17 and glucose 97. He underwent scrotal exploration which demonstrated A right scrotal abscess as well as a hypoplastic right testes for which he did undergo right orchidectomy. Bacteriology culture of the pus grew Salmonella serotype Typhimurium which was sensitive to Ceftriaxone, levofloxacin, and Bactrim but it was resistant to ampicillin. He had ultrasound scan and computed tomography (CT) scan of abdomen and pelvis which were reported as normal. He was discharged home on intravenous Ceftriaxone for 4 weeks to be followed up by a Urologist and the Infectious disease specialist in the out patients department. Considering that the patient was stated to immunocompromised by his HIV status, based upon the finding of the development of Salmonella infection of the testis not long after he had undergone a 5-day course of antibiotics for Salmonella urinary tract infection (UTI), some people would argue from the hind sight that perhaps if he had been given a ten days to 14 days course of Salmonella Urinary tract infection, perhaps he may not have developed Salmonella infection of the testis and scrotal region. For this reason, it could also be argued that immunocompromised individuals who develop Salmonella infections should be given 10 days to 14 days of appropriate antibiotics based upon the antibiotic sensitivity pattern of the disease and the allergy status of each individual patient to ensure complete destruction of all the Salmonella organisms.

Trecarten et al. [16] reported a 16-day-old neonate male who had manifested with progressive erythema and pain within his right hemi-scrotum. He was afebrile and well but was passing 15 to 20 loose stools per day that was loose, as well as mustard-yellow. He had not been in contact with any sick person and also not travelled recently. His blood and urine samples were taken and for culture and sensitivity and he was commenced on intravenous Ampicillin and tobramycin on admission. His C-reactive protein level was 47, and his white blood cell count was 14.6, and his urinalysis showed a trace of red blood cells but no evidence of nitrites and leukocytes. He had Doppler ultrasound scan of the scrotum which demonstrated features of right sided epididymoorchitis that was associated with moderate to large sized right hydrocele. He had ultrasound scan of the abdomen which was normal. His blood culture grew significant growth of Salmonella Javanica and he was commenced on intravenous cefotaxime. He had a lumbar puncture and his cerebrospinal fluid (CSF) was sent for culture that did not grow any organism. Despite having received intravenous antibiotics, an increase in the size of his right-sided hemi-scrotal swelling as well as erythema was noted. He had a repeat ultrasound scan of scrotum which revealed
persistence of his epididymo-orchitis as well as a new complex intra-scrotal collection that measured 2 cm x 1.6 cm x 1.1 cm. He did undergo subsequently bedside incision and drainage of his abscess and the pus was submitted for culture that was positive for a light growth of Salmonella. He received a two-week course of intravenous ceftriaxone that was changed to oral amoxicillin for another 12 days. At his one month follow-up, he was reported as well as found to have recovered fully from his infection. Examination of his scrotum did reveal normal scrotum and normal bilateral testes, with regard to size and consistency. He had a repeat ultrasound scan of the scrotum which revealed normal scrotum and scrotal contents. A lesson that needs to be learnt from this summation is the fact that neonates can also develop Salmonella epididymoorchitis and testicular abscess and hence clinicians should have a high-index of suspicion for the disease and they should ensure that they send all pus specimens obtained from the scrotum and scrotal contents for culture and sensitivity.

Huth and Goldstein [17] in 1991, iterated that they had reported the first case of a bacteriologically proven infection of the testis which had been caused by Salmonella Typhi. They also iterated that their reported case did illustrate the occurrence of Salmonella testicular abscess within the convalescent phase of typhoid fever and the absence of a clinically evident preceding bacteriaemia phase. They additionally stated that the reported case also did emphasize the need to provide prolonged antibiotic treatment as well as the role that is played by surgery in the treatment of relapse of Salmonella infection.

Ejlertsen and Jensen [18] in 1990 reported the case of a 36-year-old man who had developed epididymoorchitis that was ensued by the development of testicular abscess formation 4 weeks subsequently due to Salmonella Berta. Lessons learnt from this summation include the fact that Salmonella Berta can also cause epididymoorchitis and testicular abscess.

Gibbs et al. [19] reported a 17-day old infant boy who had manifested with right hemi-scrotal swelling, tenderness, and erythema. It was noted that he had a previous fever of 38.9 degrees centigrade and he also had an initial raised white blood cell (WBC) count of 26 x 10³ per microlitre. There was no ascertained history of a known exposure to Salmonella and no history of diarrhoea or immunocompromised state and no significant past personal medical history or family history. His clinical examination demonstrated that his scrotum was oedematous and erythematous with retraction of his left testicle into the inguinal canal and the right testis had descended into a dependent position. His right hemi-scrotum was especially tender and it did contain a tense fluctuant mass. He had ultrasound scan of the scrotal contents which did show a 2 cm x 2.5 cm complex heterogeneous fluid collection within the scrotum. The ultrasound scan also did show adequate blood flow to both testes with an increased flow of blood on the right. His white blood cell (WBC) count was raised at 14.52 x 10³/micro-litre. He was admitted for incision and drainage of scrotal abscess and to be given broad spectrum antibiotics. He underwent exploration of his right hemi-scrotum, which demonstrated that the right testis was not healthy and it could not be saved and therefore right orchidectomy was undertaken as well as as drainage of 50 cc of purulent exudate was undertaken. Tissue specimens for culture were obtained during the procedure were obtained during the procedure and a temporary Penrose drain was tunnelled via a superior and inferior incision within his right hemi-scrotum. Pathology examination of the specimen demonstrated a testicular abscess with associated chronic active inflammation that had involved the tunica albuginea, the epididymis, as well as the spermatic cord. His wound culture grew Salmonella species. His antibiotic treatment was changed to Ampicillin accordingly based upon the antibiotic sensitivity pattern of the cultured Salmonella. The Penrose drain was removed on the 3rd post-operative day and the incision was left open to drain. He recovered well. During his follow-up assessment he had ultrasound scan pelvis plus voiding cystourethrogram which were normal and which did exclude anatomical abnormalities and vesico-ureteric reflex. He was discharged home on the 5th post-operative day to complete a 14-day course amoxicillin oral suspension twice daily. At his 1 month follow-up assessment he was found to have complete resolution of his infection. The lesson that needs to be learnt from this narration is the fact that Salmonella epididymo-orchitis does occur in neonates and for this reason clinicians should always have a high index of suspicion for the possibility of Salmonella epididymoorchitis as a differential diagnosis when they encounter neonates or infants who present with signs and symptoms of epididymo-orchitis so that they would undertake urine cultures, stool cultures, and blood cultures as well as Widal test. Perhaps when Widal test is done during the first presentation of the child and it comes out positive for typhoid then appropriate antibiotics would be given early to cover Salmonella infection which might help prevent the development of testicular abscess as well as infarcted testis and by so doing clinicians would hopefully avoid the need to undertake orchidectomy.
Sausville et al. [20] reported a kidney transplant patient who developed Salmonella infection of his penile prosthesis with erosion of the prosthesis following an episode of a diarrhoeal illness. They stated that following removal of the penile prosthesis on urgent basis and commencement of culture-specific antibiotic treatment, he was discharged home at his baseline functional status and kidney function. Sausville et al. [20] iterated that to their knowledge, their reported case was the first case of Salmonella infection of a penile prosthesis to be reported in the literature. They additionally stated the following:

- While their reported patient’s immunocompromised status might have made him more vulnerable to infection of the device, literature has generally tended to be supportive of insertion of penile prosthesis in the transplant population when other modes of treatment for erectile dysfunction have failed.
- Additionally, they postulated a haematogenous mechanism the seeding of the device with regard to the patient.

A lesson that has been learnt from this narration is the fact that though very rare, Salmonella infection of a penile prosthesis can occur and clinicians should have a high index of suspicion for Salmonella infection of a penile prosthesis which should be considered as a differential diagnosis of infection of penile prosthesis and clinicians should include a Widal test in the investigation of symptoms and signs of infection of a penile prosthesis to ascertain if the individual could have Salmonella infection but generally culture of Salmonella organism in an infected penile prosthesis that has been removed would definitely establish the diagnosis of Salmonella infection of a penile prosthesis.

Svenungsson et al. [21] reported a 50-year-old man who developed suppurative epididymo-orchitis 3 weeks pursuant to an episode of his development of gastroenteritis. Culture of his testis that was removed by orchidectomy yielded Salmonella enteritidis. Svenungsson [21] pointed out the importance of considering Salmonella as a differential diagnosis of epididymo-orchitis.

Foster et al. [22] reported a 1-month-old newly-born child who developed testicular abscess which was treated by means of surgical debridement and drainage that was combined with antibiotic treatment that proved to be curative and which resulted in salvage of the testicular tissue. Culture of the pus revealed a growth of Salmonella. A lesson learnt from this narrative is that newly born boys could occasionally be diagnosed as having developed Salmonella testicular abscess therefore clinicians should have a high-index of suspicion for the disease and any pus they drain from a testicular abscess of every individual should be submitted for culture and sensitivity.

Conclusions
Salmonella infections of the penis, testis, and scrotal contents may be encountered on rare occasions and hence a high index of suspicion is required to confirm the diagnosis. With regard to Salmonella infections of the penis, testis, and scrotal contents, there may or may not be an antecedent history of diarrhoea or Salmonella infection of the gastrointestinal tract. The manifestation of Salmonella infection of the penis, testis, and scrotal contents are non-specific and would tend to simulate that of non-specific infections of the penis, testis and scrotal contents.

Conflict of interest
None

REFERENCES


