



Omphalitis in Newborns: A Review on its Prevalence, Risk Factors, Complications, Prevention, and Treatment

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Omphalitis refers to the inflammation of the umbilical stump, often observed in newborns, and is a major cause of mortality among newborn in underdeveloped and developing countries with poor financial conditions. Unfortunately, home-born newborns are six times more likely to contract omphalitis compared to those born in hospitals. This condition is common in developing countries, affecting 55 to 197 infants per 1,000 live births, while cases are rare in developed nations due to good financial status and having standard monitoring from umbilical cord after delivery. Symptoms of omphalitis include localized redness, swelling, and purulent discharge, with severe cases showing signs of sepsis and systemic infection. The occurrence of omphalitis is associated with several risk factors which include premature and low-birth-weight births, unclean home birth conditions, and unstandardized monitoring of umbilical cord. In addition to that, lower level of maternal education, limited access to healthcare, and harmful traditional practices in the monitoring of umbilical cord contribute to the increased prevalence of omphalitis. If the omphalitis is not diagnosed and treated promptly, it can lead to life-threatening complications such as necrotizing fasciitis, peritonitis, septicemia, and death. Globally, about 7,000 newborns lose their lives each day within the first 28 days due to various causes, including omphalitis. Proper monitoring of the umbilical stump, maintaining sterile conditions during delivery, enhancing maternal awareness, and using antiseptics like chlorhexidine are crucial for the prevention of omphalitis in newborns. Treatment includes local and systemic antimicrobial therapy, with surgical intervention sometimes required. This review article aimed at gathering, analyzing, and summarizing comprehensive information on the prevalence, risk factors, treatment, prevention, and complications of omphalitis to inform the relevant stakeholders and consider relevant aspects for reducing mortality rates among newborns caused by omphalitis.

Keywords: Complication, Newborn, Omphalitis, Prevention, Risk Factors, Treatment

Introduction

The World Health Organization (WHO) has a comprehensive and thorough guideline for the post-natal and newborn care. The guideline includes numerous recommended activities such as regular visits for mothers and newborns during the first six weeks after birth, maternal care (identifying complications, emphasizing good nutrition, addressing postpartum depression, family planning, and dietary guidance) [1].

In those remote areas where there is little access to health centers, in-person contact of health workers with mothers, awareness of mothers, observance of hygiene, knowledge of the symptoms of infection and treatment in case of infection are the significant parts of this comprehensive guideline. In addition, another major and



important part of this comprehensive guideline is the newborn care which includes evaluating babies for complications, for example, newborns should be evaluated for jaundice, infection, and nutritional problems. Emphasis on exclusive breastfeeding is another important aspect of the newborn care. Prevention of Hypothermia, attention to immunity (application of Oral Polio Vaccine, “BCG”, and Hepatitis B vaccines), special attention to premature and underweight newborns and keeping the umbilical cord clean are other important aspects of the care of newborns [1].

If the umbilical cord of a newborn baby is not taken care of according to the guidelines of the WHO, a condition called Omphalitis will arise which could be mainly due to the lack of cleanliness. Newborn omphalitis is the inflammation of the umbilical stump of a newborn, which often occurs in the first weeks of life after birth [2, 3].

The affected area becomes red, warm, inflamed and has purulent discharges. In case of interference of anaerobic microbes, the said discharges become foul-smelling [2, 4]. If it is not diagnosed and treated in time, there is a high chance of infection spreading from the umbilical stump and it can also cause sepsis. In case of sepsis, fever, hypothermia, fatigue, itching, lack of breastfeeding, weak cry, breathing problems, increased or decreased heart rate, decreased blood pressure, fatigue, cold extremities, vomiting, diarrhea, abdominal swelling, hypotonia, convulsions, jaundice, petechia and purpura are the symptoms that are added to the above-mentioned clinical picture [4]. Not only are the microbes that invade the stump easily transferred to the blood stream and cause bacteremia, but the necrotic tissue of the stump also serves as the best culture medium for pathogenic microbes and bacterial colonization in the area. You will soon have a favorable environment [2].

The prevalence of omphalitis is not the same in all countries of the world. For example, in developed countries, according to the guidelines of the WHO, cases of omphalitis due to proper monitoring of umbilical cord are rare, while in developing countries, the trend of prevalence of omphalitis is very high due to many defects in the monitoring of umbilical cord [5]. Many risk factors are responsible for the increase in the prevalence of omphalitis, including neonatal, maternal, environmental, financial risk factors, cultural, and health care risk factors [5, 6, 7]. In addition to that, Celik et al. (2021) reported that there are several risk factors for the occurrence of omphalitis in newborns which include maternal age (younger age are more prone), primiparity, the lower level of mother's education, and poor personal hygiene particularly poor hand washing habit. Moreover, use of clothes other than cotton, weather of the environment (warmer weather facilitates for the omphalitis due to the provision of optimum growth environment for the microorganisms) [8]. In addition to the use of local and systemic antimicrobial drugs in the treatment of omphalitis, it is very important to observe hygiene. Omphalitis often responds to medical treatment and careful observation, rarely requiring surgical treatment [3]. If omphalitis is not diagnosed and treated in time, it can cause a number of life-threatening complications, the best examples of which are peritonitis, sepsis, and meningitis.

Not only that Omphalitis is a common problem in developing and underdeveloped countries, but it is also the main reason for the death of newborns in these countries [5]. Globally, more than a quarter of children lose their lives in the Neonatal Period due to many reasons, the main cause of death in this period is 30 percent of infections, which often enter the body through the umbilical stump and causes death [5]. The mortality rate of omphalitis varies from 7 to 15 percent [7]. According to the research conducted, the prevalence of omphalitis differs in developed, developing and backward countries, for example: in developed countries the prevalence



of omphalitis is 0.7% due to access to health services, higher level of knowledge, delivery in hospitals and health centers, environmental cleanliness, sterilized conditions, and monitoring of umbilical cord according to WHO guidelines. It is very high in developing and backward countries due to the shortcomings of the health sector, lack of knowledge level, local treatment and many other reasons [9]. For example, in developing countries, the prevalence of omphalitis in children born in hospitals and health centers is 8 percent, while this percentage increases to 28 percent in children born at home [9]. There is no accurate information about the prevalence of omphalitis in backward countries. Out of every thousand newborns, 105 in Nepal, 217 in Pakistan, 197 in India and 77 in Turkey suffer from omphalitis [5, 9].

Risk Factors of Omphalitis in Newborns

Many risk factors are responsible for the increased prevalence of omphalitis as indicated in figure1. To make it simple, it can be classified as follow:

1. Neonatal Factors

Premature babies due to their weak immunity are not only prone to the infections of umbilical stump, but also to the infections of other parts of the body. Moreover, the wounds of premature babies heal late, so the wound of the umbilical stump does not heal quickly. In this sense, the length of wound healing period is another contributing factor to the prevalence of umbilical stump infection. Low birth weight (<2500 g) is an important predisposing factor for Omphalitis. On the one hand, the weak immunity of the child and on the other hand, the long-term stay of these children in the hospital for intensive care and catheterization increases the chance of getting infected with hospital microbes. In addition, children born with low weight have a problem of temperature regulation, which in turn affects the defense system of the skin and facilitates an interventional environment for infection [7, 10, 11].

2. Maternal Factors

Maternal poor health directly and indirectly affects the defense ability of the newborn. For example, if the mother has an infectious disease during pregnancy and it has not been treated effectively, it can cause many harmful bacteria and viruses to be transmitted to the children during birth. The poor health of the mother is directly related to the lack of nutrients. The immune system of a child born from a malnourished mother is very weak, which in turn makes such newborn susceptible to the infection of the umbilical stump. In addition, malnutrition weakens the mother's defense system and cannot pass the passive immunity through the placenta and milk to the newborn at the level that is necessary which in turn causes newborn with weaken immune system and are mostly prone to the infection attack. Mothers with poor health also have social and financial problems, which have a direct impact on the care of the newborn. Financial problems force mothers to give birth at home in unsanitary conditions and to cut the umbilical cord unsterilized and tie it with unsterilized thread, which in turn leads to an easy intervention for infection. Wounds of children born from malnourished mothers do not heal quickly which pave the way for lengthy recovery and provide the opportunity for infection [2]. Another maternal factor of Omphalitis is Chorioamnionitis. In this disease, many microbes such as *E. coli*, Group B Streptococcus and others infect the amniotic fluid and amniotic membrane, which also causes infection of the umbilical stump during childbirth. In addition, this disease causes premature birth, delayed and urgent membranes rupture. In the first case the main cause is the weak immunity and in the second case it is due to the exposure to infection for a long time [2]. Low level of education and inexperience of mothers



are other significant factors leading to infection of the umbilical stump [6]. In a research it was reported that, the lower level of mother's education, poor hand washing habits, maternal age parity are the maternal associated factors with the newborn omphalitis [8].

3. Environmental and Socioeconomic Factors

Poor hygiene, dirty environment and lack of attention to cleanliness during umbilical cord cutting, tying and monitoring are the most important factors contributing to the development of omphalitis, which means giving birth in an unclean place, dirty hands, unclean cutting the cord, tying the stump with a thread and filling the wound with clay, ashes and gums are the main factors contributing to the occurrence of Omphalitis. In addition to that, poor financial status prevents access to health centers, inability to take medicines, inability to buy essential nutrients, home delivery, and weak immunity together lead to the occurrence of Omphalitis. Families with financial status generally have a low level of education, especially the level of health information which is a leading factor for omphalitis [12].

4. Cultural factors

Traditional treatment that has no scientific sources, not only that it is not effective and not included in the accepted monitoring of the umbilical cord, but it is harmful and leads to the occurrence of Omphalitis. This is due to the presence of contaminating bacteria and increase the risk of infection [5, 10]. For example, combining herbs with oil and applying it on umbilical stump, pouring milk or saliva, using the extract of pumpkin flowers and other plants, applying mud to the wound, sprinkling of ashes and dungs on the wound are part of the traditional treatment of umbilical stump. In addition, in backward societies, it is a tradition to remove the clump in delayed manner which also causes omphalitis [5]. A research was carried out to investigate the practices and risks of umbilical cord infection in newborns in Parakou, the results of a study showed that along with the lower level of mother education level and lower economic status, the traditional practices to speedy the separation of umbilical cord has been significantly associated with the omphalitis of newborn [13].

Health Care Related Factors

Inadequate health care is a contributing factor to omphalitis, for example, forced to give birth at home due to lack of access to hospitals and health centers, lack of professional midwives or skilled birth attendants, non-standard cord cutting and non-use of anti-septic (Chlorhexidine 4%) which leads to bacterial colonization [14].

5. Geographical Factors

Omphalitis cases are more common in villages where sterilization conditions during childbirth are not well followed, compared to cities where there are many health centers and access to them is possible. A hot and humid climate that facilitates the spread of infection is another geographic contributing factor to Omphalitis [15].

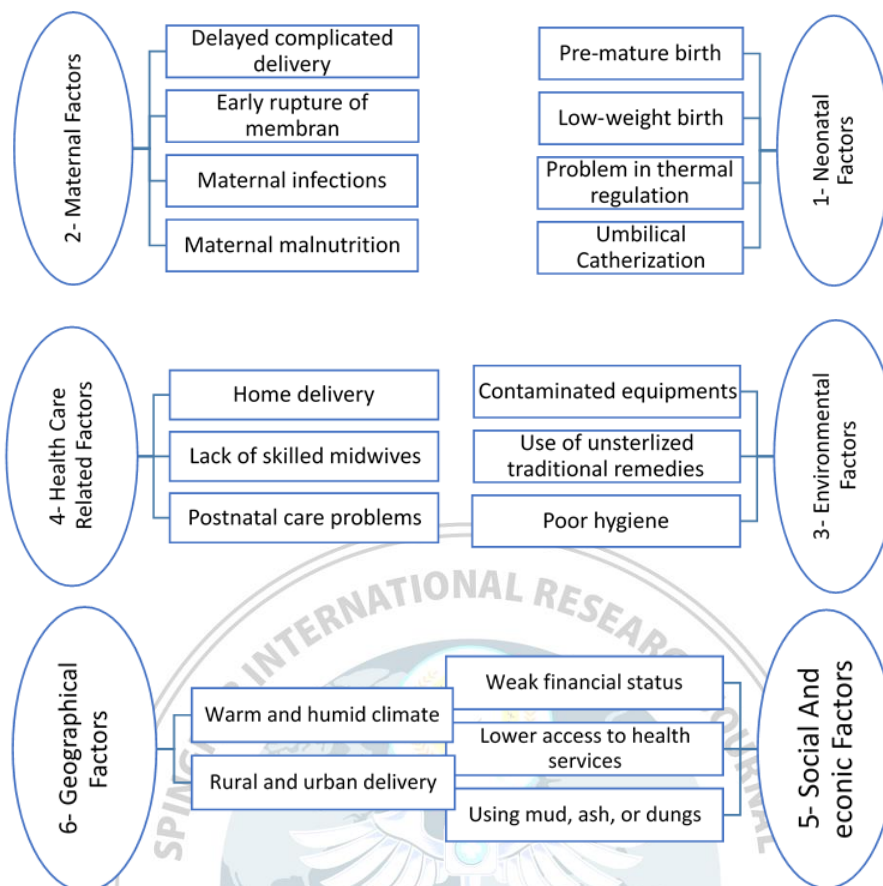


Figure 1: Risk factors associated with newborn omphalitis

Complications of Omphalitis in Newborns

Omphalitis causes many life-threatening complications that require medical treatment as well as surgical intervention. The most important complications are classified and explained as follow.

1. **Local Complications:** The local complications of omphalitis in newborns are summarized in Figure 2 and discussed as follow:
 - a. *Umbilical Abscess:* In this case, pus collects around the umbilical stump [3]. Moreover, if the condition dese not treated well it may result in distant abscesses formation. These abscesses could be retroperitoneal, pelvic, cutaneous, and hepatic [11].
 - b. *Cellulitis:* In this type of complication, the skin surrounding the umbilical stump becomes inflamed, which causes pain, swelling and redness in the area [3].
 - c. *Umbilical Granuloma:* It is actually a granulation tissue in the remaining part of the umbilical cord as a result of the reaction against infections, which produces pus-filled secretions [3].
 - d. *Delayed Umbilical Cord Separation:* Under normal circumstances, the cut umbilical cord dries and falls off in 5-15 days, but infection delays the umbilical cord separation [6].
 - e. *Persistent Umbilical Discharge:* From the umbilical cord, purulent secretions flow, which sometimes have a bad smell [3].
 - f. *Umbilical Hernia:* Infection does not allow the umbilical ring to close, when the umbilical ring does not close completely or remains partially open, the umbilical hernia occurs [3].

g. *Evisceration*: It is rare complication of omphalitis. In this condition, the abdominal contents (intestines) come out of the cystic cicatrix, which is facilitated by infection [3]. The eviscerated bowel may be strangulated, resulting in gangrene [11].

2. **Systemic Complications**: The systematic complications of omphalitis in newborns are illustrated in Figure 3 and the detailed information are drawn as follow:

- Sepsis*: it is a very common and life-threatening complication of omphalitis. It occurs when the infection enters the bloodstream from the umbilical stump [7]. The clinical features of sepsis include poor suck, respiratory rate more than 60/min, lethargy, excessive crying, temperature less than 36 °C, and weak abnormal or absent cry, persistent vomiting, abdominal distension, hypoglycemia (less than 40 mg/dl, presence of skin, eye, or local umbilical infection. If any of three signs in the aforementioned list are present it will be called sepsis [16].
- Meningitis*: In the occurrence of this disease, entrance of infection into the circulation on the one hand and the weak immunity of the newborn baby on the other hand leads to the infection, which can reach the central nervous system and infect the meninge of the newborn [3].
- Distant Site Abscess*: An infection entered into the blood stream in the form of a septic emboli spreads to other organs of the body, for example, to the kidneys, liver and lungs, and causes the formation of microbial cysts in these organs [3].

3. **Abdominal Complications**: The Abdominal complications of omphalitis in newborns are depicted in Figure 4 and discussed as follow:

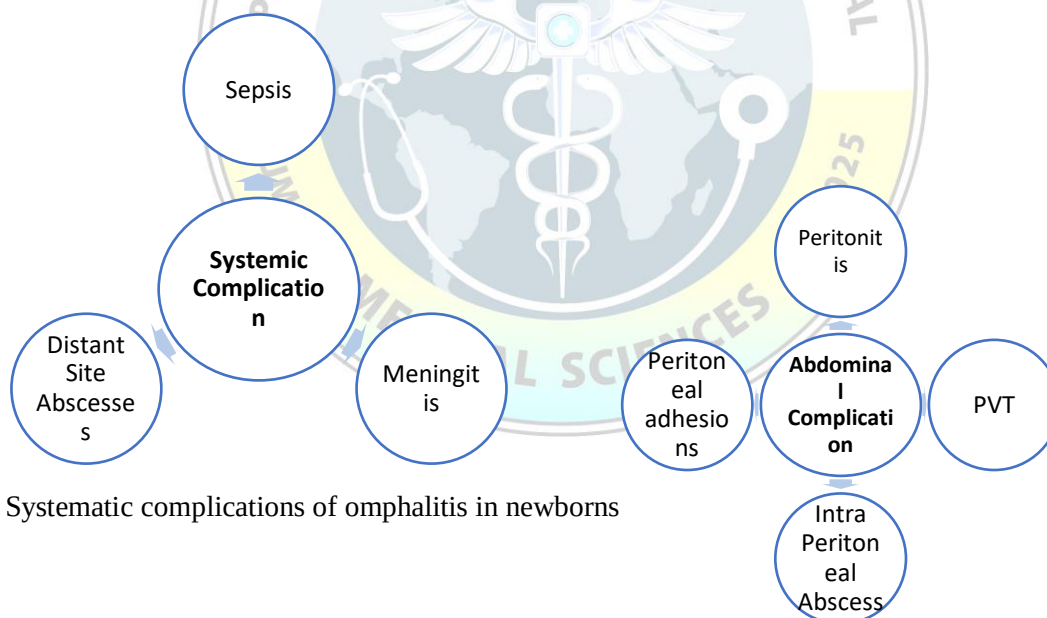


Figure 3. Systematic complications of omphalitis in newborns

Figure 4. Abdominal complications of omphalitis in

- Peritonitis and Peritoneal Abscess*: Although it is one of the rare complications of omphalitis, but it is life threatening. Such complications occur when infections find their way into the abdominal cavity. This means that when the umbilical cord infection is not treated properly, the infection spreads to the tissues. A superficial infection begins to penetrate deeper and eventually reach to peritoneal cavity. When the infection infects the peritoneal membrane and causes its inflammation, it is called Peritonitis. The body's

defense response wants to localize the entered infection and prevent its spread, which leads to the formation of local intraperitoneal abscesses, which in turn lead to sepsis, intestinal perforation, and intestinal fistula formation [3].

- b. *Portal Vein Thrombosis (PVT)*: The umbilical stump has a direct relationship with the portal vein in newborns. In newborns with omphalitis, the surrounding veins of the umbilical stump facilitate the transmission of infection to the portal vein. When the infection enters to the portal vein and its branches it causes inflammation and deteriorates the endothelium which leads to clot, this internal clot is called Thrombosis. This can cause intestinal ischemia in addition to high blood pressure of portal vein, liver dysfunction. In order to prevent the complications mentioned above, it is necessary to diagnose PVI in time and treat it urgently [7, 11].
- c. *Peritoneal Adhesions*: Peritoneal adhesions are caused by the body's reaction to the infection in such a way that the accumulation of fibrin due to the release of inflammatory mediators, the arrival and increase of fibroblasts in the area, and formation of collagen, which results in intra-abdominal adhesions, which make future surgical abdominal interventions difficult along with intestinal obstruction and chronic abdominal pains [3].

4. Soft Tissue Complications: The soft tissues complications of omphalitis in newborns are summarized in Figure 5 and discussed as follow

- a. *Necrotizing Fasciitis*: It is a very rare but fatal and commonly reported complication of omphalitis [11]. refers to a severe infection of connective tissue in which fatty tissue, muscle, peritoneum and skin are destroyed [3]. This complication results in 60-85 percent mortality [7].
- b. *Gangrene of the abdominal wall*: It is a rare complication of omphalitis that occurs due to infection, inflammation and reduced blood flow to the area. In omphalitis, firstly cellulitis is established, which spreads to other parts of the abdominal wall due to ineffective treatment, which impairs and reduces the blood flow to the inflamed area. In the first time, it causes ischemia but if it improves will causes tissue necrosis. In addition, infection grow more in the peripheral necrotic tissue and leads to necrosis and gangrene of other neighboring tissues, which kills newborns due to sepsis and septic shock [3].



Figure 5. Soft tissues complications of omphalitis in newborns

Preventive Measures for Omphalitis in Newborns

The following measures are necessary to be followed in order to reduce the prevalence of omphalitis and the risk factors that cause it:

1. **Cleanliness**: Washing hands with soap before touching the baby's navel and cleaning the rest area of newborns is very important to reduce and prevent the prevalence of omphalitis [5].
2. **Monitoring of umbilical cord**: keeping the umbilical stump clean and dry, leaving it in the open air as much as possible to speed up the drying process of the stump, in case of contamination with urine, washing it with clean water and soap and drying it with a clean cloth, using an antiseptic recommended by the

doctor if necessary, and not covering the umbilical stump with a cloth or pumper are the best examples of good monitoring from the umbilical stump [5].

3. **Avoiding harmful traditional practices:** The use of traditional harmful materials (clay, ash, oil, dungs and extracts from natural plants) is not only useless, but also provides a favorable environment for the intervention of infection. The full bath of the newborn baby, which causes hypothermia, is another harmful procedure that needs to be delayed for at least 6 hours. If necessary, sponge bath should be used [5].
4. **Finding signs of infection:** It is necessary to carefully monitor the umbilical stump. The affected area should be evaluated for redness, swelling, and foul-smelling discharge and pus. In addition to the above symptoms, fever, fatigue, itching and not breastfeeding are other signs and progress of infection that should be taken into account when finding symptoms.
5. **Taking medical advice:** In case of finding signs of infection, taking advice from medical doctors not only prevents complications but also saves lives [3].
6. **Implementation of health professionals' instructions:** Mothers and other family members should follow professional people's instructions regarding monitoring of the umbilical cord in order to reduce the prevalence of omphalitis and prevent complications. Professionals advise mothers and families to consult health centers and hospitals in case of symptoms of infection, jaundice, and nutritional problems. Moreover, they emphasize breastfeeding in the first hour of birth because it reduces the risk of omphalitis. Not creating crowd in the newborn's room and not picking-up the child by each member of the family, drying the newborn child quickly to prevent hypothermia, keeping him warmer and delaying the bath are other the aspects of their guidance. In addition, the application of Polio, BCG and Hepatitis B vaccines at birth and the special attention to premature and low birth weight newborns who need intensive care and hospitalization and the promotion of birth in hospitals are other important parts of professional guidelines [5].

Treatment of Omphalitis in Newborns

Local and systemic signs of infection, elevated levels of white blood cells, blood and secretions, and imaging tests help the diagnosis of omphalitis and its complications. After confirming the diagnosis of omphalitis, a treatment plan should be implemented immediately to prevent other threatening complications such as necrotizing fasciitis and sepsis. The effective treatment of omphalitis is as follows [7].

- 1- **Antimicrobial treatment:** This treatment can include:
 - a. *Topical antimicrobial treatment:* In developed countries, there is no need for it, but in developing countries where the risk of infection is high, topical antimicrobial drugs such as Fusidic acid, Mupirocin, Chlorhexidine 4% gel or Chlorhexidine 7.1% solution may be needed for 7-10 days in mild cases [17].
 - b. *Systemic antimicrobial drugs:* In severe cases with systemic infection symptoms, systemic antimicrobial drugs such as Ampicillin and Gentamycin and sometimes Metronidazole are prescribed depending on the nature of the infection. The duration and type of systemic antimicrobial medication varies depending on the severity and type of infection, which takes 10-14 days on average [7].
- 2- **Proper hygiene:** giving birth in a clean place, cutting the umbilical cord with sterile scissors and tying it with a sterile thread, using sterile gloves, keeping the umbilical cord clean and dry are the best hygiene



practices. Washing the area with clean water and soap and drying it again with a clean cloth and using an antiseptic recommended by the health professional are important parts of proper hygiene [7].

- 3- **Monitoring:** A newborn needs regular, serious monitoring in the first week of life. In this monitoring, there are many activities such as checking the area for redness, swelling and the presence of pus, and gaining information about fever, fatigue and not breastfeeding [7].
- 4- **Hospitalization:** In serious cases where omphalitis is complicated, the newborn should be hospitalized for the application of systemic antimicrobial drugs and intensive monitoring [3].
- 5- **Surgical treatment:** Omphalitis often responds to medical treatment and careful monitoring. In this sense, surgical treatment is rarely needed. Some complications of omphalitis such as abscess, tissue necrosis, intestinal obstruction, etc., require surgical treatment to drainage, remove the necrotic tissue and maintain intestinal transit [3].
- 6- **Prevention:** it is an important part of omphalitis treatment. Keeping the area clean and dry and seeking immediate medical advice in case of early signs of infection are very effective in preventing cases of omphalitis [3].

Conclusion

Omphalitis is a serious infectious disease that is diagnosed by the area's redness, swelling, foul-smelling secretions, and other characteristics. Timely and effective treatment prevents life-threatening complications. In order to prevent this disease, it is very important to give birth in a clean environment and conditions and follow the guidelines of WHO for the proper monitoring of umbilical cord.

Recommendations

Unfortunately, the prevalence of omphalitis is high in our country and the mortality rate of newborns is high in our country. The following suggestions are provided to be followed in order to prevent and reduce this tragedy.

- 1- Increasing access to health facilities particularly in remote areas to receive the newborn care services.
- 2- Convincing and promoting institutional delivery instead of home delivery.
- 3- Training a large number of skilled midwives who can assist pregnant women during their delivery and provide the needed newborn and postnatal care services to mothers and newborns.
- 4- Increasing the awareness level of primipara mothers and the local birth attendants who help in delivery about the standard monitoring the umbilical cord.
- 5- Effective treatment of maternal infections before birth.
- 6- Taking the necessary measures to prevent maternal malnutrition and improve the financial status of families which will in turn contribute to the decrement of omphalitis prevalence.
- 7- Elimination of perceptions about the effectiveness of traditional remedies for omphalitis through lunching a wide awareness about the harms and defects of these remedies.
- 8- In case of finding the signs of infection, it is quite important to go to the health center for treatment and seek medical advice.



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