Salmonella thomson outbreak in a Canadian newborn nursery

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OBJECTIVE: To determine the mode of salmonella transmission during an outbreak in a newborn nursery.

DESIGN: Outbreak investigation with retrospective review of medical, microbiological and work records, active case-finding, and active surveillance. A case was defined as a newborn with salmonella isolated from any site.

SETTING: University affiliated community hospital near Montreal with 125 active care beds and 3000 deliveries annually.

PATIENTS: Cases were identified from the microbiology reports and public health notifications for one month before to six months after detection of the outbreak. All neonates with diarrhea had stool cultures during the period of observation.

RESULTS: Four cases of neonatal salmonella infection were detected. The index infection was acquired at birth from a mother with severe gastroenteritis from contaminated chicken. The first of five secondary cases - three other neonates and two mothers - was only detected 11 days after departure of the index case. Three of the four infants required intensive treatment and one remained a chronic carrier and was rejected for daycare services. No food or health care worker was associated with infection of neonates. The diapering technique had been changed one month earlier because the hospital had stopped purchasing disposable washcloths.

CONCLUSIONS: Three of the four neonatal salmonella infections caused severe morbidity. The organism was easily transmitted when breaks in technique probably allowed contamination of fomites, survival in the inanimate environment, and subsequent cross-infection to other neonates. Simple unexpected changes in the availability of material resources such as washcloths may have adversely influenced clinical practises with a resultant breakdown in infection control procedures.

Key Words: Gastroenteritis, Neonatal infections, Nosocomial infections, Salmonella, Salmonella infections, Salmonellosis

Épidémie de Salmonella thomson dans un pouponnière canadienne

OBJECTIF: Déterminer quel a été le mode de transmission de salmonelle lors d’une épidémie qui a affecté une pouponnière. MOindle: Enquête épidémiologique avec examen rétrospectif des dossiers médicaux, microbiologiques et de travail, recherche de cas actifs et surveillance attentive. Un cas a été défini comme tout nouveau-né atteint de salmonellose, isolé peu importe l’endroit. CONTEXTE: Hôpital communautaire universitaire près de Montréal, doté de 125 lits de soins aigus, où se pratiquent 3000 accouchements par année.

PATIENTS: Les cas ont été identifiés à l’aide de rapports de microbiologie et d’avis des autorités sanitaires, de un mois avant à six mois après l’identification de l’épidémie. Tous les nouveau-nés atteints de diarrhée ont subi une culture de selles au cours de la période d’observation. RÉSULTATS: Quatre cas de salmonellose ont été décédés. L’infection du tout premier cas a été acquise à la naissance, d’une mère atteinte de gastro-entérite sévère suite à une contamination par du poulet. Le premier sur cinq cas secondaires (trois autres nouveau-nés et deux mères) a été décelé 11 jours après le départ du tout premier cas. Trois des quatre nouveau-nés ont nécessité des soins intensifs et un est demeuré porteur chronique et a été exclu des services de garderie. Aucune source alimentaire ni aucun travailleur de la santé n’a été associé à l’infection des nouveau-nés. La façon de mettre les couches avait été changée un mois auparavant, parce que l’hôpital avait cessé d’utiliser des gants de toilettes jetables. CONCLUSIONS: trois des quatre cas

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Salmonella causes severe infections in newborn infants (1). In the community, salmonella is acquired from contaminated foods. Conversely, in newborns and other hospitalized populations, it is more frequently transmitted by cross-infection with health care workers, visitors, or the inanimate environment, serving as a physical conduit from primary to secondary cases. Conversely, in newborns and other hospitalized populations, it is more frequently transmitted by cross-infection with health care workers, visitors, or the inanimate environment, serving as a physical conduit from primary to secondary cases (1,2). We investigated an outbreak of Salmonella thomson in a newborn nursery where a cost-cutting measure imposed a simple change in clinical practices and may have favoured cross-infection.

METHODS

On October 7, 1988, an outbreak of salmonella was recognized in the newborn nursery of a 125-bed Montreal area community hospital with 3000 deliveries annually. The public health authorities were notified, an investigation initiated, part of the nursery was closed to new admissions, and the environment was scrupulously cleaned. A case was defined as a newborn in whom S thomson was isolated. The investigation consisted of: a review of patient charts; examination of work records; active case-finding in the hospital and through a regional salmonella surveillance system, screening stool cultures for all nursery personnel, newborns in the nursery, and parents of the infected newborns.

DESCRIPTION OF THE OUTBREAK

The epidemic curve and additional case information are presented in Figure 1. All outbreak bacterial isolates were S thomson. The index case was born at 36 weeks' gestation on December 17, 1988, from a mother who had severe salmonella gastroenteritis starting two days earlier. She had consumed contaminated barbecued chicken purchased from a local supermarket. Fifty-five other cases of S thomson infection were detected in the community during a three-week period starting September 1, 1988, all linked directly to barbecued chicken from a single supermarket; this concurrent epidemic was attributed to an inappropriate holding temperature and use of the same brush to baste cooked and uncooked chicken.

The index patient, infant A, rapidly became septic and was transferred to the intensive care unit of another hospital. Both of his parents had negative stool cultures and had not purchased nor consumed foods from the supermarket implicated in the community salmonella outbreak. None of the infants died, two required intensive care, and one was still a salmonella carrier six months later and had therefore been refused admission to daycare services.

INVESTIGATION

A review of records failed to detect a worker common to all four infants. None of workers admitted to a diarrheal illness during the outbreak period. One employee had a stool culture positive for Salmonella derby, a serotype different from the outbreak strain; this worker had no contact with any of the infected newborns and had not had a diarrheal illness. The infected infants received the same commercial feeding formula as uninfected infants did.

One room in the nursery received all newborns before redistribution to one of four other rooms. Infants with clinical problems were kept in the receiving area for longer periods.

Nursing practices were evaluated. Newborns were usually re-diapered with disposable diapers in their own bassinets. One month before the outbreak, minor modifications in the technique of changing diapers had been made because, as a cost-saving measure, disposable washcloths were replaced by reusable cotton ones. Previously, soiled disposable washcloths went directly from the hand into the wastebasket and infants were then wrapped in a fresh diaper. At the time of the outbreak, soiled reusable washcloths were initially dropped on a convenient surface and retrieved for the dirty linen hamper only after re-diapering the infant.
The nursery policy required washing of the hands after every contact with a newborn. Adherence to the policy was not evaluated.

**CONTROL MEASURES**

When the outbreak was detected, the receiving room was closed for one day and thoroughly scrubbed with an antiseptic soap. No environmental cultures were obtained. Disposable washcloths were reintroduced. No further cases were detected in spite of routine culturing of stools for all neonates and mothers with even mild diarrhea. For a period of six months after the outbreak, all reports of *S. thomson* received by the regional public health units were investigated. Except for case D, no others were linked to the outbreak hospital.

**DISCUSSION**

An outbreak of four cases of salmonella infection occurred in a newborn nursery with three cases requiring intensive treatment. One of the cases remained a carrier for many months and could not gain admission to daycare services. Salmonella infections in newborns frequently cause severe clinical illness with mortality rates up to 14% (1,3). Prematurity in the index case may even have resulted from the maternal salmonella infection (4). It is clear that the index infection was acquired from the mother. However, the mode of transmission to the three other cases was not clearly established. Two of the three other mothers had *S. thomson* in their stool. However, they were asymptomatic, the stool cultures were positive after disease symptoms developed in their infants. Neither the mothers nor any close relative had consumed or purchased contaminated barbecued chicken. Thus, although unproven, the additional maternal infections were probably acquired through changing diapers. No health care worker had diarrhea during the nursery outbreak and none was a carrier of the epidemic salmonella strain. Transmission to patients from health care workers who are asymptomatic salmonella stool carriers has not been documented. Salmonella organisms can be recovered transiently from the fingers of a person with diarrhea, but not from asymptomatic carriers (5). Furthermore, simple handwashing will effectively remove salmonella from the hands (5). Globally, contaminated foods are the most common source of salmonella infections. However, the cases in this outbreak had been fed the same commercial formulas as uninfected infants. Newborns are highly susceptible to even low inocula of salmonella and will usually develop severe symptoms (1,3,6,7). Thus, it is unlikely that a contaminated feeding formula was the source of the outbreak because only four infants were involved and no others were detected with screening cultures.

Within health care institutions, salmonella is most frequently transmitted by person-to-person spread rather than by contaminated food (2). Thus, cross-infection probably occurred between the last three cases. However, it is not possible to demonstrate a clear link of cross-infection between the first and second cases. The index case was discharged from the nursery four days before the second case was born.

Three unproven hypotheses could explain this eclipse in the transmission cycle: salmonella acquisition by a health care worker through exposure to the index case and subsequent transmission from the health care worker to the second case; cross-infection from the index case to an asymptomatic newborn who then served as the source and reservoir for the subsequent cases; salmonella contamination of fomites by the index case with later cross-infection from the inanimate environment to the second case.

The first hypothesis is unlikely because no symptomatic worker was detected and transmission from asymptomatic health care workers has not been reported (5). The second hypothesis is also quite unlikely because review of all medical charts and microbiology reports failed to detect any cases during the eclipse period. Thus, the third hypothesis of environmental contamination by the index case is most likely. The withdrawal of disposable washcloths one month earlier and the resulting change in the diapering technique increased the likelihood of environmental contamination. It is conceivable that a washcloth was contaminated by the index case and was then left in contact with fomites, such as a table top, before being returned to the dirty laundry hamper. Subsequently, upon contact with the contaminated fomites, a health care worker or visitor may have become a transient hand-carrier of salmonella and transmitted it to the second case. Salmonella can survive for prolonged periods in the inanimate environment: it is recovered from fresh water, play-

**Figure 1** Histogram showing salmonella outbreak in the neonatal nursery. Onset of cases is represented by vertical bars. The horizontal bars represent the time spent in the nursery from birth to discharge with the case identified by a letter inside the bar.
ground and vacuum cleaner dirt, rectal thermometers, bedside tables and cribs (2, 8-10). Although not proven, it is quite likely that the inanimate environment of the nursery became contaminated by the epidemic strain of salmonella which was subsequently transmitted to other newborn infants on the hands of either a worker or a visitor.

Five conclusions can be drawn from this outbreak. First, salmonella is very pathogenic for newborn infants. Second, salmonella is easily transmitted within health care institutions, usually when breaks in proper infection control practises provide the physical conduit required for cross-infection. Third, salmonella organisms survive in the inanimate environment and this probably can explain the eclipse observed in the transmission cycle during the nursery epidemic. Fourth, without proper planning and coordination, even seemingly minor changes in the availability of hospital materials can have detrimental results; the decision to cut costs by discontinuing the purchase of disposable washcloths was unexpected and forced the health care workers to improvise a new and possibly inappropriate diaper changing protocol. Fifth, secondary transmission of foodborne salmonella can result in serious secondary epidemics, further emphasizing the need for vigilance in food handling practises.

Salmonella is easily transmitted in nurseries and can only be prevented by strict adherence to personal hygiene, effective communication between obstetrical and nursery personnel and observance of infection control practises. Newborns with diarrhea or infants born to mothers with gastroenteritis should be considered contagious and pre-emptively isolated until a transmissible agent has been ruled out.

REFERENCES