A Study on the Measurement of the Microbial Contamination Level of Mammography

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Abstract

Objects: This study aims to find a way to control infection of mammography effectively, by culture identification of the microbial flora in hospitals. And, it will suggest importance of infection management and necessity of education for workers and patients. Methods/Statistical Analysis: The way of collecting clinical material was done by keyboard and mouse being used by most of workers for mammography among 10 medical institutions using cotton swabs as transport medium on contacted skin part of patient and wiping out top, middle and bottom of it. Transport medium used after collecting examining materials was put and sealed with tip dipped in an individual culture medium (10cc). Sealed materials are assorted by examination and used within 24 hours. Findings: When examining the distribution of detected bacteria, Staphylococcus epidermidis comprised 6 cases, 15% of the total, while Enterococcus faecalis was detected in 4 cases, 10%, each of I, and Serratiamarcescens, occurred in 3 cases, 7.5%, each of Enterococcus faecium, and Gram negative bacilli occurred in 2 cases, 5%, Providenciaretgeri, Klebsiella pneumonia, and Micrococcus species occurred in 1 case, 2.5% percent. There are cases where bacteria did not grow after culture for 24 hours at 37°C, accounted for 42.5% of 17 cases, and bacteria were not detected in a significant proportion of locations tested. Among the specimens collected, the lowest amount of bacteria was found on the Face block. Also, while the Staphylococcus epidermidis, which was found at the highest levels, was detected on none of the compression paddles, it was detected most frequently on the grid. Application/Improvements: Especially, detection of contamination materials in breast imaging room that makes patient’s skin straight exposed and has highest contact frequency between examiners and patients. Will be expected to contribute to high sense of sterilization of examiners and much more putting priority on prevention of infection.

Keywords: Bacteria, Identification, Infection, Mammography, Pollution

1. Introduction

With the recent developments in medical technology, the social demand for medical care and professionals involved in healthcare are increasing. Medical workers are required to ensure disinfection and sterilization, since they are working in the most infectious pathogenic environment and being continuously exposed to cross-infection and contact infection. In particular, the contamination from the patient as the infection source can easily take place in the mammography room, because of the very small contact distances to the patient. Due to the characteristics
of hospital organizations having close treatment accessibility, compared to the workers of other industries, there is a strong perception to take disease outbreak not as seriously. However, when examining examples, such as the MERS outbreak that occurred in 2015, it reminds us once again of the importance of infection control, considering that the infected medical have played the role of the propagating intermediary.

The Ministry of Health and Welfare, as a measure of strengthened hospital infection control, has made the installation of an infection committee in hospitals mandatory, expanding the range of targeted hospitals, to include those with over 100 beds, that must report to the Minister of Health and Welfare immediately in the event of hospital infections. However, most of the mammography screening centers of these hospitals, that have more than 100 beds, are not included in the management targets. As such, it is to be considered a risk to the pollution by the patients who are exposed, as well as the hands of the tester, as the mammograms are used to check the exposed skin, and are vulnerable to the hospital infection control targets.

Hospital infection refers to infections that occur after hospital admission or discharge. In addition, it includes topical or systemic symptoms accompanying the result of a reaction to a toxin, in addition to infectious agents. Recently, the importance of this is emerging as a key element for the quality assessment of medical care, and the state of the patient, as well as the use of various aids and the like. Mammography is conducted for most women entering menopause with a normal immune system off state, in contrast to young women. When the same mammography equipment is repeatedly used for more than 30 women with their skin exposed to the same part of the machine on the same day, it means potential unprotected exposure to bacterial or viral infectious diseases. Very few infection studies exist regarding mammography devices used in an enclosed space due to the nature of the current test practice, making this current research of vital importance.

In this study, research on the actual situation in terms of both the worker and the patient was carried out in order to identify infection management practices in the mammography room among the inspections conducted by the Department of Radiology. Regarding the workers aspect, the bacteria in the Control box and on the X-ray exposure button, most commonly used by the radiograph operators, were collected, while, regarding the patients side, the bacteria from the patient contact area i.e., face block, grid, and breast compression paddle of the mammography equipment were collected, and both sets were passed over for identification. Across 5 provincial areas, 2 hospitals per province were selected, not limited to one area of targeting, the hospitals were conducting a daily average of more than 30 test cases. In this study, we aimed to determine the status of pollution and sanitary conditions of the mammography room, on the basis of the identified bacteria. We present the importance of infection control and the training needs of workers and patients.

2. Methods

2.1 Bacterial Measurement

The equipment used in this study include sterile transport medium (Micromedia, Korea) used for bacterial measurement (Figure 1), sterilized medical gloves (Dreamtex Glove, TG Medical SdnBhd) to prevent contamination by the tester, and medical use masks (mask dental 81001, Korea) to prevent infection by the respiratory (Figure 2).
2.2 Germiculture

2.2.1 Specimen Collection

Regarding the collection of samples, a total of 10 medical institutions were selected, targeting 2 hospitals located in Seoul, Gyeonggi, Jeonbuk, South Chungcheong Province, and North Chungcheong Province, which conduct mammography inspection of more than 30 cases on average per day. The study was carried out from December 12th to December 31st, 2015. The samples were collected by wiping the top, middle, and bottom of the mammography equipment using a sterile cotton swab of transport medium from a total of 4 areas, including the upper part of the control box and the X-ray exposure button that are used most frequently by the mammography room practitioners, and the full part of the grid, the contact area with the skin of the patient, the whole part of the breast compression paddle and the face block, that are most frequently in contact with the patient. After the acquisition of samples, the nipple portions of the used transport medium swabs were put in to individual sample bottles containing a nutrient medium (10 cc) to be sealed, and the sealed samples were classified within 24 hours. The medium samples were entrusted to the clinical pathological inspection agencies for identification, and we received identification results from the laboratory medicine specialists.

2.2.2 Germiculture

After culture for 24 hours inside a 37°C incubator, after putting the nipple portion of the swab into the individual sample bottles containing a nutrient medium (10 cc) and moving 1 cc of each copy of the sample solution which contained the samples in Blood Agar Plate (BAP) for the growth of bacteria, samples were cultured for a further 48 hours in a 37°C incubator (Figure 3). In addition, we cultured bacteria in MAC (McConkey agar) medium to identify the presence or absence of enteric bacteria (Figure 4).

3. Results

The inspection for the pollution of the mammography devices in a total of 10 institutions were carried out in areas such as the compression paddle, face block, grid, and the control box. 1 or more bacteria were detected in 8 hospitals while, in 2 hospital within the Jeolla region, no bacteria were detected across all machine parts. The detected surface contamination strains were Enterococcus faecalis, Staphylococcus epidermidis, Gemella species, Serratiamarcescens, Enterococcus faecium, Klebsiellapneumoniae, Micrococcus species, Gram negative bacilli, Providenciastuartii and Providenciaretgeri strains, which are known as the causative agent of nosocomial infections, and there were no strains with specificity (Table 1).

Table 1. Strains of bacteria detected

| Hospital | Collection location | Bacteria detected                  |
|----------|---------------------|-----------------------------------|
| A        | Compression paddle  | Enterococcus faecalis            |
|          | Face block          | No growth in 2 days              |
|          | Grid                | Staphylococcus epidermidis        |
|          | Control box         | Gemella species                  |
| B        | Compression paddle  | Providenciastuartii              |
|          | Face block          | No growth in 2 days              |
|          | Grid                | Providenciastuartii              |
|          | Control box         | Providenciaretgeri               |
| C        | Compression paddle  | Serratiamarcescens, Enterococcus faecium |
|          | Face block          | No growth in 2 days              |
|          | Grid                | Staphylococcus epidermidis        |
|          | Control box         | Serratiamarcescens               |
|          | Compression paddle  | Klebsiellapneumoniae             |
|          | Face block          | Enterococcus faecalis, Staphylococcus epidermidis |
When examining the distribution of detected bacteria, *Staphylococcus epidermidis* comprised 6 cases, 15% of the total, while *Enterococcus faecalis* was detected in 4 cases, 10%, each of *Gemella species*, *Providencia stuartii*, and *Serratia marcescens*, occurred in 3 cases, 7.5%, each of *Enterococcus faecium*, and Gram negative bacilli occurred in 2 cases, 5%, *Providencia rettgeri*, *Klebsiella pneumoniae*, and *Micrococcus species* occurred in 1 case, 2.5% percent. Cases where bacteria did not grow after culture for 24 hours at 37°C, accounted for 42.5% of 17 cases, and bacteria were not detected in a significant proportion of locations tested.

Among the specimens collected, the lowest amount of bacteria was found on the Face block. Also, while the *Staphylococcus epidermidis*, which was found at the highest levels, was detected on none of the compression paddles, it was detected most frequently on the grid (Table 2).

### 4. Conclusions

The increase in antibiotic resistant bacteria, due to the overuse of antibiotics owing to recent medical developments, has increased hospital infections. This anxiety that one could be infected with bacteria with a stronger resistance whilst in hospital is spreading in Korea, due to the MERS crisis and the fact that this is becoming more and more common.

**Table 2.** The number of bacteria detected at each collection location

| Bacteria                  | Collection location | Total number(%) |
|---------------------------|---------------------|-----------------|
|                           | Compression paddle  | Face block      | Grid       | Control box |           |
| **Enterococcus faecalis** | 1                   | 2               | 1          | 0           | 4(10)     |
| **Staphylococcus epidermidis** | 0               | 2               | 3          | 1           | 6(15)     |
| **Gemella species**       | 0                   | 0               | 1          | 2           | 3(7.5)    |
| **Providencia stuartii**  | 2                   | 0               | 1          | 0           | 3(7.5)    |
| **Providencia rettgeri**  | 0                   | 0               | 0          | 1           | 1(2.5)    |
| **Serratia marcescens**   | 1                   | 0               | 1          | 1           | 3(7.5)    |
| **Enterococcus faecium**  | 1                   | 0               | 0          | 1           | 2(5)      |
| **Klebsiella pneumoniae** | 1                   | 0               | 0          | 0           | 1(2.5)    |
| **Micrococcus species**   | 0                   | 0               | 0          | 1           | 1(2.5)    |
| Gram negative bacilli     | 1                   | 0               | 1          | 0           | 2(5.0)    |
| No growth in 2 days       | 4                   | 7               | 3          | 3           | 17(42.5)  |
After a medical examination of a total of 10 hospital locations, strains were detected in 8 of these, and just as in previous studies, *Staphylococcus epidermidis* was the most frequently detected [11–13]. *Staphylococcus epidermidis* is one of the non-pathogenic Staphylococci detected in dry skin, and there is no food borne poisoning. However, it can sometimes causing sepsis, urinary tract infections, endocarditis, etc., and recently antibiotic-resistance for methicillin and penicillin G, amongst others, caused serious illness in persons with weakened immunity, so it cannot be overlooked [14]. Due to the nature of mammography, a patient's skin is expected to be exposed, so that it was smeared from dry skin so it shows that the areas where the skin was touched should be cleaned with alcohol swabs after each inspection.

After *Staphylococcus epidermidis*, *Enterococcus faecalis* was detected second most frequently, and is also a pathogenic intestinal bacteria, together with *Enterococcus faecium*, which rarely causes disease but in rare cases can cause food poisoning, urinary tract infections and endocarditis [15].

In addition, *Providencia stuartii* and *Providencia retgeri* belonging to the Providencia 5 species and common in soil and water were detected and, as with other bacteria, can cause diseases such as urinary tract infections. In addition, *Serratiamarcescens* was also detected and is a non-pathogenic bacteria that can cause meningitis, septicaemia through infections of the non-urinary tract, respiratory tract infection, and wounds in nosocomial infections, and *Klebsiellapneumoniae*, also detected, may cause bacterial respiratory infection when the immune system is weakened [16,17].

In addition, as previous studies revealed, we found that the most bacteria was detected on the irradiation apparatus, such as the exposure button which is the abutting portion of the patient's skin, also in this study, the strains were detected in high levels on the control box, including the exposure button and on the grid [5]. As this means that the infection can be spread on the radiation operator's hands, although removing bacteria with alcohol swabs is also important, we have to try to prevent secondary infections in hospitals by cautionary activities, such as washing of hands after inspection.

This study intended to investigate the infection management practices of the workers in the mammography room, and will be the new Survey on Infection Control, common challenges in health science. While it confirms the recognition of the infection risk through the inspection of equipment even for healthy patients, we should also be aware that infection-caused diseases are expected to increase, depending on the types of bacteria or viruses that were detected.

In particular, inspectors are expected to increase awareness of disinfection, and to prioritize infection prevention in view of the fact that microbe detection was in the mammography room where the patient's skin is exposed and the degree of contact between the radiologist and the patient is the most high.

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6. References

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