

Effect of one and half years of clinical nursing practice on the immune status of nursing students to the hepatitis B virus, varicella-zoster virus, rubella, measles, tuberculosis, and the nasal carriage of MRSA .

Tomomi Hasegawa¹⁾, Yuriko Gejo²⁾, Nami Yasukuni³⁾, Kyoko Sasano⁴⁾

1) School of Nursing, University of Toyama, 2) former School of Nursing, University of Toyama, 3) University Hospital of Toyama, 4) School of Nursing Kanazawa Medical University.

Abstract

Objectives: The first objective of this study was to examine the possible occupational risk of contracting hepatitis B virus (HBV), the varicella-zoster virus (VZV), rubella, measles, tuberculin skin test (TST) or methicillin-resistant *Staphylococcus aureus* (MRSA) among nursing students during clinical practice for patient's care. The second objective was to investigate whether testing for the diseases increased student awareness of infection control. **Methods:** Sera from 56 nursing students before their clinical practice and post clinical practice were tested for the presence of HBV surface antigen (HBs), VZV, rubella and measles antibodies. The TST and the testing for the nasal carriage of MRSA were examined in 22 and 48 nursing students respectively. We also examined the effect of participation in immune status testing on the perception of nursing students for occupational infection control through the use of questionnaires.

Results: After clinical practice, one student had a significant rise in the antibody titer to HBsAg. Except for HB, no significant difference was detected in the antibody titer to VZV, measles, rubella between sera from before and after the nursing practice of the nursing students. However, a (4.5%) rise from weak positive to strong positive in the in TST status was observed in one student. One student, who administered direct care to a MRSA carrier patient, contracted temporary nasal carriage of MRSA (2.2%).

As for the nursing students' perception, thirty-nine of fifty six students, or 69.6%, gave this affirmative answer to participation in this immune status testing for occupational infection control.

Key words

nursing student, infection control, virus infection, TST, MRSA

Introduction

The first purpose was to test the immune status change with relation to hepatitis B virus (HBV), varicella-zoster virus (VZV), rubella, measles, the reaction of tuberculin skin test (TST) and the nasal carriage of MRSA in nursing students during their clinical nursing practice and how much occupational risk existed for nosocomial infection in the school of nursing. The second purpose was to determine whether such testing increased student awareness of infection control.

We found that occupational infection control is important for nursing students to protect them from nosocomial infection. The current status of the risk in nosocomial infection is described from both sides of infection prevention measures and student's infection prevention technique. Goetz suggests that nursing students are inadequately protected against HB in the United States^{1,2)}. In Japan, 80~82 and 70~84% of nursing schools performed hepatitis B surface antigen (HBs) and HBs antibody tests, respectively. However, only 29~31.6% of nursing schools administered the HBV vaccine to the students^{3,4)}. In addition, 20~30 % of nursing schools in Japan evaluate the antibody titer of nursing students to the antibody titers of pediatric common infectious diseases⁵⁾. The Ministry of Health, Labor and Welfare is presenting the level of the nursing art in Japan in the report of the study committee concerning the ideal way of the technical education in the basic nursing education in 2003. The technical level of clinical nursing that “the student can do independently” is requested by the average about Standard precaution in the infection prevention technique. However, only half the number students has been reached to “the student can do independently” in Standard

precaution in the infection prevention technique⁶⁾. Accordingly, in cases where nursing students are providing direct care to patients, who have undergone complicated medical treatments, the risk of exposure for nursing student increases as a direct result of inadequate infection control knowledge. The prevention of rubella, measles, the chicken pox, and mumps is important in pediatrics nursing practice, because these infectious diseases cause severe problems in pediatric wards. Concerning occupational infection control for nursing students, we first assessed infection with HBV, VZV, rubella, measles, TST and the nasal carriage of MRSA by serology and microbiological methods after clinical practice. Then we pointed out the necessity of infection control measurements in schools of nursing. We also showed the efficacy of the recognition of the nurses' immune status on the education of nursing infection control.

Methods

These studies were approved by the university hospital ethical committee (No.15, 1997). Before participating, all student enrolled in this study gave their written informed consent.

Study Design

Nursing students participated in the follow-up survey pre-clinical and post-clinical practice. Paired serum samples were taken from 56 nursing students (almost all born in 1978). The students were all female, their mean age was 20 years old at pre-clinical practice and they were followed post-clinical practice. The interval between pre and post sampling was one and half years. Clinical practice was performed in the surgery, internal medicine, orthopedic surgery, obstetrics & gynecology, pediatrics, psychiatry, and urology wards, the Intensive

Care Unit and the operation room at the university hospital. Other practice was performed in community health, Kindergarten and in Gerontology nursing homes. The content of practice consisted of observation, vital signs checks, dressing, bed baths, head washes, massage and health care education. Students did not touch syringes when they gave direct care to patients.

Fifty-six paired sera for HB antibody titers were performed using the passive hemagglutination technique (PHA test: New seroclit-anti HBs); fifty-five students had already received a recombinant HBV vaccine in the first grade. The VZV antibody titers were determined by enzyme-linked immunosorbent assay (ELISA) and confirmed for their negativity by the Western blot method. For ELISA we did a preliminary Box test and determined the optimal combination of dilutions of sera and peroxide. Then serum samples 1:200 and 1:400 were diluted with 2% skim milk in PBS. Anti-human IgG conjugated with Peroxide 1:6000 was also diluted with 2% skim milk in PBS. After 10 minutes of substrate reaction, absorbance values (A) were obtained at a wavelength of 470nm. Sera of 0.1< absorbance value were retested using the Western blot method and an immunofluorescent antibody (IF), respectively. We plotted the absorbance as antibody titers. We found that when conversion occurred there was a significant rise in antibody titer levels.

Rubella and measles antibody titers were determined using a hemagglutination inhibition (HI) technique (R-HI Seikenn, HI test: Seiken's HA antigen and HI antibody test solution, respectively). Rubella (HI test: R-HI Seiken that was purchased from Denka Seiken Co.) and measles (HI test: Seiken's HA antigen and HI antibody test solution that were purchased from Denka Seiken Co.) were

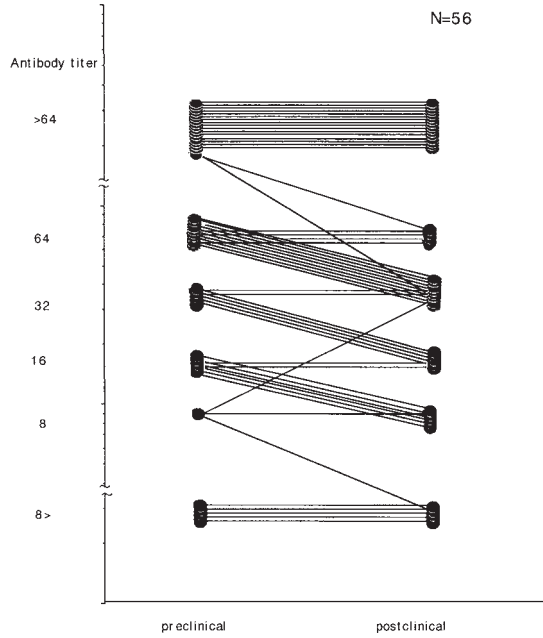
examined according to the manufacturer's instruction. We found that when seroconversion or significant antibody rise occurred there was a four-fold rise in titer.

Examinations of 22 pre-clinical and post-clinical nursing students' TST were performed. The PPD was purchased from Japan BCG product Co. By the time they reached junior high school, all of these students had received BCG vaccinations in the Japanese vaccine program. They had already experienced TST conversion by the time they reached junior high school, at the latest. The TST diagnoses was conducted after 48 hours i.s. (by intradermal injection), which is the standard by law for tuberculosis prevention in Japan (Table 1). In the case of a negative TST test after 72 hours i.s. was performed with a two-step TST test. Post-clinical TST tests were performed on the opposite arm of the initial test. To exclude the possibility of bias related to the TST's booster effect, we found that when conversion occurs there is a significant change in the reaction (Table 1.).

We examined 48 pre- and post-clinical nursing students' nasal carriage for MRSA. To find *S.aureus* cultures and MRSA cultures, we used a Mannitol Salt Agar "Nissui" and a Nissui Plate MSO Agar that contained 6 μ g/ml of Oxacillin, respectively. The agars were also purchased from Nissui Co. Samples were incubated 72 hours in an incubator at a temperature of 33 °C. A gram staining, coagulase test and catalase test was performed to define the *S.aureus* colony.

We determined the students' impression of the recognition of their immune status to antibody levels of HBs, VZV, rubella, measles, reaction to the TST, and nasal carriage of *S.aureus* using open-ended questions.

Figure 1.
The change of HBs antibody titers between preclinical and postclinical by PHA test



They had HBs vaccination before 1 year of the start of clinical practice (except one HBV antigen positive student)

Figure 2.
The change of VZV's antibody titers between preclinical and postclinical by ELIZA

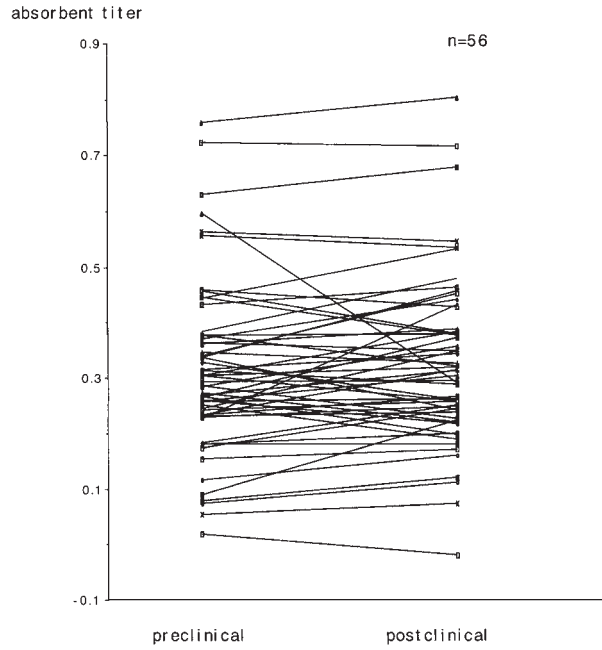
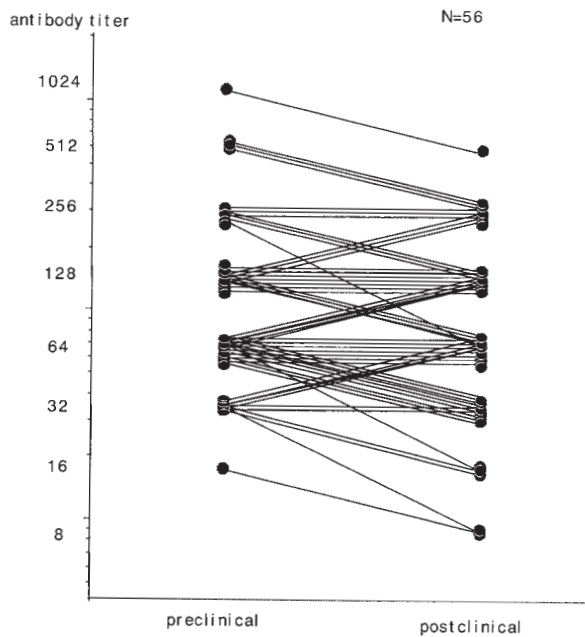
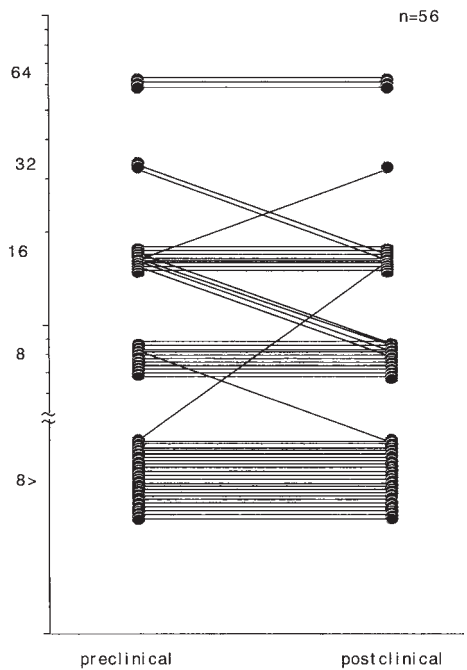


Figure 3.
The change of rubella's antibody titers between preclinical and postclinical by HI test



They already had rubella's vaccination at junior high school

Figure 4.
The change of measles's antibody titers between preclinical and postclinical by HI test



They had antibody titer by personnel natural infection in childhood. One student had vaccination on her own initiative after preclinical negative data was returned.

Table 1. The decipher standard by the law for tuberculosis prevention in Japan.

reaction	judgment	mark
in case of the major axis of rubor is ≤ 9 mm	negative	(-)
in case of the major axis of rubor is ≥ 10 mm	positive(weak positive)	(+)
in case of the major axis of rubor is ≥ 10 mm and the rubor involves scleros	positive (moderate positive)	(++)
in case of the major axis of rubor is ≥ 10 mm and the sclerose involves dualistic rubo or bulla or mortician	positive(strong positive)	(+++)

Table2. The change of tuberculin reaction between preclinical and postclinical

	judgment	major axis of rubor	major axis of sclerosis	major axis of dualistic rubor
Preclinical	1.77 \pm 0.87	24.96 \pm 13.17	5.82 \pm 6.86	4.52 \pm 7.73
Postclinical	1.91 \pm 0.92	29.46 \pm 15.55	7.55 \pm 6.89	4.82 \pm 7.70

n=22(mean \pm SD)

P<0.05

One student's TST reaction changed from weak positive to strong positive

Table3. The change of the nasal carriage of S.aureus between preclinical and post-clinical

	MSSA	MRSA
Preclinical	10 (20.8%)	0 (0.0%)
Postclinical	9 (18.8%)	1 (2.1%)

n=48

Table 4. The perception of Nursing students that the efficacy of participation in immune status testing and Questionnaire (the open-ended answers were content analyzed, A total of 103 answers had gain)

affirmative answer (90 answers)

I could recognize the status antibody titer in myself	39 (69.6%)0
The motivation for infection control was got higher	21 (37.5%)0
My knowledge of tuberculin reaction was got higher	6 (10.7%)0
It was good chance of study of injection technique	5 (8.9%)0
I could realized the risk of hospital infection	5 (8.9%)0
I could recognized my indigenious flora	3 (5.4%)0
It was good chance of experience study	3 (5.4%)0
I could gave vaccination based on the data	1 (1.8%)0
others	7 (each1 1.8%)0

negative answer (13 answers)

Injections were painful	5 (8.9%)
I bound my time by research	2 (3.6%)
The adverseeffect of PPD(itching)	below each 1 (1.8%)
I could not interpreted the result	
There were no good advice for interpretation of results	
I want to method of testing	
I did not remember this research exactly	

Results

Serological immune status change during clinical practice.

Fifty-six nursing students participated in serological tests. The change of antibody titers to HBV, VZV, rubella, and measles are presented in Figures 1~4. One student's anti-HBsAg antibody titer rose significantly (1:8 to 1:32). She gave direct care to a patient with chronic HB during clinical practice, but she had not aware of any exposure to the patient's blood (Fig 1.). A student's antibody titer to meacnegativity by pre-clinical test.

The change of TST reaction during clinical practice.

Twenty-two and 48 students participated in pre-clinical and post-clinical TST examinations, respectively. Therefore the comparison of the change in TST reaction between pre-clinical and post-clinical numbers was performed only on the 22 students who participated in both examinations. We judged the TST reactions according to the scale in Japan as shown in Table 1. To prevent false negative results, we used two-step testing for students with negative reactions. The changes in TST reactions between pre-clinical and post-clinical practice are shown in Table 2, excluding a bias of the TST's booster effect. One student's TST reaction changed from a weak positive to a strong positive.

The change of the nasal carriage of *S.aureus* during clinical practice.

Forty-eight students participated in the nasal carriage culture examination during clinical practice. There was not a significant change in incidence of the nasal carriage of *S.aureus* between pre-clinical and post-clinical practice. However, one student's MSSA (*methicillin-sensitive Staphylococcus aureus*) changed to

MRSA (Table3.). Only MSSA was present two weeks later. Thus, her nasal carriage of MRSA was temporary. Before post-clinical sampling, she gave direct care to an elderly MRSA carrier patient in the urology ward.

The student's subjective recognition concerning the immune status test

The qualitative research showed the effectiveness of awareness (Table 4.) We questioned the student, saying that "What are may your participation in this research and badness?". The content of open-ended answers was analyzed. A total of 103 answers were recorded, 90 / 103 answers or 87.4% were affirmative. The major reason for a negative answer was the painfulness of the injection.

Discussion

This study focused on the immune status change with relation to HBV, VZV, rubella, measles, TST and the nasal carriage of MRSA for nursing students during clinical nursing practice. The expanded theme of this study was to determine the efficacy of immune status testing for nursing education. It is suggested that nursing students are inadequately protected against hospital infectious materials⁷⁾. However such studies were made through an investigation of actual conditions by questionnaire. Research that measures the antibody value between pre-clinical and post-clinical practice is rare⁸⁾. There are few cumulative, scientific studies that focus on medical or dental students. This study is worthwhile because it scientifically tests nursing students' immune status related to such infectious agents as HBV, VZV, rubella, measles, TST or the nasal carriage of MRSA simultaneously between pre-clinical and post-clinical practice.

At the time of this writing, the rate of HBV

infection among nursing students in Japan, expressed as anti-HBs seroconversion rate per year, was 0~0.2%. This was determined by an epidemiological study^{9,10}. In this study, none of the subjects seroconverted during pre-clinical and post-clinical practice because they had already received the HBV vaccine; however, the antibody titer of 1 student rose 4 fold between pre-clinical and post-clinical practice. This suggests that there is evidence of HBV infection during clinical practice for nursing students in Japan. Twenty-nine percent of nursing schools have an HBV vaccine program in Japan¹¹; the School of Nursing used in our study was one of the ones that had a HBV vaccine program. This study shows the occupational HBV infection risk for nursing students by using a more sensitive and ethical method than seroconversion.

The antibody titer of VZV, rubella and measles did not change during pre-clinical and post-clinical practice. However, one student received a measles vaccine on her own initiative after pre-clinical negative data was returned. In Japan, the school of nursing university or nursing junior college that inspects the antibody value is reported to be few with 20 to 30 percents now¹². Because the problem grows once it has been developed, the infectious disease measures are necessary.

Internationally, the morbidity of tuberculosis is still higher in Japan than in Western countries. The Japanese tuberculosis disease society prevention committee put out the indicator entitled "Health care practitioner's collapse prevention measures", and recommended that health care providers, including student nurses, receive the tuberculin reaction inspection and BCG vaccination in 1993. The university that administrates the tuberculin reaction inspection to student nurses increased in 2000 up to 89.2%, though

before they practice states that was 34.5% in the investigation in 1998¹³. The fact that the Ministry of Health and Welfare's declared the tuberculosis emergency in July of 1999 also influences testing rates, and can be said that the concern for tuberculosis infection prevention will have risen at any university. The BCG's protection against tuberculosis can be sustained for 10~15 years and perhaps longer after the primary vaccination. Concerning health care workers, including nursing students, regular TST testing was recommended in order to reduce occupational risk. The outcome of this TST study suggests evidence of tubercle bacillus exposure between pre- and post-clinical practice among nursing students. In order to make a close examination, we performed two-step tests which take into account the possibility of the TST's booster effect. Two-step tests were performed only on pre-clinical students with negative TST test results. As a result of the two-step testing, one student's TST reaction changed from a weak positive to a strong positive. It is not considered to be related to the booster effect.

The antibody examination and the vaccine inoculation of the students' infection prevention measures to HB had been done at the health administration center of the university before this research. The result of this research influenced the infection control at the university hospital. The additional contents of the inspection are mumps, measles, VZV and rubella. Moreover, the tuberculin reaction inspection was also begun. These testing costs became a public expense at the university. Receiving the vaccination at the health administration center of the university, the university assists the part at public expense though the student pays expenses by the individual payment. The supporters' association by the guardian is also assisting

with the expense. The students can discuss preventive measures with the doctor at the health administration center.

A current report of the MRSA nosocomial infection doesn't include the report of the appearance of the MRSA outbreak that affected the student nurse¹⁴⁾. In this study, at the time of post-clinical practice one student was considered to be a temporary carrier of MRSA. It is necessary to be thorough in standard precautions in the clinical nursing practice in the future, especially when the nursing students take part in caring for a patient who has decreased immunity.

As for the nursing students' perception for immune status testing, thirty-nine of fifty-six students, or 69.6%, gave this affirmative answer. Table 4 shows that 90 out of 103, or 87.4%, were affirmative answers. During the pre-clinical test, most of students did not recognize the risk of tuberculosis but after clinical practice they learned awareness of the risk of tuberculosis. An increase in their participation rate might account for the rise in the consideration of the prevention of transmission. Good advice by the doctor at the health administration center or the teacher of nursing will help the students understand the risks.

We conclude that the need for further studies on infection control for nursing students is imperative. Moreover, we hope for the enhancement of nationwide preventive measures for nursing clinical practice.

Conclusion

Our study indicated that there is an occupational HBV and Tuberculosis infection risk and for temporary nasal carriage of MRSA for nursing students. Moreover, immune status testing increased students' awareness of infection control.

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看護学生の実習前後における B 型肝炎，水痘，風疹，麻疹抗体価およびツベルクリン反応，MRSA 鼻腔保菌の変化

長谷川ともみ¹⁾，下条由季子²⁾，安國奈美³⁾，笹野京子⁴⁾

富山大学医学部看護学科¹⁾，元富山大学医学部看護学科²⁾，富山大学附属病院³⁾，
金沢医科大学看護学部⁴⁾

要 旨

本研究は，1年半にわたる看護実習における院内感染のリスクを査定し，看護教育において抗体価測定等の実施が感染予防の視点から看護学生に及ぼす効果を検討することを目的に行った。富山医科薬科大学（現富山大学）において，倫理審査委員会の承認を得，学生への説明と同意の下，56名の看護学生において実習開始前と1年半後の実習終了時にB型肝炎ウイルス抗体価，小児ウイルス感染症（水痘，風疹，麻疹）抗体価，ツベルクリン反応，MRSAの鼻腔内保菌状態の変化，および意識調査を行った。その結果，実習前後で比較し，B型肝炎ウイルス抗体価において4倍以上の抗体価の上昇があった学生が1名（1.8%）みられた。ツベルクリン反応は実習前後での比較は22名に行い，実習前後で弱陽性から強陽性になった学生が1名（4.5%）いたが，発症はしていなかった。MRSAの鼻腔内保菌状態については，48名に行い，黄色ブドウ球菌の保菌率には差がなかったが，MRSAについては，実習後1名（2.1%）に一時的な保菌が認められた。意識調査においては，自由回答で56人中39人（69.6%）が「自分の抗体価を知ることができた」，「感染予防に対する意識が高まった」などの肯定的な回答を示した。以上から，実習中のB型肝炎ウイルス，結核菌，MRSAに関する暴露が示唆され，抗体価等の検査は学生の感染予防への意識を高める効果があった。実習時の感染については，教育機関として健診活動を強化し，学生への感染予防教育を推進する必要がある。

キーワード

nursing student, infection control, virus infection, TST, MRSA