# Influence of Flushing Conditions on Incompatibility in Y-site Injection (Second report) : Survey and Evaluation Flushing Conditions at Medical Institutions

Tetsuro Yumoto<sup>\*1,2</sup>, Maki Sato<sup>1</sup>,

Yoshiaki Mizukami<sup>1</sup> and Yoshiharu Machida<sup>2</sup>

Department of Pharmacy, Sagamikousei Hospital<sup>1</sup> Department of Drug Delivery Research, Hoshi University<sup>2</sup>

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From the viewpoint of safety management, the examination of incompatibility by pharmacists and their provision of information on this subject are essential in ensuring that drugs are used properly.

In the present study, we investigated the situation regarding the enforcement of flushing, which is carried out to prevent incompatibility on injection, by means of a survey of members of the nursing department. The results showed that nursing staff recognized the necessity of flushing to a certain extent, but no standards had been established regarding the kinds of drugs that need to be flushed, or the volume and rate of flow of the flushing fluid. This suggests that pharmacists could do more in providing information on flushing and advising nursing staff concerning it, and in the survey many staff said that they would welcome the provision of information on flushing by pharmacists. The results of the survey thus showed that pharmacists can play an important role in drug safety management.

Key words - Y-site injection, flushing, incompatibility, injections

## Introduction

Pharmacists should be scientists in the medical team. From the viewpoint of safety management, investigations into drug incompatibility by pharmacists as scientists are essential for medical staff to receive useful information<sup>1)</sup>.

When concentrated medical fluids are injected from the Y-site during infusions during the implementation of intravenous I.V.push or piggyback techniques<sup>2)</sup>, drug precipitation occasionally occurs due to their incompatibility. A technique called "flushing" is used to prevent drug separation. It involves injecting a washing solution, such as physiological saline or glucose solution, from the Y-site before and/or after injection.

This technique is quite important to prevent incompatibility and maintain the safety of patients; however, flushing is poorly recognized among medical staff and no standards have been established.

In this study, the present condition and the problems of flushing were investigated.

#### Methods

The investigation was performed during three months (April to June, 2006) at 100 hospitals in the Kantokoshinetsu regions via a questionnaire survey of the nursing department. Recognition of the necessity and the standard of flushing, namely the drugs to be flushed, the volume and rate of flow of flushing fluid, were investigated. These questionnaires were filled out anonymously (**Table 1**).

#### Results

# 1. Response rate, classification of hospitals and number of beds

Seventy hospitals (70.0%) responded to this survey. The hospitals consisted of 20 incorporated medical institutions (28.6%), 9 incorporated educational institutions (12.9%). 6 Red Cross and Red Crescent (9.0%) and 6 public hospitals (9.0%). As educational institutions, 12 hospitals (17.1%), such as incorporated educational institutions and national universities, replied to the survey (**Fig. 1**).

As shown in **Fig. 2**, the number of beds was 100-200 at 18 hospitals (25.7%), 300-400 at 12 hospitals (17.1%), and 200-300 or 500-600 at each of 9 hospitals (each 12.9%).

神奈川県相模原市小山 3429; 3429, Oyama, Sagamihara-shi, Kanagawa, 229-8555 Japan

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Table 1. Questionnaire on Flushing.

1	Classification of hospitals:
2	Number of beds:
3	Recognition of necessity of flushing (Yes/No/No idea)
4	Practice standard for flushing: Decision maker (doctors/pharmacist/nurse) Drug item ( ) No practice standard Others ( )
5	Problems related to flushing:
6	Drugs to be flushed before and/or after injection. bromhexine hydrochloride (Bisolvon <sup>®</sup> Injection) / furosemide (Lasix® Injection) potassium canrenoate (Soldactone <sup>®</sup> Injection) / phenytoin (Aleviatin <sup>®</sup> Injection) omeprazole (Omepral <sup>®</sup> Injection) / antibiotics / anticancer drugs others (
7	Volume of flushing fluid before drug injection. 5mL > / 5mL / 10mL > / 10mL / 20mL > / 20 mL / 20mL <
8	Volume of flushing fluid after drug injection. 5mL > / 5mL / 10mL > / 10mL / 20mL > / 20 mL / 20mL <
9	Flow rate of the flushing fluid after injection. one shot, regardless of drugs same flow rate of drugs slowly in the case of a high-risk drug, others are by one shot others (
10	Character or risk of drugs to change the volume of flushing fluid. Specific drugs and volume of flushing fluid.
11	Pharmacists provide information to medical staff positively (Yes/No)   Medical staff expect information from pharmacists in future (Yes/No)



Fig. 1. Classification of Hospitals Surveyed.

#### 2. Recognition of the necessity of flushing

The necessity of flushing was recognized at 46 hospitals (65.7%). The answer, "No idea" was obtained from 17 hospitals (24.3%). Seven hospitals considered flushing unnecessary (10.0%), as shown in **Fig. 3**. There was no relationship between the number of beds and the recognition of flushing (**Fig. 4**).

At educational institutions (12 hospitals), such as incorporated education institutions and national universities, flushing was considered necessary at 6 hospitals (50.0%), the answer, "No idea", was obtained from 3 hospitals (25.0%) and three hospitals considered flushing unnecessary (25.0%). There was also no relationship between the number of beds and the recognition of flushing.

#### 3. Practice standard for flushing

In this study (multiple answers), the decision to flush was made by doctors at 33 hospitals (47.1%), pharmacists at 21 hospitals (30.0%) and nurses at 18 hospitals (25.7%). No practice standard for flushing has been established at 14 hospitals (20.0%), (**Fig. 5**). In contrast, at 17 hospitals (24.3%), a practice standard of flushing has been established by a committee, such as the medical safety measures committee or infection control committee.

As shown in **Fig. 6**, the drugs to be flushed (multiple answers) were phenytoin (Aleviatin<sup>®</sup> Injection) at 33 hospitals (47.1%), furosemide (Lasix<sup>®</sup> Injection) at 32 hospitals (45.7%), potassium canrenoate (Soldactone<sup>®</sup> Injection) at 28 hospitals (40.0%), bromhexine hydrochloride (Bisolvon<sup>®</sup> Injection) at 20 hospitals (28.6%), and omeprazole (Omepral<sup>®</sup> Injection) at 19 hospitals (27.1%). "No answer" or "No implementation", were ansered by 10 hospitals (14.3%). As for the therapeutic category of drugs, antibiotics and anticancer drugs were predominant at 16 hospitals (22.9%).

The volume of flushing fluid before drug injection was "10 mL" or "No answer" at 16 hospitals (22.9%), and less than 10 mL (5 mL $\leq$ ) at 12 hospitals (17.1%) as shown in **Fig. 7**. The volume of flushing fluid after drug injection was



Fig. 2. Number of Beds.



Fig. 3. Recognition of Necessity of Flushing.



and the Size of Hospitals.

"10 mL" at 19 hospitals (27.1%), less than 10 mL or "No answer" at 14 hospitals (20.0%).

As shown in **Fig. 8** the rate of flow of the flushing fluid after injection (multiple answers) was one shot, regardless of the drug, at 28 hospitals (40.0%). At 19 hospitals (27.1%), flushing was carried out slowly for high-risk drugs, and others by one shot. "No answer" was obtained from 13 hospitals (18.6%).

#### 4. Problems related to flushing

The problems related to flushing (multiple answers) are

shown in **Fig. 9**. Incompatibility was found by nurses in the intravenous tubing (20 hospitals, 28.6%), disunity of doctor's directions at 19 hospitals (27.1%), lack of recognition of nurses about flushing because of their busy schedule at 14 hospitals (20.0%) and lack of practice standard of flushing at 8 hospitals (11.4%). No problem with flushing was found at 21 hospitals (30.0%).

#### 5. Present condition of information from pharmacists

The present condition of information from pharmacists is shown in **Fig. 10**. The nursing department obtained information about flushing from pharmacists at 26 hospitals (37.1 %). No information was provided at 27 hospitals (38.6%), and no answer was obtained from 17 hospitals (24.3%). Medical staff expected information from pharmacists at 45 hospitals (64.3%), whereas they did not expect information at 4 hospitals (5.7%). No answer was obtained from 21 hospitals (30.0%).

In detail, medical staff are not provided information from pharmacists but expect information in future (22 hospitals, 31.4%), medical staff are provided sufficient information and expect information to continue (20 hospitals, 28.6%); however, at 5 hospitals (7.1%), medical staff were not provided information from pharmacists and do not expect information in future.

#### Discussion

For the safe management of drug therapy, consideration of injected drug interactions based on prescriptions and providing appropriate information to medical care staff by pharmacists are very important. When a drug interaction is identified but alteration of the prescription is not possible in the treatment, adequate avoidance is needed.

A technique called "flushing" is used to prevent the precipitation of drugs on injection of concentrated medical fluids from the Y-site during intravenous push or piggyback techniques. In this study, we investigated the present condi医療薬学 Vol. 33, No. 11(2007)



Fig. 5. Practice Standard for Flushing.



Fig. 6. Classification of Drugs to be Flushed.



Fig. 7. Volume of Flushing Fluid.

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Fig. 9. Problems Related to Flushing.







Fig. 10. Present Information from Pharmacists.

tion and problems concerned with flushing.

The necessity of flushing was recognized by about 70.0% hospitals (Fig. 3). There was no relationship between the number of beds (size of hospital) and the recognition of flushing. The results from educational institutions, such as incorporated educational institutions and national university hospitals, showed a different response (Fig. 4), indicating that "flushing" as a safety management activity has not been

sufficiently established. Therefore, investigating drug incompatibility and providing useful information to medical staff by pharmacists are regarded as essential. Only 30.0% of pharmacists decided to implement flushing and many decisions were made by doctors or nurses, which could cause a medical accident. Incompatibility found by nurses, or disunity of doctor's directions were shown. In contrast, in some hospitals pharmacists took the initiative and a practice stan-

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dard of flushing was established by a committee or ward (Fig. 5). Overall, 60.0% of medical staff expected information from pharmacists concerning flushing (Fig. 10). These results have suggested that the importance of the pharmacist's role in the field of drug safety management.

It was shown that various drugs are the subjects of "flushing". Most of the drugs were those in which medical staff could easily identify incompatibility such as changes in the outside appearance or blockage of the filter (Fig. 6). Concentrated medical fluids are usually injected from the Y-site during infusion, especially for intravenous push or piggyback techniques. Moreover, drugs injected via the main route often vary according to the patient's condition. Therefore, the implementation of flushing for high-risk drugs which could cause incompatibility is suggested. However, gaining consensus from all hospital staff is essential to implement "flushing" under staff shortages.

Most hospitals used 10 mL as the volume of flushing fluid before and/or after injection (Fig. 7). To ascertain the most efficient flushing conditions, we investigated the relationship between the amount of residual drug in intravenous tubing, and the volume and flow rate of the flushing solution (physiological saline) in Y-site injection of furosemide (Lasix<sup>®</sup> Injection), in our first study<sup>3)</sup>. The results showed that the volume of physiological saline required to prevent drug incompatibility by flushing out the intravenous tubing was five to six times the inner volume of intravenous tubing, but the flushing rate were showed no effect on flushing. However, the target of the previous study was an ordinary water-soluble injection with good fluidity, so further study should be carried out considering the viscosity of the injection as an important factor. The validity of 10 mL for flushing should be clarified later.

Concerning the flow rate of flushing fluid after injection, 40.0% hospitals answered "one shot" regardless of the drug (Fig. 8). Flushing by one shot can cause an abrupt increase of the drug concentration in blood and subsequent adverse reactions. Therefore, information given by pharmacists is essential for the rational use of drugs. We are also investigating the relationship between the flow rate of flushing fluid and the change in blood drug concentration.

Based on this survey, a lack of education and insufficient information provided by the pharmacy department leads to the inadequate establishment of flushing conditions, and a lack of skills required to apply basic pharmaceutical sciences to clinical practice was suggested to be an underlying background. As scientific experts in medical care teams, pharmacists should master sufficient practical knowledge and techniques of basic pharmaceutical sciences, in addition to clinical pharmacy.

In America, the Infusion Nurses Society (INS) prepared protocols concerning flushing<sup>4,5)</sup>, which specify the need to perform routine flushing before and after the administration of blood and blood products, blood sampling, administration of incompatible drugs and transfusion solutions, drug administration, intermittent transfusion, and switching from continuous to intermittent transfusion. However, no concrete subjects or infusion rates are described. In Japan, no clear criteria with an original scientific basis are available.

Under such circumstances, pharmacists are the sole professionals capable of investigating and dealing with the incompatibility of recent complex prescription designs, and providing appropriate information. Based on questionnaire results, pharmacists should take the lead in establishing flushing conditions with the understanding and cooperation of hospitals and medical care teams.

We investigated the flushing conditions of water-soluble low-viscous furosemide injection as an example<sup>3)</sup>. We are planning to investigate the influence of viscosity of injections, and design Japanese flushing criteria.

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