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INFECTION HAZARD FROM SYRINGES

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SUMMARY

Bacterial contamination of the contents of disposable plastic syringes was demonstrated experimentally after repeated refilling. Supporting evidence for this mechanism as a potential source of bacteraemia was obtained by a spot check of syringes used for repeated injections. It is recommended that disposable syringes should be discarded after a single injection.

It is now standard practice to use disposable syringes for injection. In situations where repeated injections are required in the same patient—for example, by doctors and nurses in intensive therapy units (ITU) and by anaesthetists in operating theatres—it is common practice for these syringes to be refilled. Simple observation demonstrates that mishandling of the plunger may readily occur (fig. 1), thus creating a potential source of contamination.

This hypothesis has been investigated. In addition, syringes which had been used over a prolonged period in operating theatres and in an ITU were examined for bacterial contamination.

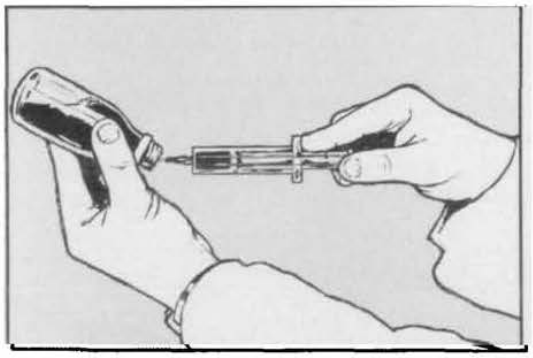

Fig. 1. Common method of drawing up with a syringe showing mishandling of the plunger shaft, that leads to bacterial contamination of the contents.

METHOD

(A) *Investigation of syringes with a marker organism.*

A variety of sizes of sterile plastic and glass syringes were used.* Each syringe pack was opened in a sterile, filtered-air, positive-pressure room, and the syringe held with sterile rubber gloves. The syringes were filled and refilled using the common technique of withdrawing the plunger with one hand, whilst the other held the bottle from which the culture medium (1% peptone water) was aspirated (fig. 1). The culture medium was withdrawn from capped bottles through a sterile rubber seal to the maximum calibration mark on the syringe and then re-injected into the bottle. The specimen was labelled "control".

The gloved right hand was then dipped into a culture of Serratia marcescens, used as a marker organism. The syringe plunger was pulled back with the contaminated right hand, whilst the uncontaminated left hand held only the bottle. Approximately 25×10^6 organisms per sq.cm were present on the glove. This represents a severe challenge. The procedure was repeated with the same syringe until five refills had been made. Separate culture bottles were used for each refill.

(B) *Investigation of syringes in prolonged use.*

Plastic syringes, which had been used throughout operative procedures for the repeated administration of drugs, were collected from anaesthetists in the operating theatres immediately after use and the needle and needle cover removed from the nozzle, which was then sealed with a sterile plastic cap (Braun). Care was taken not to contaminate the nozzle. The contents were then cultured. Similarly capped plastic syringes were collected from the ITU, where they had been used for the repeated flushing of intravascular cannulae.

In all cases the culture medium was incubated at 36°C for 48 hours. The bottles were then examined for bacterial contamination.

* Plastic syringes manufactured by Gillette, Beckton & Dickinson and D.H.S.S. Glass syringes manufactured by Smith & Nephew.

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RESULTS

(A) From table I it can be seen that contamination never occurred at the first refill but by the second refill all of the glass syringes and at least 50% of the plastic syringes had their contents contaminated. Because the likelihood of transfer of bacteria from the plunger to the syringe contents was similar with all the makes of plastic syringe examined the results have been pooled.

TABLE I. *Contamination of syringe contents. Syringe plungers mishandled by a hand contaminated with a marker organism (Serratia marcescens).*

	No. of syringe contents contaminated/No. of syringes tested			
		Refills		
Syringes	Control	1st	2nd	5th
Plastic				
1 ml	0/10	0/10	6/10	10/10
2 ml	0/10	0/10	5/10	10/10
5 ml	0/15	0/15	7/15	15/15
10 ml	0/15	0/15	11/15	15/15
20 ml	0/15	0/15	6/15	15/15
Glass				
5 ml	0/5	0/5	5/5	5/5
10 ml	0/5	0/5	5/5	5/5
20 ml	0/5	0/5	5/5	5/5

(B) One hundred plastic syringes were collected from the ITU and the operating theatres (table II). The contents of eight syringes were contaminated. Of these, five had been used in the ITU. The contents grew Staphylococcus epidermidis[1] (3 syringes), Staphylococcus aureus[2] (1 syringe) and Streptococcus viridans[3] (1 syringe).

The remaining three syringes had been used for patients undergoing major surgery. The contents of two syringes used in two separate cases of resection of an aortic aneurysm grew Escherichia coli[4]. The third syringe had been used for a patient undergoing mitral valve surgery and from its contents Staphylococcus aureus was grown.

No patients had clinical evidence of septicaemia.

1. Staphylococcus epidermidis: gram positive, fermentative, catalase positive, slide coagulase negative, D.N. ase negative coccus.
2. Staphylococcus aureus: gram positive fermentative, catalase positive, slide coagulase positive, D.N. ase positive coccus.
3. Streptococcus viridans: gram positive, catalase negative, α-haemolytic (horse blood agar), coccus.
4. Escherichia coli: gram negative, motile, citrate negative, K.C.N. negative, Eijkman positive rod.

TABLE II. *Organisms cultured from the contents of 100 syringes collected after use in the operating theatres or the Intensive Care Unit.*

Organism	No. of Syringes	Total No. of Syringes
From theatres		
Escherichia coli	2	
Staphylococcus aureus	1	50
From ITU		
Staphylococcus epidermidis	3	
Staphylococcus aureus	1	50
Streptococcus viridans	1	

DISCUSSION

It is undesirable that contamination of syringe contents should occur, although such contamination cannot necessarily be equated with clinical bacteraemia. Our results show that if the plunger of a syringe is contaminated by soiled hands, organisms can be transferred to the syringe contents.

Anaesthetists and intensive care nurses frequently soil their fingers with tracheobronchial secretions and mucopus, and Lowbury and Lilly (1973) demonstrated that even a 2-min wash with ordinary bar soap does little to reduce the bacterial count on hands. Furthermore, it has been suggested (Teres et al., 1973) that in the intensive therapy unit, sinks provide reservoirs of *Pseudomonas* infection and that the hands of personnel are the vehicles of transmission.

There have been many investigations into the sources of bacterial contamination of intravenous fluids and cannulae (Banks et al., 1970; Freeman and King, 1971; Colvin et al., 1972; Philips, Eykyn and Laker, 1972; Department of Health and Social Security, 1972; Committee of the Medicines Commission, 1973; Lapage, Johnson and Holmes, 1973; Leading Articles, 1972, 1973a,b), but little has been reported on the possible introduction of bacteria into infusion systems, or directly into patients by the mishandling of syringes (Scurr and Edgar, 1962).

The reported incidence of bacteria in intravenous fluids to which drugs had been added (D'Arcy and Woodside, 1973) may be accounted for by the use of contaminated syringes for the addition of the drugs. This is especially hazardous as intravenous nutrients are excellent culture media. In particular, the risk to patients undergoing cardiac and transplant surgery may be considerable.

The fact that patients are at risk is shown by our findings of organisms in the contents of 8 of 100

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syringes collected at random. Pathogenic organisms were present in 4 of these 8 syringes. We have demonstrated that the use of disposable syringes for more than one injection is potentially hazardous. This study demonstrates that as well as taking the obvious precautions of avoiding manual contact with the needle or nozzle of the syringe, careless mishandling of the syringe plunger with repeated injections may allow bacteria to pass from the hands to the syringe contents via the plunger. Total avoidance of handling the plunger shaft is difficult, especially when both hands cannot be employed, and therefore the only sensible precaution to be taken is to confine the use of the syringe to one injection. The seal formed between the washer of the syringe plunger and the barrel of the syringe cannot be considered as a barrier to bacteria.

We recommend that syringes should not be used for more than one injection, and that a fresh sterile syringe should always be used whenever it is necessary to draw up and inject a further supply of a drug into the same patient.

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BOOK REVIEW

Intractable Pain. By Mark Mehta. Published by W. B. Saunders Co. Ltd, London. Pp. 304, illustrated, indexed. Price £6.00.

In opting to write a book about intractable pain Dr Mehta has chosen one of the most difficult subjects in medicine. He has also chosen one of the most misunderstood, despite the fact that most doctors encounter pain in one form or another almost every day of their lives. Concern has been expressed in the medical press with increasing frequency that this paradox, namely familiarity with pain in the clinical sense on the one hand and ignorance of its many physiological and psychological aspects on the other, should exist. Most medical undergraduates receive lectures concerning probable pathways for noxious impulses following stimuli in various parts of the body, and turgid accounts of the properties of hosts of analgesic agents with a limited review of indications for their administration. Few teachers are sufficiently inspired to explain the problems of those suffering from pain in the light of present-day knowledge of psychological, social, and physiological factors. Lack of knowledge of this kind is not confined to doctors alone, for others involved in the care of patients are often unaware both of their role in treating the severely ill, and of the effects of their attitudes towards pain upon the manner in which they treat it. With these points in mind it is refreshing to find that Dr Mehta has taken steps to correcting some of the deficiencies. At the outset it should be said that his book is primarily concerned with methods of treatment for intractable pain, but he does not neglect to refer to the nature of pain and to comment upon the importance of the knowledge of its psychological aspects. He gives a brief review of the current theories which attempt to explain how pain becomes a conscious experience, and proceeds to give an analysis of conditions which give rise to intractable pain. The third section of his book deals with methods of treatment. This includes familiar approaches to treatment with analgesic drugs and various forms of injection, both locally and at sites distant from the pain. He also considers less commonly used methods of treating pain, including neurosurgical procedures, hypnosis, psychotherapy and even acupuncture.

For the student of pain, intractable or otherwise, Dr Mehta presents us with a fascinating description of this area of medicine. His writing is clear and there is an even quality about the work, which suggests that in most areas, particularly those concerning treatment, he has a good deal of personal experience. This is not the book, however, for those who seek detailed accounts of the theoretical, physical or psychological bases for pain, but it is heartily recommended both for undergraduates and postgraduates, although the price of £6.00 may initially seem a little prohibitive.

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