

Relationship Between Anesthetic Procedure and Contact of Anesthesia Personnel with Patient Body Fluids

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We recorded the frequency with which anesthesia personnel came in contact with patient body fluids in order to provide an empirical basis for the recommendation of relevant precautions. Anesthesia personnel completed a questionnaire when performing a range of standardized procedures. The rate of contact with blood was as follows: catheterization of peripheral vein, 18%; insertion of central venous catheter, 87%; arterial puncture, 38%; lumbar puncture, 23%; catheterization of the extradural space, 34%; tracheal intubation, 4%; tracheal extubation, 9%; suction of oral cavity, pharynx, or trachea, 13%; intramuscular injection of drug, 8%; and establishment or discontinuation of drip for blood transfusion, 43%. By using protective gloves, 98% of contacts with patient blood would have been prevented. Blood contact was more frequent in the emergency ward than in the operating room ($P < 0.05$). Health care workers were not able to predict when a specific procedure would imply that contact with patient blood would occur. We recommend that specific precautions be adopted for the various procedures and discuss precautions that could have prevented contact with body fluid. (Key words: Anesthesia techniques: Body fluids contact. Infection, Acquired Immune Deficiency: risk.)

BY APRIL 1988, 15 cases of documented human immunodeficiency virus (HIV) seroconversion had so far been reported after contact with HIV-infected blood or concentrated virus in health-care or laboratory settings.‡ Nonoccupational risk factors could not be identified, and the types of exposure were needle sticks or cuts with sharp objects in 10 cases, mucous-membrane exposure in 3 cases, contact with nonintact skin in 2 cases, and long-term cutaneous exposure in 1 case.‡ Longitudinal surveillance studies of health-care workers with parenteral, mucous-membrane, open-wound, or nonintact skin exposure to body fluid have revealed a 0.5–1% seroconversion rate to HIV after parenteral exposure to blood from HIV-infected patients.‡¹

HIV has been isolated from blood, semen, vaginal secretion, saliva, tears, breast milk, cerebrospinal fluid, amniotic fluid, and urine, but epidemiologic studies have identified only blood, semen, vaginal secretion and possibly breast milk as risk factors in HIV-transmission.§ Guidelines on precautions against HIV infection are both

specific and general.§ The main principle is that all health-care workers should routinely use appropriate barrier precautions to prevent patient body fluid contact with skin and mucous membrane.

The risk of transmission of HIV infection in anesthetic practice has been thoroughly reviewed, and appropriate precautions have been discussed.² However, this has been done without detailed knowledge about the frequency of the personnel's contact with the body fluids; we present this data here.

The aim of this study was to describe the frequency and type of contact with body fluids experienced by anesthesia personnel, in relation to specific anesthesia procedures. Such data may provide a basis upon which appropriate precautions may be taken for specific procedures. In addition, we wanted to find out whether the health-care worker was able to predict when contact with patient body fluid would occur.

Materials and Methods

We studied procedures performed by anesthesia personnel in the operating rooms, the emergency ward, and the general medical wards. The personnel were instructed to perform these procedures in their usual manner and with the usual precautions.

All physicians and nurses were requested to complete a questionnaire when, in a given period, they were performing one of fourteen specified procedures (table 1). The questionnaire asked for the extent of physical contact with the patient body fluids, *i.e.*, contact to hand region, mouth region, eye region, arm region, or other part of the body. Additional information recorded included the kind of secretion they had been in contact with, *i.e.*, blood, saliva, or other type (specifying which); the type and extent of protective devices used (none, gloves, face mask, or glasses/protective spectacles); and the location (within the hospital) in which the procedure was performed.

To ensure uniform and correct completion of the questionnaire, its use was demonstrated by the same investigator to all personnel before start of the registration period. Questions about proper completion were answered on this occasion.

§ Centers for Disease Control: Recommendations for prevention of HIV transmission in health-care settings. *Morbidity and Mortality Weekly Report* 36(Suppl. 2S):3S-18S, 1987.

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‡ Centers for Disease Control: Update: Acquired immunodeficiency syndrome and human immunodeficiency virus infection among health-care workers. *Morbidity and Mortality Weekly Report* 37:229-234, 239, 1988

TABLE 1. Procedure-Related Overall Frequency of Contact with Body Fluid and of Needle Stick Injury

Procedure	Total Number	Overall Contact with Body Fluid	Needle Stick Injury
		Number (%)	Number (%)
CPV, catheterization of peripheral vein	278	52 (19) [14-24]	0 (0) [0.0-1.3]
CVC, insertion of central venous catheter	15	13 (87) [60-98]	0 (0) [0.0-22]
AP, arterial puncture	32	12 (38) [21-56]	0 (0) [0.0-11]
LPS, lumbar puncture of the subarachnoid space	93	21 (23) [15-32]	0 (0) [0.0-4]
CES, catheterization of the extradural space	32	11 (34) [19-53]	0 (0) [0.0-11]
BPB, brachial plexus block, axillary approach	3	1 (33) [1-91]	0 (0) [0.0-71]
PP, pin prick in determining level of analgesia	18	0 (0) [0-19]	0 (0) [0.0-19]
TI, tracheal intubation	134	46 (34) [26-43]	
TE, tracheal extubation	110	53 (48) [39-58]	
S, suction from mouth, pharynx, or trachea	100	62 (62) [52-72]	
IM, intramuscular injection of drug	26	2 (8) [1-25]	0 (0) [0.0-13]
PHF, prevention of hematoma formation by digital pressure	5	3 (60) [15-95]	
BS, drawing of blood sample	3	1 (33) [1-91]	0 (0) [0.0-71]
BT, establishing or discontinuing blood transfusion	14	6 (43) [18-71]	0 (0) [0.0-23]

Square brackets indicate bounds of the 95% confidence interval.

The questionnaires were pocket-sized and always at hand, and completion was done anonymously.

In an additional study we examined endotracheal tubes and suction catheters after use in general anesthesia. The endotracheal tubes and suction catheters were examined for visible and invisible blood using an immunochemical agglutination test, Hemolex[®], traditionally used for detection of fecal blood. The test is specific for human hemoglobin.^{3,4} Immediately after use of endotracheal tubes and suction catheters, secretions from them were incubated into a diluting suspension using a sterile swab.

The study was performed in accordance with the Helsinki II Declaration, and informed consent was obtained.

Confidence intervals (95%) were calculated for the frequency of binomial distributions. When the frequency is 0, the square brackets in the data below indicate a 97.5% confidence limit. Frequencies were compared using Fisher's exact test.

Results

FREQUENCY OF CONTACT WITH PATIENT BODY FLUIDS

The overall contact rates for blood and saliva are given in tables 1-3 and figure 1. A few health-care workers experienced contact with other body fluids or against other parts of the body; these cases include the following:

Catheterization of peripheral vein (CPV) led to contact with blood with the foot region in one case (0.4%) [0.01-2%].

Lumbar puncture of the subarachnoid space (LPS) was associated with one case of cerebrospinal fluid touching the hand region (1%) [0.03-6%].

Suction from mouth, pharynx, or trachea (S) led to contact with blood with the arm in one case (1%) [0.03-5%].

In 39 instances health-care workers came into contact with patient body fluids during other procedures:

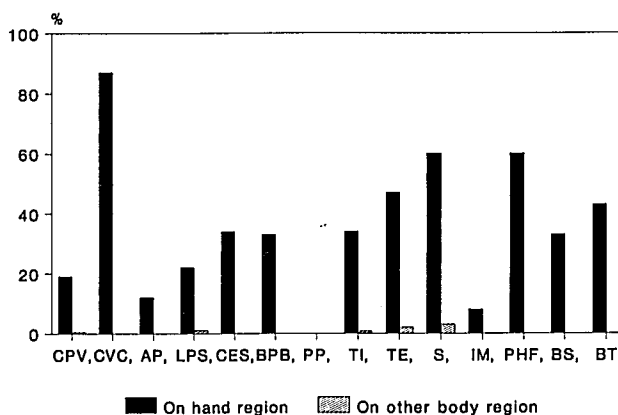


FIG. 1. Frequency of contact with body fluids when performing anesthesia-related procedures. CPV = catheterization of peripheral vein. CVC = insertion of central venous catheter. AP = arterial puncture. LPS = lumbar puncture of the subarachnoid space. CES = catheterization of the extradural space. BPB = brachial plexus block, axillary approach. PP = pin prick in determining level of analgesia. TI = tracheal intubation. TE = tracheal extubation. S = suction from mouth, pharynx, or trachea. IM = intramuscular injection of drug. PHF = prevention of hematoma formation by digital pressure. BS = drawing of blood sample. BT = establishing or discontinuing blood transfusion.

TABLE 2. Procedure-Related Frequency of Contact with Blood

Procedure	Overall	Hand Region	Mouth or Mouth Area	Eye or Eye Area	Other Body Parts
	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)
CPV	50 (18) [14-23]	49 (18) [13-23]	0 (0) [0-1.3]	0 (0) [0-1.3]	1 (0.4) [0.01-2]
CVC	13 (87) [60-98]	13 (87) [60-98]	0 (0) [0-22]	0 (0) [0-22]	0 (0) [0-22]
AP	12 (38) [21-56]	12 (38) [21-56]	0 (0) [0-11]	0 (0) [0-11]	0 (0) [0-11]
LPS	21 (23) [15-32]	20 (22) [14-31]	0 (0) [0-4]	1 (1) [0.03-6]	0 (0) [0-4]
CES	11 (34) [19-53]	11 (34) [19-53]	0 (0) [0-11]	0 (0) [0-11]	0 (0) [0-11]
BPB	1 (33) [1-91]	1 (33) [1-91]	0 (0) [0-71]	0 (0) [0-71]	0 (0) [0-71]
PP	0 (0) [0-19]	0 (0) [0-19]	0 (0) [0-19]	0 (0) [0-19]	0 (0) [0-19]
TI	5 (4) [1-8]	5 (4) [1-8]	0 (0) [0-2.7]	0 (0) [0-2.7]	0 (0) [0-2.7]
TE	10 (9) [4-16]	10 (9) [4-16]	0 (0) [0-3.3]	0 (0) [0-3.3]	0 (0) [0-3.3]
S	13 (13) [7-21]	12 (12) [6-20]	0 (0) [0-3.6]	0 (0) [0-3.6]	1 (1) [0.03-5]
IM	2 (8) [1-25]	2 (8) [1-25]	0 (0) [0-13]	0 (0) [0-13]	0 (0) [0-13]
PHF	3 (60) [15-95]	3 (60) [15-95]	0 (0) [0-52]	0 (0) [0-52]	0 (0) [0-52]
BS	1 (33) [1-91]	1 (33) [1-91]	0 (0) [0-71]	0 (0) [0-71]	0 (0) [0-71]
BT	6 (43) [18-71]	6 (43) [18-71]	0 (0) [0-23]	0 (0) [0-23]	0 (0) [0-23]

Square brackets indicate bounds of the 95% confidence interval.

Abbreviations of the procedures are listed in table 1.

Contact between patient's blood and the hand region occurred in 10 cases, 2 of which occurred during insertion of a gastric tube. A single incident was recorded for each of the following procedures: administration of sacral anesthesia, physical examination, assisting with tracheal intubation, recording blood pressure, inspection of epidural catheter, accidental contact with wound, and unspecified assistance.

Contact of blood with the arm occurred once, during assistance to a coughing patient. Contact of blood with the eye occurred once, as a result of pulsation from the operating field.

Contact of saliva with the hand was seen in 22 cases,

14 of which occurred during insertion of a gastric tube, 2 during assistance at tracheal intubation, 2 during manual ventilation, 1 during assistance to a vomiting patient, 1 during removal of a denture, and 1 during installation of a nasal thermometer. In 1 case the cause was inadequately described.

Contact of saliva with the arm occurred in 1 case where a patient was coughing.

Contact of saliva with the eye was reported in one unspecified case.

One health-care worker accidentally pricked his finger on a needle that had been used for intravenous injection via the injection port of an intravenous infusion.

TABLE 3. Procedure-Related Frequency of Contact with Saliva

Procedure	Overall Number (%)	Hand Region	Mouth or Mouth Area	Eye or Eye Area
		Number (%)	Number (%)	Number (%)
CPV	2 (0.7) [0.1-3]	2 (0.7) [0.1-3]	0 (0) [0-1.3]	0 (0) [0-1.3]
CVC	0 (0) [0-22]	0 (0) [0-22]	0 (0) [0-22]	0 (0) [0-22]
AP	0 (0) [0-11]	0 (0) [0-11]	0 (0) [0-11]	0 (0) [0-11]
LPS	0 (0) [0-4]	0 (0) [0-4]	0 (0) [0-4]	0 (0) [0-4]
CES	0 (0) [0-11]	0 (0) [0-11]	0 (0) [0-119]	0 (0) [0-11]
BPB	0 (0) [0-71]	0 (0) [0-71]	0 (0) [0-71]	0 (0) [0-71]
PP	0 (0) [0-19]	0 (0) [0-19]	0 (0) [0-19]	0 (0) [0-19]
TI	43 (32) [23-41]	42 (31) [24-40]	1 (0.8) [0.02-4]	0 (0) [0-2.7]
TE	49 (45) [35-54]	47 (43) [33-53]	2 (2) [0.2-6]	0 (0) [0-3.3]
S	58 (58) [48-68]	57 (57) [47-67]	2 (2) [0.2-7]	0 (0) [0-3.6]
IM	0 (0) [0-13]	0 (0) [0-13]	0 (0) [0-13]	0 (0) [0-13]
PHF	0 (0) [0-52]	0 (0) [0-52]	0 (0) [0-52]	0 (0) [0-52]
BS	0 (0) [0-71]	0 (0) [0-71]	0 (0) [0-71]	0 (0) [0-71]
BT	0 (0) [0-23]	0 (0) [0-23]	0 (0) [0-23]	0 (0) [0-23]

Square brackets indicate bounds of the 95% confidence interval.

Abbreviations of the procedures are listed in table 1.

Contact of gastric content with the hand occurred in 4 cases during fluid gastric aspiration.

Contact of tears with the hand occurred once.

Frequency of Contact with Patient Blood in Relation to the Location in Which the Procedure was Performed

We investigated the possible influence of location on the frequency of contact with patient blood, by analyzing in detail the number of contacts during intravenous catheterization (Table 4).

The frequency of contact was significantly higher in the emergency ward than in the operating room ($P < 0.05$).

Frequency of Use of Protection Related to Rate of Contact with Patient Blood

The health-care worker's ability to foresee blood contact in given situations is reflected in the relationship between the use of gloves and the frequency of contact to blood with the hand region.

During intravenous catheterization, tracheal intubation and tracheal extubation, contact of blood with the hand region occurred in 18.2% [2.3–52%], 0% [0.0–26.5%], and 8.6% [1.8–23.1%] of the cases, respectively, in which gloves were used. Contact of blood with the hand region occurred in 17.6% [13.2–22.7%], 4.1% [1.3–9.3%], and 9.3% [3.8–18.3%] of the cases, respectively, in which gloves were not used.

Therefore, no difference could be found between the frequencies of contact of blood with the hand region when gloves were used or not used.

PERCENTAGE ERROR

Four per cent of the questionnaires were incompletely or incorrectly completed.

TABLE 4. Frequency of Contact with Blood in Relation to the Location in Which the Procedure was Performed

Place	Venous Catheterizations (no.)	Frequency of Contact with Blood
		%
Operating room	207	13 [8.8–18.4]
Emergency department	28	36 [18.6–56]*
Ward	38	32 [17.5–49]
Other location	5	20 [0.5–72]

Numbers in square brackets indicate bounds of the 95% confidence interval.

* $P < 0.05$ compared with operating room frequency.

Frequency of Blood on Endotracheal Tubes and Suction Catheters

We examined 29 endotracheal tubes and 28 suction catheters for visible blood with the use of an immunochemical agglutination test. A positive test means that the endotracheal tube or suction catheter contains a minimum of 0.04 mg hemoglobin, which, converted into volume of normal blood, corresponds to approximately 1 μ l blood containing at least 2,200 lymphocytes.

Secretion from 16 endotracheal tubes (55%) [36–74%] contained visible blood. All were positive for hemoglobin on subsequent agglutination testing. There was no visible blood in secretion from 13 endotracheal tubes (45%) [26–64%], but 6 (21%) [8–40%] of these cases were positive for hemoglobin on subsequent agglutination testing. Immunochimistry thus showed hemoglobin in secretions from a total of 22 endotracheal tubes (76%) [56–90%].

Secretions from 5 suction catheters (18%) [6–37%] contained visible blood. All were positive on subsequent agglutination testing. There was no visible blood in secretion from 23 suction catheters (82%) [63–94%], but 10 (36%) [19–56%] of these cases were positive on subsequent agglutination testing. Immunochimistry thus showed hemoglobin in secretion in a total of 15 suction catheters (54%) [34–73%].

Discussion

Results from this study show that contact with patient body fluids occurs in 36% of common anesthesia procedures. Blood and saliva are by far the most frequent body fluids encountered.

Saliva has been shown to contain HIV in 1% of the HIV-seropositive patients.⁵ In one case a human bite has been suggested as the probable mode of HIV transmission,⁶ but this mode of transmission has been questioned.⁷ Follow-up studies on 16 persons bitten by AIDS patients or HIV-infected patients reported no seroconversion.⁷ The Center for Disease Control (CDC) considers that the risk of HIV transmission *via* saliva is negligible unless it contains visible blood,⁸ but states that for dental patients saliva should be considered infective.** In the current study, 99% of contacts with saliva occurred during tracheal intubation or extubation or during suction from

† Centers for Disease Control: Update: Universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus, and other bloodborne pathogens in health-care settings. *Morbidity and Mortality Weekly Report* 37:377–388, 1988.

** Centers for Disease Control: Recommendations for prevention of HIV transmission in health-care settings. *Morbidity and Mortality Weekly Report* 36(Suppl. 2S):3S–18S, 1987.

the mouth, pharynx, or trachea. During these same procedures a 4–13% [1–21%] rate of contact with visible blood was recorded. Examination of tracheal tubes and suction catheters revealed an 18–55% [6–74%] occurrence of visible blood and a 21–36% [8–56%] occurrence of invisible blood in an amount of at least 1 μ l blood. We cannot assess the immediate importance of this last finding in relation to HIV infection, as we do not precisely know the amount of contaminated blood required to induce a HIV infection. However, these findings, combined with the inability of predicting contact with blood as described below, indicate that for practical purposes saliva and tracheal secretions should be considered potentially infective when encountered during anesthesia procedures.

Other body fluids for which contact was recorded include cerebrospinal fluid, tears, and gastric contents.

Cerebrospinal fluid (CSF) has been shown to contain HIV in 62.5% of seropositive patients.⁸ Infection *via* CSF has not been described.

The CDC recommends the same precautions against contact with patient CSF as against contact with blood.^{††} Tears and gastric contents have not been associated with HIV transmission and are not considered infectious unless mixed with blood.

If health-care workers were able to predict when a specific procedure implied that contact with blood would occur, they were expected to protect themselves more often in such situations. However, no difference could be demonstrated between the frequencies of blood contact with the hand region in situations where gloves were used and where they were not used. We therefore conclude that the health-care workers were not able to predict in which situations the performance of a certain procedure would result in contact with blood.

This conclusion argues for procedure-related precautions, and against reliance on the individual's personal judgment of the risk of contact and the need for protection.

In table 5 we have listed the preventive measures, that would have prevented contact to potentially infective body fluid, during performance of the procedures investigated. Furthermore, the results indicate that gloves should be used during insertion of a gastric tube and during assistance at tracheal intubation.

The location in which a given procedure is performed was significantly associated with the rate of blood contact. Catheterization of a peripheral vein was thus associated

TABLE 5. Preventive Measures That Would Have Prevented Contact with Potentially Infective Body Fluid

Procedure	Preventive Measure
Catheterization of peripheral vein	Gloves, footwear
Insertion of central venous catheter	Gloves
Arterial puncture	Gloves
Lumbar puncture of the subarachnoid space	Gloves, glasses
Catheterization of the extradural space	Gloves
Brachial plexus block, axillary approach	Gloves
Pin prick in determining level of analgesia	None
Tracheal intubation	Gloves, face mask
Tracheal extubation	Gloves, face mask
Suction from mouth, pharynx or trachea	Gloves, face mask, long sleeveess
Intramuscular injection of drug	Gloves
Prevention of hematoma formation by digital pressure	Gloves
Drawing of blood sample	Gloves
Establishing or discontinuing blood transfusion	Gloves

with a significantly higher frequency of blood with the hand region when performed in the emergency ward than when performed under optimal conditions in the operating room.

Critically ill "emergency patients" have been reported to have a higher prevalence of HIV infection than would be expected.⁹ Such critically ill patients are often bleeding on arrival to the hospital,¹⁰ and it is therefore of even greater importance to adopt precautions during emergency procedures when the critically ill patient is being received at the hospital.

A single study has investigated the procedure-related frequency of contact with patient body fluids due to needle sticks. The frequency was calculated as the number of reported needle pricks in relation to the number of different needles bought by the hospital over a given period. The reported needle prick frequency was 0.018% for "intravenous catheters."¹¹ This frequency is within the 97.5% confidence interval reported in the current study (table 1).

In conclusion:

- Performance of anesthesia procedures results in a 36% rate of contact to patient body fluids, predominantly blood and saliva.
- Saliva and tracheal secretions should be considered infective when encountered during anesthesia related procedures.
- The health-care worker is not able to predict when a specific procedure will lead to contact with blood. Therefore, procedure-related precautions are suggested.

†† Centers for Disease Control: Update: Universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B Virus, and other bloodborne pathogens in health-care settings. *Morbidity and Mortality Weekly Report* 37:377–388, 1988.

- Contact with blood occurs more often in the emergency room than in the operating room, even when the procedures performed are the same.

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