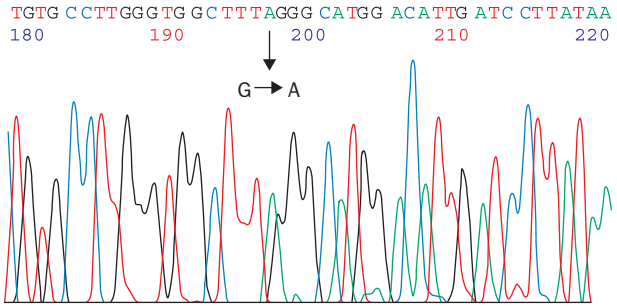

Figure 2: **Electropherogram of precore region of HBV genome showing classic G to A mutation at nucleotide 1896**
Numbers on readout refer to PCR amplicon, not whole genome.

transmission of HBV is contrary to an earlier report,[3] in which lamivudine given to three pregnant women from week 36 of pregnancy until delivery resulted in prevention of transmission of persistent HBV infection in all three newborns. Our results indicate that, despite optimum maternal therapy and neonatal vaccination, perinatal transmission can still occur.

An interesting observation in the newborn was that at birth he was HBeAg negative and carried the same 1896G→A mutation as the mother. This finding is contrary to the general belief that the HBeAg negative status develops due to sero-conversion from an HBeAg positive status. Our observations are supported by an earlier report in which an HBeAg negative strain was shown to be transmitted in the same manner.[4]

The HBsAg negative status of the infant at birth was intriguing. At 9 months of age, the HBsAg negative status could be due to the presence of a high titre of neutralising antibody or the formation of an antigen-antibody immune complex. Selection of vaccine-escape or immune-escape mutants is unlikely since the complete major hydrophilic region of the major surface antigen was found to be wild-type on direct DNA sequencing. Viral breakthrough despite adequate active-passive immunisation could have occurred because of specific allelic mutations in the maternal HBV.[5] Also, the remote possibility that the HBsAg negative status was caused by mutations in the promoter region of the surface open reading frame cannot be excluded.

Contributors

The patient and baby were under the care of S K Sarin, who diagnosed and treated them. He, with S E Hasnain, designed and supervised the investigations. L A Khan provided intellectual input and helped in data analysis. S N Kazim and S M Wakil did the experiments and analysed the data. The paper was jointly written.

Conflict of interest statement

None declared.

Acknowledgments

We thank R C Guptan for his guidance, Mohammed Iliyas Ghazi and Sunder Singh Bisht for technical assistance, and Mina Bajaj for secretarial assistance. This work was supported by grants from the Indian Council of Medical Research and Department of Science and Technology, Government of India.

1 del Canho R, Grosheide PM, Mazel JA, et al. Ten-year neonatal hepatitis B vaccination program, The Netherlands 1982–1992: protective efficacy and long-term immunogenicity. *Vaccine* 1997; **15:** 1624–30.

2 Moodley J, Moodley D, Pillay K, et al. Pharmacokinetics and antiretroviral activity of lamivudine alone or when coadministered with zidovudine in human immunodeficiency virus type 1-infected pregnant women and their offspring. *J Infect Dis* 1998; **178:** 1327–33.

3 van Nunen AB, deMan RA, Heijtink RA, Niesters HG, Schalm SW. Lamivudine in the last 4 weeks of pregnancy to prevent perinatal transmission in highly viremic chronic hepatitis B patients. *J Hepatol* 2000; **32:** 1040–41.

4 Akorea US, Green S, Lok ASF. Detection of precore hepatitis B virus mutants in asymptomatic HBsAg-positive family members. *Hepatology* 1994; **19:** 1366–70.

5 Ngui SL, Andrews NJ, Underhill GS, Heptonstall J, Teo CG. Failed postnatal immunoprophylaxis for hepatitis B: characteristics of maternal hepatitis B virus as risk factors. *Clin Infect Dis* 1998; **27:** 100–06.

Department of Gastroenterology, G B Pant Hospital, New Delhi (S N Kazim MSc, S M Wakil MSc, Prof S K Sarin MD)**; Department of Biosciences, Jamia Millia Islamia, New Delhi** (S N Kazim, L A Khan PhD)**; Department of Toxicology and Medical Elementology, Jamia Hamdard, New Delhi** (S M Wakil)**; Eukaryotic Gene Expression Laboratory, National Institute of Immunology, New Delhi** (S N Kazim, S M Wakil, S E Hasnain PhD)**; and Centre for DNA Fingerprinting and Diagnostics, Hyderabad, India** (S E Hasnain)

Correspondence to: Dr Shiv K Sarin, Department of Gastroenterology, G B Pant Hospital, New Delhi 110002, India (e-mail: sksarin@nda.vsnl.net.in)

Limited efficacy of alcohol-based hand gels

Axel Kramer, Peter Rudolph, Gonter Kampf, Didier Pittet

Alcohol-based gels have been introduced recently in many hospitals worldwide for hand antisepsis. We investigated the antimicrobial efficacy of ten gels and four rinses according to European standards (EN 1500). No gel met the EN 1500 requirements within 30 s of application, whereas all hand rinses did. The tested hand gels should be considered a retrograde step for hand hygiene because the application time in clinical practice is often shorter than 30 s; they should not replace alcohol-based liquid hand disinfectants currently used in hospitals or be implemented as first choice agents.

Lancet 2002; **359:** 1489–90

Control of hospital-acquired infections represents a major challenge to modern medicine. Nosocomial pathogens are mostly transmitted via the hands of health-care workers and hand hygiene is considered the leading preventive measure to reduce cross-transmission in health-care settings.[1]

Two different types of hand hygiene procedures can be distinguished worldwide.[1] Antimicrobial or plain soap and water is mainly used for hand hygiene in the USA, and waterless alcohol-based hand rub in many parts of Europe if hands are not visibly dirty. Arguments for the preference of waterless hand antisepsis are that it acts faster, irritates hands less often, has higher efficacy than handwashing with plain or antimicrobial soap, and can be immediately available at the bedside.[1,2] Recently, we verified the relation between sustained improvement in hand-hygiene compliance facilitated by the routine use of hand rub and reduced nosocomial infection rates.[2]

Irritant dermatitis resulting from frequent application of soaps and detergents is commonly experienced by care givers. Gel formulations have been proposed to reduce the drying effect of alcohols and potentially enhance compliance with hand hygiene, which remains almost universally low.[1,2]

Hand-hygiene agents should have antimicrobial efficacy against nosocomial pathogens prior to introduction. In Europe, the state-of-the-art protocols to test their efficacy are referred to as the European norms (EN).[3] EN 1500 is the standard by which the efficacy of waterless products such as hand rinses or gels are tested under practical conditions by comparison with the reference disinfectant (2-propanol, 60% volume per volume [v/v]) tested on *Escherichia coli* K12 (NTCC 10538).[3] The tested product should not be significantly less effective than the reference alcohol.

The antimicrobial efficacy of each product was compared with 2-propanol 60% (v/v) on artificially contaminated

Product	Active ingredients	Mean (median) reduction factor of product alcohol	Mean (median) reduction factor of reference alcohol	Difference	p
Hand gels					
Assanis pro	Ethanol (53%)	3·31 (3·28)	4·28 (4·28)	0·97	<0·01
Endure 300	Ethanol (70%)	2·13 (2·19)	4·12 (4·10)	1·99	<0·01
Gel-Hydro-alcoolique	Ethanol (60%)	4·09 (4·11)	5·07 (5·03)	0·98	<0·01
Levermed Alcohol Gel	1–propanol and 2–propanol (total: 70%)	3·87 (3·98)	4·58 (4·43)	0·71	<0·01
Manugel	2–propanol (60%) plus other antiseptic ingredients	4·07 (3·99)	4·96 (4·66)	0·89	<0·01
Microsan	Ethanol (70%)	3·36 (3·43)	4·26 (3·98)	0·89	<0·01
Prevacare	Ethanol (60%)	3·07 (3·10)	4·12 (4·10)	1·05	<0·01
Purell	Ethanol (62%)	3·07 (3·05)	4·10 (4·10)	1·03	<0·01
Spirigel	Industrial methylated spirits (70%)	3·58 (3·57)	4·68 (4·64)	1·10	<0·01
Stokosept	Ethanol (57%)	2·68 (2·59)	3·78 (3·79)	1·10	<0·01
Hand rinses					
AHD 2000	Ethanol (75%)	4·78 (4·62)	4·78 (4·89)	0	NS
Monorapid Synergy	Ethanol (54%) and 1–propanol (10%)	4·32 (4·59)	4·45 (4·51)	0·13	NS
Softaman CH	2–propanol (45%) and 1–propanol (30%)	4·88 (5·24)	4·23 (4·07)	0·55	NS
Sterillium	2–propanol (45%) and 1–propanol (30%) plus Mecetromium etilsulfate (0·2%)	4·26 (4·19)	4·10 (4·03)	0·16	NS

NS=not significant. Compounds are listed in alphabetical order. Mean (median) reduction factors are given. p values were derived using Wilcoxon's matched-pairs signed-ranks test.

Comparative efficacy of alcohol-based hand antisepsis agents with the EN 1500 reference alcohol

hands using a crossover design with 15 volunteers.[3] Eight volunteers rubbed their hands with the tested product first, and the other seven with the reference alcohol first. Hands were washed for 1 min with soft soap, dried with paper towels, immersed in the contamination fluid up to the midmetacarpals for 5 s with fingers spread, and then allowed to dry for 3 min. Fingertips were rubbed for 1 min in a petri dish containing a liquid broth (prevalues). 3 mL of the tested product were applied to the hands. Postvalues were determined immediately after the rub-in period using petri dishes containing liquid broth with neutralisers.[3] For both reference and test procedures, the log counts of bacteria from the left and right hands of each person were averaged separately for prevalues and postvalues. The arithmetic means of all individual log reduction factors were calculated. Wilcoxon's matched-pairs signed rank test (one-sided) was used for comparison ($p=0·01$).[3]

Tested hand gels and rinses contained mainly ethanol or 1-propanol or 2-propanol as active ingredients (table). The total alcohol content of the gels varied from 53% to 70% (v/v). The mean microbial reduction factors of the reference alcohol varied from 3·7 to 5·07 and those of the gels from 2·13 to 4·09. The mean reduction factor of each gel was about 1 log-step lower than that of the reference alcohol (table). The mean reduction factors of the four hand rinses tested varied from 4·26 to 4·88 and did not differ significantly from that of the reference alcohol (table).

Our data show that a 30 s handrub with a gel containing a total amount of up to 70% (v/v) alcohol is significantly less effective than a hand rub with 2-propanol 60% (v/v). Most alcohol-based hand rinses meet the EN 1500 requirement within 30 s of application,[4,5] a highly desirable prerequisite for their use in the health-care setting. The tested gels did not fulfil this criterion, whereas the rinses did.

Thus, in hospitals where most health-care workers use alcohol-based solutions that already meet the EN 1500 requirements, the introduction of any of the tested gels would be a backward step and unnecessarily lower the hygiene standard. An increased risk of cross-transmission would certainly result because the application time in daily practice averages 8–15 s and is unlikely to exceed 30 s.[1,2] The main reason for the use of gel formulation is to reduce skin irritation and dryness, but this can be prevented by the addition of emollients in hand rinses or by the use of a protective skin cream.[1]

When taking a closer look at the antimicrobial efficacy of different alcohols, it is not surprising that an ethanol content of up to 70% (v/v) is not as effective as 2-propanol 60% (v/v). In terms of bactericidal efficacy, 1-propanol can be regarded as the most effective alcohol, followed by 2-propanol and ethanol.[1] Comparison of 2-propanol with ethanol showed that the efficacy of 2-propanol 60% (v/v) is almost equivalent to ethanol 80% (v/v). Therefore, ethanol-based hand formulations should contain at least 80% ethanol (v/v). Based on our efficacy data, we do not consider any of the tested alcohol-based hand gels to be suitable for hand antisepsis in the health-care setting because their antimicrobial efficacy may be insufficient to prevent the spread of pathogens. Future ethanol-based hand gels used in hospitals should contain at least 80% (v/v) ethanol as the active ingredient and should be as effective as the EN 1500 reference alcohol within 30 s.

Contributors

A Kramer and D Pittet designed the study. D Pittet was responsible for study coordination, data collection, analysis, and writing of the paper. A Kramer and P Rudolph contributed to the project idea, laboratory analyses, and writing of the paper. G Kampf participated in data collection and writing of the paper.

Conflict of interest statement

G Kampf is a paid employee of Bode Chemie GmbH.

Acknowledgments

Bode Chemie GmbH assisted with data collection and analysis of hand rinses.

1 Rotter ML. Hand washing and hand disinfection. In: Mayhall CG, ed. Hospital epidemiology and infection control, 2nd edn. Philadelphia: Lippincott Williams and Wilkins, 1999: 1339–55.
2 Pittet D, Hugonner S, Harbarth S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet* 2000; **354:** 1307–12.
3 Deutsches Institut für Normung, European Norm 1500. Chemische Desinfektionsmittel und Antiseptika. Hygienische Händedesinfektion. Prüfverfahren und Anforderungen (Phase 2/Stufe 2), 1997.
4 CEN (European Committee for Standardization) EN 1500. Chemical disinfectants and antiseptics—hygenic handrub: test method and requirements (phase 2, step 2). Brussels: CEN, 1997.
5 Société française d'hygiene hospitaliére. Liste positive des désinfectants 2000. *Hygiéne* 2000; **8:** 73–89.

Institute for Hygiene and Environmental Medicine, University of Greifswald, Greifswald, Germany (A Kramer MD, P Rudolph MD); **Bode Chemie GmbH, Scientific Affairs, Hamburg, Germany** (G Kampf MD); **and Infection Control Programme, Department of Internal Medicine, University of Geneva Hospitals, 1211 Geneva 14, Switzerland** (Prof D Pittet MD)

Correspondence to: Prof Didier Pittet
(e-mail: didier.pittet@hcuge.ch)