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Safety of Maintaining Intravenous Sites for Longer Than 48 H

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Two years of experience with infections in intravenous (IV) therapy were studied through cohort analysis of infection surveillance records. The overall rate of infection was low compared with other published reports, but the risk of infection was related to the duration of cannulation. IVs in place for no more than 48 h accounted for 75% of all IVs and 26% of IV-associated infections, those in place for 48 to 72 h accounted for 12.5% of IVs and 23% of IV-associated infections, and those in place in excess of 72 h accounted for 12.5% of IVs, but 51% of IV-associated infections. Septicemia was associated with site infection in 20% of cases. This application of routinely obtained infection surveillance data demonstrates the ability of comprehensive surveillance programs to facilitate administrative decisions and to document subsequent quality of patient care.

The cost of frequent change in intravenous (IV) site, as well as the technical difficulties, must be weighed against the risk of IV-associated sepsis. It has been recommended that IV sites should be changed at intervals no longer than 72 h and preferably at 48 h (3, 5, 6). Different definitions of infection and methods of rate calculation make it difficult to determine the advantage of a 48-h time limit versus a 72-h limit from the literature (6). We therefore decided to review our own experience, utilizing the comprehensive data base obtained by our routine infection surveillance system.

MATERIALS AND METHODS

A comprehensive infection surveillance program has been in operation at Victoria General Hospital since late 1977. Reports of suspected infections, whether hospital or community acquired, are generated at the nursing units upon clinical suspicion of any type of infection (based upon broad but objective criteria for evaluating signs and symptoms) as well as in the laboratory upon discovery of specified findings. The inherent redundancy in this reporting system allows weekly comparison to determine reporting compliance; further, monthly random chart reviews (prevalence rounds) allow direct measurement of surveillance sensitivity (number of infections reported divided by number found during the round, multiplied by 100%) and specificity (true negatives divided by [true negatives plus false-positives], multiplied by 100%). In the case of IV-associated infection, our IV team provides a third source of case finding.

Each suspected infection is reviewed by the hospital epidemiologist, the clinical record is abstracted onto the report form, and IV-associated infection is coded if the site is purulent or if septicemia is discovered to be secondary to site infection. Cannula cultures are performed semi-quantitatively as described by Maki et al. (7); however, infection is defined by clinical evidence (purulence, cellulitis) or matching blood and cannula culture results in the case of septicemia. IV sites are prepared for cannulation with alcohol followed by iodophor and then examined daily by the nursing staff.

All surveillance records for 1978 and 1979 were reviewed to determine the frequency of IV-associated infections (total parenteral nutrition, cardiac catheters, and cut-down sites excluded). To estimate the size of the population at risk, the proportion of IVs in place for various durations was also estimated from this source of information. Since approximately one-third of reports received involve some type of hospital-acquired infection, one-third involved community-acquired infection, and one-third involved no infection and since all IV therapy patients are effectively under surveillance, review of 1,500 records from two different surveillance periods was assumed to provide a representative sample of the general hospital population at risk.

Relative risk was selected as the test statistic. To calculate the relative risk for each day of cannula duration, the attack rate for each day was divided by the attack rate for a duration of $\leq$24 h. Attack rates were calculated by dividing the number of infections discovered during each time period by a standardized estimate of the population at risk. This was obtained by multiplying the number of IVs started among the 1,500 cases reviewed by 10 (as our annual number of hospitalized patients is approximately 15,000) and then using the proportions calculated for each time period to estimate the number of IVs in place for each of those time periods. Since calculation of relative risk inherently corrects for uniform systematic bias in case detection, the absolute number of infections detected in each time period was not corrected for surveillance sensitivity (overall sensitivity of 70% and specificity of $\geq$95% had been established by prevalence rounds;

mean sensitivity for wound and skin infections is approximately 68%).

RESULTS

Almost all IVs were Teflon catheters, and the proportion in place for various time intervals is summarized in Table 1. Figure 1 indicates the number of infected IV sites as a function of duration. From the pooled data of 2 years, the attack rate for infection in cannulas indwelling for no more than 24 h is on the order of 2 to 3/10,000. With a more liberal definition of infection, the rate would still be less than 1/1,000. Compared to this base line, the infection probabilities (95% confidence interval) and the relative risks for longer periods of cannulation are as follows: ≤24 h, probability of 0.0000 to 0.0009, relative risk of 1; 24 to ≤48 h, probability of 0.0002 to 0.0014, relative risk of 3.7; 48 to ≤72 h, probability of 0.0019 to 0.0031, relative risk of 9.7; and >72 h, probability of 0.0044 to 0.0056, relative risk of 21.5.

TABLE 1. *Duration of IV cannulation*[a]

Duration of cannulation (h)	Absolute (and relative %) frequency	
	Fourth quarter, 1979[b]	First trimester, 1978[c]
≤24	345 (54)	495 (53)
>24≤48	144 (22)	192 (21)
>48≤72	82 (13)	112 (12)
>72	74 (11)	135 (14)

[a] Excludes total parenteral nutrition, cardiac catheter, and cut-down sites. The data are from the Victoria General Hospital, Victoria, British Columbia, infection surveillance records.

[b] Total, 645 among ca. 500 records.

[c] Total, 934 among ca. 1,000 records.

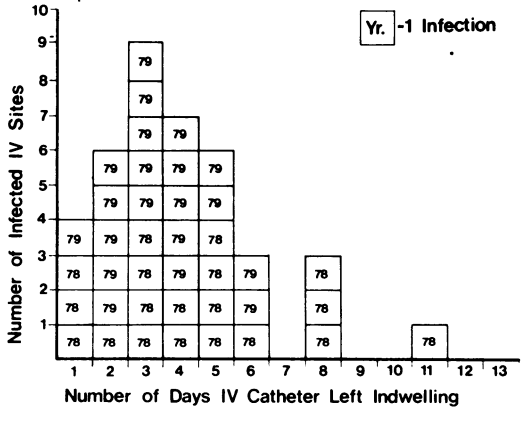

FIG. 1. *Reported IV-associated infections versus duration of IV catheterization.*

DISCUSSION

In 2 years of experience, 75% of IVs were in place for no longer than 48 h and accounted for 26% of all IV-associated infections, 12.5% were in place from 48 to 72 h and accounted for 23% of infections, and 12.5% were in place in excess of 72 h and accounted for 51% of infections. The risk of infection is very low in short-duration cannulation and rises most dramatically 1 order of magnitude by day 3. A 24-h time limit to minimize the risk of infection would suffer from the law of diminishing returns; the greatest reduction in IV-associated sepsis can be achieved by limiting duration to 48 h whenever possible, as has been recommended by a number of sources, but our most cost-effective strategy was determined to be duration limited to 72 h.

Adopting a 48-h limit would be expected to prevent approximately seven infections each year, whereas more stringent adherence to a 72-h limit would be expected to prevent approximately two infections. Only one infection out of five would be "serious" (i.e., septicemia involved), the others being relatively minor and self-limiting. Since our rate of IV-associated infection is comparatively low, the cost of providing safer care rises much more sharply than the savings accrued. The cost of IV tubing, catheters, related supplies, and additional staff to support a 48-h time limit exceeds the cost of treating one or two cases of septicemia by at least 1 order of magnitude. Our acceptably low rate of infection and the excessive cost of providing a higher margin of safety justify our selection of a 72-h limit.

Comprehensive surveillance of an institutional population utilizing objective definitions and known sensitivity and specificity can overcome the problems of transition and chronological bias as well as provide control of random error in case detection and selection of study groups. These safeguards against bias are important in surveillance programs and are important prerequisites to the use of ratios for risk estimation. Whereas the absolute risk must be kept in mind, the comparison of relative risks can be of value in evaluating institutional strategies for large populations exposed to low risk levels.

In this study, detection of cases (infected IVs) involved objective case-finding methods with uniform probability of detection among all patient groups. The estimation of the number of IVs in place is the weak point in this study, but the error introduced is self-correcting in the relative risk calculation. Inclusion of a large number of pediatric respiratory infection pa-

tients, neonates with skin infection, and patients admitted with pressure sores for conservative treatment may bias surveillance records so as to underestimate the total number of IVs started in all hospital patients. This will affect calculation of absolute risk, but not relative risk. Exclusion of short-duration IVs associated with minor surgical procedures (and patients not usually infected) would be the most likely direction of bias in the estimation of proportion of IVs in place for various durations. This implies that correction of underestimation of total number of IVs by more accurate measurement would increase the proportion in place for no more than 24 h and further increase the relative risk statistic for longer durations.

Our rate of site infection appears to be low in comparison to other published reports (2, 6). Severity of infection seems comparable, though, with septicemia associated with approximately 20% of our site infections. The risk of site infection, rather than contamination of infusate, appears to be the major factor in selecting an optimal time limit for safe IV therapy (6). None of our infections were attributed to contaminated IV fluids, and the frequency of *Staphylococcus aureus* in these infections supported the cannula rather than the fluid path as the source of infection. A matched control study would be necessary to determine whether the risk is uniform for all IV therapy patients or whether a specific type of patient is at higher risk of IV-associated infection.

Retrolective cohort studies (3) of this nature can be incorporated into routine surveillance programs. The full value of such programs can only be achieved through complete analysis of findings, and this requires utilization of a comprehensive data base rather than simply producing gross infection rates. Augmenting surveillance with electronic data processing facilitates this process and increases the value of infection surveillance and control programs in management decisions.

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