Treatment of mild immersion hypothermia by direct body-to-body contact

GORDON G. GIESBRECHT, DANIEL I. SESSLER, IGOR B. MEKJAVIĆ, MARC SCHROEDER, AND GERALD K. BRISTOW
Department of Anesthesiology, University of California San Francisco, California 94143–0618; Laboratory for Exercise and Environmental Medicine, Faculties of Physical Education and Recreation Studies and of Medicine, University of Manitoba, Manitoba R3T 2N2; and School of Kinesiology, Simon Fraser University, British Columbia V5A 1S6, Canada

Giesbrecht, Gordon G., Daniel I. Sessler, Igor B. Mekjavić, Marc Schroeder, and Gerald K. Bristow. Treatment of mild immersion hypothermia by direct body-to-body contact. J. Appl. Physiol. 76(6): 2373–2379, 1994. Body to body contact is often recommended for rewarming mildly hypothermic victims in the field. This procedure involves a eutermic individual donating heat to the recipient by direct contact in an insulated bag. However, this technique has not been critically evaluated and may not be beneficial because there is limited direct contact between recipient and donor, peripheral vasodilation may impair heat transfer to the core, skin warming may blunt the recipient’s shivering response, and cold stress to the donor may be excessive. The present study was designed to evaluate whether donation of heat by a donor would be sufficient to enhance rewarming of a hypothermic subject (recipient). Six pairs of recipients (5 men, 1 woman) and donors (2 men, 4 women) participated in the study. Esophageal and skin temperatures, cutaneous heat flux, and oxygen consumption were measured. Recipients were immersed in 8°C water until esophageal temperature decreased to a mean of 34.6 ± 0.7°C (SD). They then were rewarmed by one of three methods: rewarming by the endogenous heat generated by shivering only (SH), body-to-body rewarming (BB), or rewarming with a constant-heat source manikin (MAN). Mean afterdrop for the three conditions was 0.54 ± 0.2, 0.54 ± 0.2, and 0.57 ± 0.2°C for SH, BB, and MAN, respectively (NS), and the rate of rewarming was 2.40 ± 0.8, 2.46 ± 1.1, and 2.55 ± 0.9°C/h for SH, BB, and MAN, respectively (NS). Under our laboratory conditions, the normal increase in shivering thermogenesis early in rewarming is blunted during BB and MAN to the extent that the rewarming rates during heat donation are not greater than that during SH. BB is not an excessive thermal stress for the eutermic donor.

thermoregulation; shivering thermogenesis; heat production; heat donation; thermal manikin

MANY RECREATIONAL, commercial, and military activities require human exposure to cold air or water, leading to an overall negative heat balance and subsequent decrease in core temperature ($T_{co}$). Direct body-to-body contact with a minimally clothed eutermic heat donor in an insulated bag is often suggested for rewarming hypothermia victims (heat recipients) (2, 3, 8, 22, 25, 26). However, the efficacy of this procedure and the physiological responses of the recipients and donors have not been critically evaluated in an ethical manner.

In the field, the simplest and safest rewarming methods are either maximizing shivering thermogenesis or applying external heat from sources such as heated water bottles or rocks (22, 26), a portable STK Heatpac (17), a hydraulic sarong (heated water-filled vest) (22, 24), or possibly a warm human body (2, 3, 8, 22, 25, 26, 32). Victims of severe hypothermia ($T_{co} < ~30°C$) lose the capacity for shivering thermogenesis (5). Unless heat loss is actually decreased to below the rate of metabolic heat production, some application of external heat would be required for such a victim or $T_{co}$ would not increase. Conversely, the efficacy of external heat for victims of mild hypothermia ($T_{co} > ~30°C$) who maintain an active shivering thermogenesis is questionable because skin heating reflexly attenuates shivering (17). Therefore, an external heat source must provide enough heat to more than replace the shivering heat production it has inhibited to provide a higher rewarming rate than shivering only. For instance, a single portable STK Heatpac applied to the chest (17) or four electric heating pads applied to the neck, lateral thorax, and groin (9) do not provide any rewarming advantage over shivering only. Consequently, it is difficult to predict whether the rewarming rate during body-to-body contact would be greater than that during shivering only in victims of mild hypothermia.

Several factors suggest that heat supplied from a eutermic donor to a hypothermic victim may be ineffective. 1) The net heat loss of an adult immersed in cold water until $T_{co}$ decreases from 37 to 33°C exceeds 300 kcal. In contrast, net heat production of a resting nonshivering donor is only ~100 kcal/h (117 W) (6). 2) There is a relatively small amount (~50%) of direct skin contact (which is essential for effective heat transfer) between recipient and donor. 3) Transfer of heat from the recipient’s periphery to core will likely be minimal as a result of thermoregulatory vasodilation (14). 4) The recipient’s intrinsic shivering response may be blunted, as contact with a eutermic body warms the skin (17). One final concern is that body-to-body contact may be detrimental to the donor because of excessive conductive heat loss from the donor to the recipient.

Alexander (1) reported the only available data regarding body-to-body rewarming from studies carried out on prisoners of war in Dachau during World War II. However, these studies were grossly unethical, and the results are considered invalid and unusable because of the emaciated condition of the subjects as well as questions regarding the protocol and accuracy of results. Accordingly, we evaluated body-to-body contact as a rewarming method for hypothermia by quantifying and comparing changes in mean $T_{co}$, mean skin temperature, metabolic heat production, and cutaneous heat flux during three rewarming protocols after immersion hypothermia: 1) shivering only, 2) direct body-to-body contact with a nor-

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TABLE 1. Physical descriptors for each pair of subjects

<table>
<thead>
<tr>
<th>Subj No.</th>
<th>Sex</th>
<th>Age (yr)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BSA (m²)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>F</td>
<td>19</td>
<td>171</td>
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</tr>
<tr>
<td>2</td>
<td>M</td>
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<td>73.8</td>
<td>1.90</td>
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<tr>
<td>3</td>
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<td>80.0</td>
<td>2.00</td>
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<tr>
<td>4</td>
<td>M</td>
<td>28</td>
<td>180</td>
<td>75.5</td>
<td>1.95</td>
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<tr>
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<td>M</td>
<td>23</td>
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<td>70.1</td>
<td>1.81</td>
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<tr>
<td>6</td>
<td>M</td>
<td>32</td>
<td>185</td>
<td>79.2</td>
<td>2.03</td>
</tr>
</tbody>
</table>

Mean ± SD: 25.8 ± 4.5, 177.2 ± 5.4, 75.7 ± 3.3, 1.95 ± 0.07

Subjects in same row were paired. Note that subj 1 and 2 acted as both recipient and donor for each other. There were no significant differences between recipients and donors for any variable.

MOTHERMIC DONOR, and 3) direct contact with a thermal manikin. We hypothesized that body-to-body and manikin rewarming protocols would inhibit endogenous heat production but that the core rewarming rates would be comparable to that during shivering only.

METHODS

Subjects. With approval from our Faculty Human Ethics Committee, six sets of subjects, hereafter referred to as recipients (5 men, 1 woman) and donors (2 men, 4 women), were studied after giving informed consent. The recipients were given the opportunity to recruit their own partner to act as a donor. Two subjects acted both as recipient and donor for each other (see Table 1).

Thermal manikin. The thermal manikin was included to provide a constant heat source for all subjects, as donors did not form a homogeneous group (Table 1). The manikin consisted of two cylindrical sections of vulcanized rubber approximating the torso and legs. Each was 65 cm long and 30 cm in diameter and had a water inlet near each end. The sections were connected in series such that water was pumped from a temperature-controlled reservoir at a flow rate of 1 l/min to enter the head end of the upper section and exit the foot end of the lower section. Reservoir temperature was adjusted so surface temperature (see below) of the upper section approximated mean skin temperature of resting subjects lying in a sleeping bag (~35.5°C).

Instrumentation. Esophageal temperature (Tₑ) was measured by an esophageal thermocouple positioned at the level of the heart, since this site provides the best noninvasive representation of core blood temperature (10, 20). Cutaneous heat flux (in W/m²) and temperature (in °C) were measured from seven sites by thermal flux transducers (Concept Engineering, Old Saybrook, CT). The transducers were calibrated using a Rapidk instrument (Dynatech, Cambridge, MA) according to the method of Ducharme et al. (13). Flux was defined as positive when heat traversed the skin toward the environment (30). Transducers were situated to provide a more accurate analysis for the major areas of surface contact (i.e., recipient front to donor back; see Protocol). Accordingly, two transducers were placed on the recipient anterior torso (chest and abdomen) and on the donor or manikin posterior torso (upper and lower back). One transducer was placed on the recipient posterior torso (back), and the other was placed on the donor or manikin anterior torso (chest). Body surface area (BSA) was calculated [area (m²) = weight (kg) × height (cm) × 0.007184], and the following regional percentages were assigned based on those of Layton et al. (23): 1) recipient: 6 head, 9.5 chest, 9.5 abdomen, 19 arms, 19 back, 19.5 thighs, and 17.5 calves; 2) donor: 6 head, 19 chest, 19 arms, 9.5 upper back, 9.5 lower back, 19.5 thighs, and 17.5 calves; and 3) manikin: 15 bottom (contacting mattress), 9 upper back, 9 lower back, and 17 chest (torso section) plus 15 bottom (contacting mattress), 17.5 back, and 17.5 front (leg section). Flux values from each transducer (in W/m²) were then converted into watts per region (flux at region (W) = transducer flux (W/m²) × BSA (m²) × regional percentage × 0.01).

Serial data from the thermocouples and thermal flux transducers were acquired using an electrically isolated Macintosh IIci computer. Data were scaled using appropriate corrections and, where applicable, the calculated BSA. At 30-s intervals the results were averaged for the preceding 30-s period, displayed graphically on the computer screen, and recorded in spreadsheet format on a hard disk. The process was controlled by a "virtual instrument" written using LabVIEW II graphic signal processing software (National Instruments, Austin, TX).

Recipient oxygen consumption (VO₂) was measured with an open-circuit method from measurements of expired minute volume and inspired and mixed expired gas concentrations sampled from a mixing box. During the body-to-body contact protocol, donor VO₂ was measured with a Sensormedics (Horizon) Metabolic Measurement Cart. Subjects wore a snugly fitting face mask with a one-way valve that was connected to the appropriate instrumentation by a suitable length of lightweight flexible tubing. VO₂ was also converted to heat production by setting 1 l O₂/min equivalent to 352 W (15). Single-channel electrocardiogram and heart rate of recipients were monitored on a Hewlett-Packard monitor defibrillator.

Protocol. Each recipient was cooled on three occasions separated by at least 7 days. They were instructed to abstain from alcohol or medications for the 24 h before each study. On the day of the study the recipient (and donor when present) dressed in swimsuits, and monitors were attached in a room at an ambient temperature of 22°C. The water immersion portion of the study was identical for all trials. The subject sat quietly for a period of 10 min, during which baseline values for heart rate, Tₑ, VO₂, skin temperature, and heat flux were established. Recipients were then immersed to the neck in stirred water at 8°C. They remained in the water until they wanted to terminate immersion, a physician advised exit for safety reasons, a time of 70 min elapsed, or Tₑ reached 33.5°C. For comparative purposes, the immersion time and removal Tₑ for each recipient was kept similar in each of the three trials.

After exiting the cold bath and light towel drying, each recipient was rewarmed by one of three techniques: 1) shivering in a supine position inside a single sleeping bag (shivering only), 2) direct contact between the recipient’s front and a donor’s back inside a double sleeping bag (body to body), or 3) direct contact of the recipient’s front to the constant-heat source manikin inside a double sleeping bag (manikin). Both front-to-front and front-to-back body-to-body combinations were tested. The lat-
ter position was adopted because 1) it ensured more direct surface contact, especially when partners were unfamiliar with each other or of the same gender; 2) it was easier for the pair to fit inside the double sleeping bag; and 3) this combination is more likely to be used in the field situation. During the latter two protocols, the donor or manikin was inside the sleeping bag throughout the recipient’s immersion. The order of the trials was randomly assigned.

Rewarming procedures for subjects who exited the water at a \(T_{es}\) of \(<34.0^\circ C\) terminated when \(T_{es}\) recovered to 35.5°C. Subjects who exited at a \(T_{es}\) of \(\geq 34.0^\circ C\) continued treatments until \(T_{es}\) increased to 36.0°C. In each situation, enough data were collected to establish a clear linear rate of rewarming (see below). The recipients then were immersed in warm (38°C) water where they remained until \(T_{es}\) rose to 37.0°C (~25 min).

Data analysis. The following variables were calculated for each protocol: afterdrop (difference between \(T_{es}\) on exit from cold water and its nadir), length of afterdrop period (time between exit from cold water until \(T_{es}\) returned to original exit \(T_{es}\)), rate of rewarming (calculated by linear regression for \(T_{es}\) data during linear increase after the \(T_{es}\) nadir), net cutaneous heat transfer, mean skin temperature, and metabolic heat production. \(T_{es}\) for the immersion portion of the trials was plotted at 12.5, 7.5, and 2.5 min and immediately before exiting the cold water. \(T_{es}\) was then plotted at times corresponding to the \(T_{es}\) nadir, the end of the afterdrop period, and the time midway between these two periods. Subsequent data were plotted at 5 min intervals after the end of the afterdrop period. Data for skin temperature, heat production, and heat flux were plotted in a similar manner except that the first point, just before exit, represented the mean of the last 5 min of immersion. Data for the three trials were compared using repeated-measures analysis of variance. Post hoc analyses for significant differences between treatments were accomplished using Tukey's test. Results are reported as means ± SD; \(P < 0.05\) identified statistically significant differences.

RESULTS

Mean \(T_{es}\) values during the latter portion of cold water immersion and subsequent rewarming are plotted for the three conditions in Fig. 1. There were no significant intercondition differences in \(T_{es}\) at any time. Results for recipients during shivering only, donor contact, and manikin contact were, respectively, afterdrop: 0.54 ± 0.24, 0.54 ± 0.23, and 0.57 ± 0.23°C; length of afterdrop period: 19.4 ± 6, 19.8 ± 8, and 18.8 ± 5 min; and rate of rewarming: 2.40 ± 0.8, 2.46 ± 1.1, and 2.55 ± 0.9°C/h. None of these values differed significantly among the treatments.

Recipient mean skin temperature increased significantly \((P < 0.05)\) within the first ~6 min (time of \(T_{es}\) nadir) of all rewarming protocols and continued to increase gradually during the remainder of rewarming (Fig. 2). Skin temperature was higher during donor contact than during shivering only and manikin contact by ~2°C \((P < 0.05)\) and 1°C (NS), respectively. Although there was an initial 1°C decrease in mean donor skin and manikin surface temperatures, skin or surface temperature gradually returned to baseline values by the end of rewarming. Manikin surface temperature was consistently ~1°C higher \((P < 0.05)\) than donor skin temperature.

During all three rewarming protocols, recipient metabolic heat production at the \(T_{es}\) nadir (~6 min) was unchanged from end-immersion values (Fig. 3). Heat production then increased significantly over the next ~7 min (time midway between nadir and end of afterdrop period) during the manikin contact and shivering only protocols \((P < 0.05)\). After ~19 min of rewarming (end of afterdrop period), heat production remained elevated during the shivering only protocol but was not different from end-immersion values in the other two protocols. At this point and over the next 5 min, heat production was greater during shivering only than during body-to-body rewarming \((P < 0.05)\). Donor heat production increased by 20 W initially \((P < 0.05)\) and subsequently remained elevated by 10 W throughout rewarming.

Recipient cutaneous heat loss decreased substantially on exiting the cold bath in all protocols \((P < 0.05);\) Fig. 4). Heat flux subsequently tended to increase; this increase was significant only in the body-to-body protocol \((P < 0.05)\). Total heat flux was greater during the shivering only protocol than during the other two methods by 75–128 W initially and by ~60 W throughout the remainder of rewarming \((P < 0.05)\). Manikin and donor heat flux had similar patterns: after an initial increase of ~70 W \((P < 0.05)\), flux during the later rewarming periods returned to near baseline values. There were no significant differences between the manikin and donor heat flux values.

The major areas of surface contact were the recipient’s anterior torso (chest and abdomen), the donor’s posterior torso (upper and lower back), and the upper and lower back of the manikin torso section. Surface temperature and cutaneous heat loss from these areas are presented in Figs. 5 and 6, respectively. Recipient anterior torso skin temperature was similar during donor and manikin contact (Fig. 5). Skin temperature was greater
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During these protocols than during the shivering only protocol by 2°C initially and by 3.5°C after 30 min of rewarming (P < 0.05). Posterior torso surface temperatures for the donor and manikin were also similar during rewarming; they decreased initially by 2.5°C (P < 0.05) and subsequently increased by ~2°C (P < 0.05) during the remainder of rewarming. Recipient anterior torso flux was greater during the shivering only protocol than during donor and manikin contact by 9 W initially and by 6 W after 30 min of rewarming (P < 0.05; Fig. 6). The initial transient increase in posterior torso heat flux was greater in the manikin (13 W) than in the donor (7 W; P < 0.05). Subsequently, donor and manikin flux values decreased to near baseline values.

**DISCUSSION**

Although direct body-to-body contact has often been recommended for treatment of hypothermia victims, the efficacy of this procedure and the physiological responses of the recipients and donors have not previously been quantified. Our data indicate that external rewarming, requiring direct contact of a hypothermic recipient with a euthermic donor or thermal manikin, does not increase T, faster than the endogenous heat production of shivering only.

Numerous studies have evaluated the rewarming efficacy of external heat application. Results of these studies vary depending on the amount of heat delivered and the surface area used. Heating pads can be considered small-to-moderate sources of heat because of limited heat production in combination with limited surface area coverage. Studies using a single portable STK Heatpac (17) or four electric heating pads (9) have shown no differences in afterdrop or rewarming rates compared with shivering only. Conversely, warming was accelerated when greater sources of heat covering large portions of the body were used (12, 20, 21, 24, 27, 28). Compared with shivering only, afterdrop is greater during immersion in a water bath with water temperature slowly increased from 26 to 42°C (20). There is no difference in afterdrop when 40-43°C water is pumped through a piped suit (24), and af-

**FIG. 2.** Mean surface temperatures for recipients and (when applicable) donors and manikin during Sh, BB, and Man. Values are means ± SD. First point, plotted just before exit, represents mean of last 5 min of immersion (exit time = 0 min). For each protocol, temperatures are then plotted at times corresponding to T, nadir and end of afterdrop period. Subsequent data are plotted at 5-min intervals after end of afterdrop period for each protocol. Significantly different (P < 0.05) between: * BB and Sh; ** Man and BB; † consecutive periods for all protocols.

**FIG. 3.** Mean oxygen consumption (Vo2) and heat production for recipients and (when applicable) donors during Sh, BB, and Man. Values are means ± SD. First point, plotted just before exit, represents mean of last 5 min of immersion (exit time = 0 min). For each protocol, results are then plotted at times corresponding to T, nadir, time midway between nadir and end of afterdrop period, and end of afterdrop period itself. Subsequent data are plotted at 5-min intervals after end of afterdrop period for each protocol. Significantly different (P < 0.05) between: * Sh and BB; † Sh and end-immersion value; ‡ Sh and end-immersion value and also Man and end-immersion value; ††† BB and end-immersion value.
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**FIG. 4.** Mean total surface heat flux for recipients and (when applicable) donors and manikin during Sh, BB, and Man. Values are means ± SD. First point, plotted just before exit, represents mean of last 5 min of immersion (exit time = 0 min). For each protocol, heat flux is then plotted at times corresponding to $T_m$ nadir and end of afterdrop period. Subsequent data are plotted at 5-min intervals after end of afterdrop period for each protocol. Significantly different ($P < 0.05$) between: * Sh and other 2 protocols; † end-immersion values for all protocols; ‡ consecutive periods for BB.

The lack of any significant effect of body-to-body rewarming on the postexposure decrease in $T_{co}$, commonly referred to as afterdrop, is not surprising considering the factors known to influence this phenomenon. Afterdrop depends on 1) continued loss of core heat into cold peripheral tissue via conduction (19, 31), 2) core heat lost into colder peripheral tissue by blood convection (7, 16), and 3) heat produced by metabolism, which counteracts heat lost to peripheral tissues. The use of external heat sources in this study (donor or manikin) would most likely affect only the latter two factors. To affect the afterdrop by altering the magnitude of heat extracted from the blood by the colder peripheral tissues, the tissue perfusion would have to increase significantly. However, skin blood flow would change little with moderate peripheral warming because flow is largely determined by central thermoregulatory status at skin temperatures between 20 and 35°C (29). Skin blood flow presumably was minimal in our study because the recipients were hypothermic (11). The reflex inhibition of shivering activity as a result of peripheral warming could have opposing effects on afterdrop. Because of the tight coupling between muscle activity (i.e., shivering) and blood flow (4), peripheral muscular flow would be expected to decrease along with shivering during donor or manikin contact. This factor would tend to attenuate the afterdrop in these two protocols. In contrast, decreased peripheral (muscular) heat production might increase afterdrop. It seems that, under the present conditions, these opposing factors were of comparable magnitude with the result being no difference in afterdrop during donor or manikin rewarming compared with shivering only.

As detailed earlier, greater sources of external heat applied to large portions of the body inhibit shivering heat production but also provide sufficient heat to speed rewarming (12, 20, 21, 24, 27, 28). We hypothesized that the amount of external heat supplied by the human donor or...
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FIG. 6. Mean heat flux for recipient’s anterior torso and (when applicable) donor and manikin’s posterior torso during Sh, BB, and Man. Values are means ± SD. First point, plotted just before exit, represents mean of last 5 min of immersion (exit time = 0 min). For each protocol, heat flux is then plotted at times corresponding to Tnadir and end of afterdrop period. Subsequent data are plotted at 5-min intervals after end of afterdrop period for each protocol. Significantly different (P < 0.05) between: * Sh and BB and also Sh and Man; ** BB and Man; † consecutive periods for all protocols.

One other concern addressed by this study is the effect of this protocol on the human donor. Our data indicate that this procedure does not present a serious thermal stress to a euthermic donor. Although donor back temperature (Fig. 5) initially decreased on contact, there was a gradual increase throughout the remainder of rewarming. As expected, a 1°C decrease in mean skin temperature increased metabolic heat production (20 W), although shivering was not observed. It is important to remember that these were optimal conditions for the donors. They were not previously exposed to cold, as might be the case in a field situation, and the ambient conditions almost certainly were better than would be encountered in the field. Less favorable field conditions may render this procedure potentially harmful to human donors, particularly if they are themselves mildly hypothermic.

Because body-to-body contact does not provide a distinct rewarming advantage over shivering only, the resource requirements for this protocol may make it unnecessary for mildly hypothermic recipients who are otherwise healthy (i.e., immersion hypothermia) and vigorously shivering. First, implementation of the body-to-body protocol eliminates the possibility of manual victim evacuation to a medical facility during rewarming. Shelter size must be increased to accommodate the donor and the extra insulative bag. This procedure also occupies one member of the rescue team who may be more effectively deployed in other activities, including site preparation and maintenance, victim evacuation, or seeking rescue assistance. Also, if the donor were colder, then heat donation to the victim would be less effective. Under such conditions, the victim rewarming rate may actually be attenuated. Finally, the neck seal is greatly compromised when two sleeping bags are joined. This might decrease insulation effectiveness in cold ambient conditions.

Despite the above arguments, there may be some indications for implementing body-to-body rewarming. Maximal shivering may not always be possible or desirable. Shivering thermogenesis is absent or greatly diminished in victims with severe hypothermia, impaired thermoregulatory control (resulting from old age, alcohol ingestion, head or spinal injury, etc.), and diminished metabolic energy substrates (i.e., as a result of chronic cold exposure and physical stress). Furthermore, a shivering only protocol may be undesirable in selected victims having diminished cardiovascular or respiratory reserves. Body-to-body rewarming could also provide a psychological benefit to a victim. Therefore, all of these factors and the number of rescue personnel available should be considered when deciding whether to use this technique.

A thermal manikin was used to provide a constant heat source because of the heterogeneous characteristics of the donors. Figures 2 and 4–6 indicate that the manikin closely resembled the donors, although there was a consistently small difference in mean surface temperature. There was a 2°C surface temperature gradient from upper to lower body in the donors. However, the corresponding difference between the torso and leg sections of the manikin was only ~0.3°C. Therefore, although the torso surface temperatures were similar (Fig. 5), mean temperatures were consistently 1°C higher in the manikin. Finally, the recipient surface area of contact was
likely similar with the donor and manikin. Because there were virtually no differences in afterdrop or rewarming rates among the three treatments, differences in donor characteristics need not be a limiting factor in future studies of this kind.

In conclusion, recipient shivering thermogenesis was blunted by donor contact with the resultant rewarming rate identical to that during shivering only. The implications of our findings are that mildly hypothermic victims who are otherwise healthy and vigorously shivering can simply be removed from the cold stress to a dry insulated environment (i.e., a sleeping bag). In contrast, victims who are not shivering because of severe hypothermia, impaired thermoregulatory control, or depleted metabolic substrates should be evacuated to a medical facility immediately. If logistical considerations prevent evacuation, then the victim must then be warmed by any available external heat source, including direct contact with another human.

This study was supported by Augustine Medical Inc., Manitoba Health Research Council Grant 3123, National Sciences and Engineering Research Council of Canada, and National Institute of General Medical Sciences Grants GM-39723 and GM-49670.

Address for reprint requests: G. G. Giesbrecht, Laboratory for Exercise and Environmental Medicine, 102 Frank Kennedy Bldg., Univ. of Manitoba, Winnipeg MB R3T 2N2, Canada.

Received 4 June 1993; accepted in final form 10 January 1994.

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