Short report

Residual tactile sensitivity with self-directed stimulation in hemianaesthesia

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SUMMARY A case of hemianaesthesia caused by right hemisphere stroke was found to have good sensitivity and cutaneous localisation when she touched her impaired hand with her good contralateral hand or with a probe held by that hand. The capacity did not depend solely upon movement or positioning of her right arm, and she could also discriminate whether her own left fingers, as opposed to someone else's inter-digitated fingers, were being touched, but only when she did the touching. Thus, the threshold of the impaired hand appeared to be markedly affected by active involvement of the contralateral limb in delivering the stimulus.

We report here evidence of a surprising degree of residual cutaneous sensitivity in a patient clinically rendered severely hemianaesthetic as a result of stroke.

Case report

A 56 year old woman was admitted to the Radcliffe Infirmary, Oxford, on 1 November 1985 following an inferior myocardial infarct and right cerebrovascular accident. A CT scan revealed an extensive infarct involving the frontal, parietal, and temporal area of the right hemisphere (fig). Her condition was further complicated on 13 November 1985 by a left deep vein thrombosis and a probable extension of her myocardial infarct on 21 November 1985. She was known to have been hypertensive for years and had already had a milder infarct in January 1985, when a scan indicated involvement limited to the right parietal region. She was admitted to the Rivermead Rehabilitation Centre on 6 January 1986. Examination revealed left visual inattention as well as fifth, seventh, and tenth nerve palsies. There was a severe left-sided hemiplegia with no active movement of the upper limb. She was discharged from Rivermead on 21 March 1986, when her general condition had improved, but sensation and proprioception appeared to be totally absent on her affected side except for some response to deep pressure.

Results

On conventional testing with von Frey hairs or other cutaneous stimuli on her left hand she was found to be very insensitive. She never responded to a hair of less than 0.6 mm diameter (force of 35 g) when applied by the experimenter. With larger sizes, she very occasionally responded but showed very rapid adaptation and unreliability, as described classically by Head. She also showed a considerable reluctance to make forced-choice guesses as to which finger had been stimulated with externally applied and unfelt von Frey hairs. On the fingers of her good hand she showed normal sensitivity.

During one of the breaks in routine tactile testing for another purpose, we noticed her rubbing her inert and insensitive left hand with the normal right hand. She was asked if she felt anything, and somewhat to our surprise she said she did. She quietly and insistently maintained that she had feeling in her left hand when it was touched by her own right hand. Therefore we set out to investigate this claim. She was tested on five occasions bridging a period of just under 3 months, starting approximately 3 months after her last stroke. A third researcher was always present (Mr Peter Halligan).

With her eyes closed and head turned away (in this and all subsequent tests), the second finger of her right hand was directed by one of us (LW) to one of the fingers of her left hand and moved gently three times over its distal pad. She was asked to indicate
which finger of the left hand was being stimulated, in
two blocks of 16 trials each, in a pre-arranged ran-
dom order. She was extremely accurate. The rank
order correlation between finger stimulated and finger
identified was 0.839 (p < 0.0001). She remarked that
she “felt something definitely every time.”

In order to control for proprioceptive and posi-
tional cues from her right arm, in all further tests her
left hand was positioned so that the finger to be stim-
ulated always fell directly under the stimulating right
hand finger. This was done by one of us (DZ) inter-
digitating his fingers between the fingers of her left
hand. Her hand was placed palm upwards upon his
inter-digitated hand which, in turn, rested on a soft
pillow. A third person elevated her right elbow
slightly to ease the movement. Under these condi-
tions, the accuracy over three blocks of 16 trials each
was not quite as good, but nevertheless highly
significant (r = 0.677, p < 0.0001). Immediately
afterwards an experimenter’s finger stimulated her
left fingers in the same manner, with her right arm
resting, and in 32 trials she replied that she felt
nothing at all in 24 trials, and in the other eight her
response was non-veridical: she said it felt as though
the palm of her hand had been weakly stimulated. In
a subsequent test she “felt” 47 out of 48 times when
stroked by her own right finger, but on a number of
occasions when stimulated in the same manner and
approximately the same pressure by the experimenter,
felt nothing at all except on a few occasions, when
rapid adaptation and non-veridical responding
occurred.

Over the 3 months she was tested, her performance
gradually deteriorated slightly, but we were able
to carry a number of tests, with the following
conclusions.

(1) Good performance did not depend solely upon
movement or positioning of her right arm such as to
approximate contact with her left hand. This was
tested by having her “stroke” with her right arm, but
with the experimenter’s (LWs) finger inter-posed so
that it and not her own finger made the actual contact
with her left hand. She felt nothing in 16 trials, and
remarked that she had “received no information at
all.”

(2) Good performance did not depend critically upon
direct skin-to-skin contact. When she stroked with a
blunt pen-top held in her right hand, she could iden-
tify the finger of her left hand to which it had been
directed (r = 0.733, p < 0.0003, 32 trials). Similarly,
if she stroked with a von Frey hair (diameter
0.96 mm) or a thimble upon the finger of her right

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Fig 1  CT scan on 7 November 1985, 14 weeks before initiation of tests
hand, she reported feeling it on every trial but one (out of 48), but hardly ever if the same was done by
the experimenter (four times out of 48).
(3) Good performance did depend upon her left finger
being touched. With the experimenter’s fingers inter-
digitated between the fingers of the left hand, the
patient’s middle finger of the right hand was directed
*either* to one of her own left hand fingers or to the
experimenter’s fingers in a pre-arranged random
order. She correctly identified whether it was one of
her fingers or DZs fingers on every trial out of 32.
When this was done by her right hand stroking with
von Frey hair (diameter 0.96 mm), she correctly
assigned it to DZs fingers on every trial (out of 32).
When it touched her own fingers, she was correct 15
out of 32. While not perfect, the discrimination is
highly significant (p < 0.005, \( \chi^2 \)). Again, no such dis-
trernination was possible when the action was directed
by the experimenter stroking with the von Frey hair.
In all but one trial out of 32 she assigned the touch to
DZs fingers, although on 16 occasions it had been to
her own hand.
(4) The performance was affected by the stimulus
applied to the left hand. In the test procedure just
mentioned in (3) above, she did not perform at above
chance when she used her right middle finger with a
thimble upon it. Nor was her performance good when
she stroked with the finger nail of her right middle
finger (correctly assigned all of the stimuli that
touched DZs finger, but only six out of 16 to her own
fingers). While this is still highly significant (p <
0.009, Fisher’s exact test), when she stroked with the
flat of her right hand finger, she was virtually perfect
again (only one error out of 32).

**Discussion**

Thus, an impressive degree of residual cutaneous sen-
sitivity appeared to be present provided she was
actively involved in touching her impaired hand or
directing an object to it and an adequate stimulus was
used. The sensitivity is highly unlikely to be based
upon proprioceptive cues from her right arm. Nor
does it derive from the indirect reaction upon her
right hand from the pressure placed upon the left
hand, because she could discriminate whether the
stimulus occurred to her own fingers or the inter-
digitated fingers that were not her own.

There are some physiological findings consonant
with these observations. Sakata et al\(^2\) described
“matching” neurons in area 5 of the unanaesthetised
monkey that were driven maximally by bringing two
separate parts of the body into contact. Coquery\(^3,4\)
also described changes in skin sensitivity of the finger
tip in man caused by finger flexion. While ipsilateral
flexion was inhibitory, it was reported that facilitation
could sometimes be obtained when the flexion
occurred contralaterally.

Many questions remain to be explored in this
patient (who, however, is not available for testing
since her discharge) and others. Is an active command
signal necessary to activate the insensitive hand? An
apparatus has been designed to allow a better exami-
nation of this question. The threshold of another
cutaneous phenomenon can be changed markedly by
such active self-imposed stimulation.\(^5\) Another ques-
tion is whether the normal hand must obtain some
cutaneous feed-back, or whether a command move-
ment itself would suffice. Again, does the phenom-
enon depend upon a particular combination of joint
positioning and contralateral skin contact (as with
Sakata’s “matching” neurons), or would simulta-
eneous stimulation of skin on both sides of the body
be sufficient? Does the cooperation of the contralateral
parts of the body require roughly mirror symmetric
regions to be involved? Would the phenomenon also
be seen on other regions of the body surface? Would
sensitivity occur if the inert impaired hand were
moved to make contact with the good hand fixed in
position?

Nothing can now be said about the frequency of
occurrence of such a phenomenon, for which we can
discover no previous clinical reports. But given that
the patient had a common and unremarkable clinical
history of severe hemianaesthesia plus hemiplegia,
with an extensive unilateral lesion, it seems likely that
the phenomenon seen in her may not be unique.

**References**

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