Both rectal paraldehyde and avertin in basal anaesthetic doses were first tried to control the spasms, but were unsatisfactory because they were not retained. Pentothal, in doses of 0.25 g. intravenously, was then used as a temporary expedient, but was not very successful. Intramuscular paraldehyde in doses of 3 c.cm. was now tried, and as it proved extremely effective it was continued as required for the control of spasms until Oct. 6. For the first few days a dose of 2 or 3 c.cm. was given twice every 24 hours, and later once. To combat the increasing dehydration, an intravenous drip was started on Sept. 28 and was continued for 48 hours, the needle being kept in the vein by a plaster-of-Paris splint to the forearm.

On Sept. 29 the temperature rose to 103°, the pulse to 160, and the respirations to 45. The chest was very bubbly, cyanosis was present, and it was clear that pneumonia would be likely to supervene. Sulphathiazole was therefore given, first by drip and afterwards by mouth, until Oct. 5, to a total of 26 g. The child's condition, which was critical, showed slight improvement on Oct. 2, reflex convulsions became easier to control, and he was able to take fluids by the mouth. His condition then gradually improved, reflex spasms having ceased by Oct. 8 and the tonic rigidity by Oct. 25. He was discharged well on Oct. 30.

Comment

Local tetanus occurs in mild cases most commonly after prophylactic antitoxin has been given. Usually the local signs occur in the injured limb before any generalized symptoms appear. In head wounds, paralysis or spasm of cranial nerves, particularly the 7th and sometimes the 3rd, 6th, and 9th, is another manifestation of local tetanus. It is an important warning that generalized tetanus will almost certainly develop and an indication for giving antitoxin with the utmost dispatch without waiting for trismus or other generalized signs to appear. The work of Abel *et al.* (1938) suggests that local tetanus is caused by toxin absorbed from the wound affecting the motor nerve endings locally before toxin carried round in the blood stream has had time to produce its effect on the motor nerves generally or to involve the synapses in the brain and spinal cord.

In Case I the signs of local tetanus in the wounded limb were very slight when the signs of generalized tetanus were marked, and it was only after antitoxin had been given that the local tetanus developed to an intense degree, persisting throughout the whole illness and even longer than the signs of tetanus in other parts of the body. It is perhaps worth noting that local tetanus of the type described in this case probably occurs without any detectable signs or symptoms of generalized tetanus later. The following is an example of such a case.

An agricultural labourer aged 55 attended the out-patient department complaining of stiffness and rigidity of the left arm from fingers to shoulder. There was very little pain. Over his hand and forearm were numerous small scabs, which appeared to be some weeks old. The condition had come on gradually over a period of about a fortnight and passed off in the same time. There is a strong probability that this was an example of local tetanus in which the absorption of toxin from very slight wounds had been too small in amount to produce any generalized symptoms. The diagnosis in this case could not be confirmed because the scabs had dried up by the time the patient was seen.

Case II is an example of severe tetanus with a period of onset of not more than 36 hours. The whole march of the disease in its early stages suggested a very bad prognosis. The case is described to illustrate the use of three measures which proved particularly helpful in treatment—namely, (1) intramuscular paraldehyde to control reflex convulsions and promote sleep; (2) a plaster-of-Paris bandage to keep the needle of the intravenous drip in the vein during the period when convulsions were frequent and severe; (3) the early administration of sulphathiazole when the possibility of lung infection was threatening. For the first two suggestions I am indebted to my house-physician, Dr. E. Counsell.

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TIBIAL BONE-MARROW TRANSFUSIONS IN INFANTS

BY

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This paper records our experience with transfusions into the marrow cavity of the tibia in small children, using the apparatus described by Janet Gimson (1944). We have employed this method of administering fluids as an alternative to intravenous therapy during the past 9 months, and are now setting out details of 35 consecutive transfusions. The total number of patients was smaller, as more than one transfusion was given to the same child in several instances. Nearly all the patients were suffering from dehydration due to gastro-enteritis.

Notes on Technique

In this series we have used the technique described by Gimson, and it will be sufficient merely to enumerate some points in which we have deviated from her technique.

The legs are most satisfactorily held by firmly bandaging the soles of the feet to a padded splint so that they are about 9 in. apart, the ends of the splint being tied to the sides of the cot. This allows some movement of the legs but prevents the needle from being dislodged; and nursing is made easier because the splint is well away from the napkin area. Full surgical precautions—mask, sterile gown, and gloves—are taken against sepsis, and the skin is cleaned several times with spirit, then covered with sterile gauze until the needle is inserted. The choice of needle is not always easy, because of the difficulty of judging the thickness of the subcutaneous tissues and of the tibia itself. The most common mistake is to use too large, not too small a needle.

The site chosen is on the flat subcutaneous surface of the tibia, at least 1 in. below the level of the tibial tuberosity. Repeated post-mortem examination showed that even in the smallest infants there is a wide marrow cavity extending almost half-way down the tibial shaft, and it is reasonable to avoid the epiphysal region by a wide margin. No local anaesthetic is used for the insertion of the transfusion needle. The trauma inflicted by the needle seems to be very little more than that occasioned by an injection of novocain, and the pain is purely momentary.

The adapter connecting the needle to the giving set is not entirely satisfactory. It would seem to need redesigning, as in its present form the junction with the needle is easily loosened and will sometimes leak in an annoying way. We have used several adapters which we made from cork and rubber tubing, and have found them quite satisfactory. A heat-cradle is useful in at least two ways: it keeps the bedclothes from touching the needle and its tubing, and can be used to warm up the leg if the drip runs slowly.

The Transfusion

Saline, glucose-saline, Hartmann's solution, and half-strength serum have been given with good results. The rate of flow is usually fast enough to meet the child's total fluid needs, but we have used transfusions more often merely to supplement fluid taken by mouth. The amounts given are shown in the accompanying Table. It was soon found that the drip usually needed slowing to prevent the development of local oedema. The unrestricted rate of flow bears a fairly direct relation to the weight of the child and to the degree of dehydration, the fluid running faster with the heavier child and the greater dehydration, and slowing down automatically as body fluids become replenished. This is in contrast to intravenous transfusion, in which the rate tends to be unpredictable. The cause for this difference seems to be that, whereas in intravenous transfusions the rate of flow is determined by the height of the hydrostatic pressure and the size of the lumen of the vein, the ease of absorption of the

The Therapeutic Research Corporation of Great Britain has elected the following officers for the year 1945: Chairman, Board of Directors, Lord Trent (Boots Pure Drug Co. Ltd.); Deputy Chairman, Dr. F. H. Carr (British Drug Houses Ltd.); Chairman, Research Panel, Mr. F. A. Robinson (Glaxo Laboratories Ltd.); Deputy Chairman, Dr. C. H. Kellaway (Wellcome Foundation Ltd.).

transfused fluid through capillary walls plays an important part in determining the speed of a bone-marrow transfusion.

If the needle becomes blocked it can be freed by sucking through it a very small amount of fluid with a 2-ml. syringe.

Summary of Cases

Case No.	Age	Length of Needle (in.)	Time of Running (hours)	Quantity Given (fl. oz.)	Reason for Abandoning Drip	Remarks
1	5/12	3/8	5	15	Death	Child moribund on admission. Drip delivered 10 fl. oz. in 2 hours though slowed
2	6/12	3/8	30	40	"	Drip started at 30 drops per minute and speeded up
3	8/52	3/8	4	15	Oedema	Needle too big for child
4	8/52	1/4	9		"	Needle loose after 9 hours; ? reason
5	9/52	1/4	26	30	"	Oedema after 24 hours. Drip stopped. Oedema subsided in 6 hours; returned 2 hours after restarting
6	5/12	1/4	10	47	"	Very small baby for age. Drip probably too rapid
7	5/12	1/4	12	60	Needle blocked	Completely satisfactory
8	5/12	1/4	24	16	"	Ran very slowly all the time and was inclined to stop
9	2/12	3/8	24	30	"	—
10	5/12	1/4	60	50	Death	Needle cleared 4 times
11	6/12	1/2	36	40	Improvement	—
12	6/12	1/2	60	50	Needle blocked	—
13	6/52	1/4	60	60	Death	—
14	8/52	1/4	—	—	Oedema	Drip unsuccessful from start. Needle probably not in medullary cavity
15	8/52	1/4	62	70	Oedema	Case of pyloric stenosis. Child taken to and from operating theatre with drip <i>in situ</i> . Developed osteomyelitis of tibia
16	9/52	1/4	36	35	"	—
17	4/52	1/4	16	20	Needle blocked	Case of pyloric stenosis. Taken to and from operating theatre with drip <i>in situ</i>
18	3/52	1/4	72	60	Oedema	Very satisfactory
19	4/52	1/4	72	60	"	—
20	5/52	1/4	48	40	Oedema	Slight oedema after 12 hours. Drip stopped for 4 hours, then continued satisfactorily
21	5/52	1/4	36	20	"	Ran slowly all the time
22	8/12	3/8	36	40	Death	Necropsy showed localized infection of needle track but not of bone
23	6/12	3/8	22	18	Oedema	Very restless child. Needle loose after 22 hours
24	6/12	3/8	48	40	"	—
25	6/12	3/8	18	10	Persistent leaking at adapter	Same baby as Case 23; left leg used for both drips. Second drip started 42 hours after discontinuation of first
26	8/52	1/4	72	40	Oedema	Ran slowly throughout
27	7/52	3/8	—	—	"	Very small baby. Needle too long. Drip did not run
28	7/52	1/4	108	80	Stopped deliberately	Same baby as Case 27
29	2/12	3/8	72	Not recorded	Slowness of drip	Fat child. Needle apparently not at right angles to bone
30	2/12	3/8	72	"	Oedema	—
31	3/52	1/4	132	"	Death	—
32	3/12	1/4	30	50	Oedema	Drip given too fast; 15 fl. oz. in first 3 hours. Early oedema caused by rapid rate
33	5/52	1/4	48	50	"	—
34	9/12	1/4	60	40	"	Ran slowly throughout
35	8/52	1/4	40	40	Death	Ran well

This may cause less damage than the opposite manoeuvre—syringing through into the marrow cavity. Oedema is occasionally troublesome, and seems not to depend only on the tightness of the needle in the bone. It sometimes occurs much higher up the leg than the site of insertion of the needle, the region just above the knee being commonly affected. As previously mentioned, leaking at the junction of needle and adapter is another trouble, and even tight and carefully planned strapping does not eliminate it. Leaking due to the needle working loose occurs less often in the early stages, but is a common reason for discontinuing the transfusion after several days.

There is no doubt that osteomyelitis is to be feared. In the one case in our series of saline transfusions in which it developed the operator had not used gloves. Whether or not this led to the infection cannot be decided, but it is considered

likely. In no other case was any harmful effect noted, and the relief of dehydration by the intramedullary route appeared to be fully as effective as by any other method.

Use of Blood

The first time this technique was used 2 fl. oz. of whole blood was run in 8 hours into the tibia of a child 2 weeks old who had acute anaemia. The drip then stopped of its own accord and no attempt was made to restart it. No ill effects followed the transfusion. Two other patients were given blood: one was a child 18 months old who had empyema, the other an infant of 11 days with erythroblastosis foetalis. The first received only 4 fl. oz. of blood in 12 hours, although the pressure was raised by suspending the bottle 7 ft. above the leg (Gimson, 1944; Behr, 1944); the second received a negligible amount. In both cases repeated attempts were made to accelerate the rate of flow; both patients developed osteomyelitis, and surgery was needed.

No further attempts at giving blood by this route were made. It is worthy of note that dilution of the blood did not facilitate transfusion. The use of Officer's mixing chamber (Bailey, 1944) was attempted without success.

Comment

There is no doubt that in practised hands the intramedullary drip is valuable in the treatment of small children needing fluids. It is very quickly set up: the insertion of the needle takes only a few seconds, as compared with the 10 minutes or so needed for tying a needle into the internal saphenous vein. But a certain degree of skill is required, and this is borne out by the fact that nearly all the unsatisfactory transfusions in this series were set up—under our supervision—by house officers who had had little experience of the method.

Nursing needs particular care because of the tendency of the drip to run too fast and to speed up after an initial slowness, and because of the ease with which local oedema can develop. We have not been impressed with the regularity of flow mentioned by Gimson. Restarting immediately after the oedema has subsided is not usually satisfactory. The leg may, however, be used for an intravenous drip provided that no oedema is present. The double method was employed several times very effectively.

If precautions against sepsis are adequate there seems to be little risk of infection. A very small hole is left when the needle is withdrawn, and this heals quickly and completely. Two transfusions were given into the same tibia with an interval of 42 hours, which is considered to be the minimum.

Summary

Details of our experience with intramedullary tibial transfusions are given, with a commentary. The conclusion is reached that the method is a valuable alternative to intravenous therapy, but that it is not suitable for the giving of blood.

We desire to thank the honorary staff of Addenbrooke's Hospital for allowing access to their patients.

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New Zealand vital statistics are often quoted, and for obvious reasons. The report for 1943-4 of the Director-General of Health, Dr. M. H. Watt, records that the death rate in the Dominion in 1943 was 10.04 per 1,000 mean population. The infant mortality was 31.37 per 1,000 live births, and the stillbirth rate was 26.25 per 1,000 live births. The maternal mortality, including death from septic abortion, was 2.21 per 1,000 live births; when deaths from septic abortion were deducted the maternal death rate was 1.71. Notifications of scarlet fever rose steeply from 457 in the previous year to 1,196 in 1943—the highest number since 1931. The relative immunity of the Maori to scarlet fever is shown by the fact that in 1943 only one case of this disease was reported in the Maori population. The outbreak of influenza in the Northern Hemisphere was watched with some anxiety, but did not reach the shores of New Zealand. In order to minimize the risk of importation of mosquitoes not present in the Dominion a Mosquito Control Committee was set up to collect specimens and carry out surveys in Wellington and Auckland and in the neighbourhood of aerodromes and elsewhere, and on its advice steps have been taken to eliminate all potential breeding-grounds for mosquitoes in and about the ports and aerodromes.