THE EFFECT OF INDUCED HYPOTENSION AND TISSUE TRAUMA ON RENAL FUNCTION IN SCOLIOSIS SURGERY WITH COTREL-DUBOUSSET INSTRUMENTATION

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The surgical correction of scoliosis and open reduction of spinal fractures involve considerable trauma to bone and muscles, together with hypotensive anaesthesia, it might be expected to compromise renal function. In our clinics, 36 spinal operations with CD instrumentation were performed from december 1988 to december 1989. 30 of the anaesthesia. Induced hypotension reduces bleeding during the operation so that surgeon can operate easily on surgical hypotension, muscle damage and evidence of fat embolism, renal function was unaltered in all patients, and attention was paid to the meintenance of circulating volume which is essential to protect renal function.

The surgical treatment of scoliosis probably involves more trauma to muscle and bone than any other elective orthopaedic operation. The combination of induced preoperative hypotension, myoglobinuria and fat embolism might be expected to compromise renal function. (1)

Induced hypotension reduces intraopcralivc blood loss during major orthopaedic surgery. (2,3) However profound hypotension may be deleterious during spinal surgery because the effects of hypotension and direct pressure on the spinal cord are additive in producing impairment of spinal cord function. (4) In order to determine whether renal failure is a significant risk in scoliosis operations with induced hypotension, a prospective study was undertaken to determine the effect on renal fuction.

PATIENT AND METHODS

In our clinics, 30 spinal operations with CD instrumentation were performed from December 1988 to December 1989. All of the surgical operations were performed with induced hypotension.

There were 11 female patients and 19 male whose ages ranged from 12 to 49 years (mean 20,2). Fifteen of the patients had adolescent idiopathic scoliosis, two of the patients had adult scoliosis while in two the spinal deformity was secondary to paralytic conditions. (Polio). Ten of the patients had thoracolumbar vertebrae fractures only, one of them had Schucrmann kyphosis. All patients had preoperative plasma urea and creatine values within the normal range. Respiratory function were assessed for the idiopathic scoliosis before operation.

Anaesthesia was induced with thiopentane sodium, and muscle relaxation obtained with Atracurium besylate. The patients were ventilated with a nitrous oxide/ oxygen mixture together with isofluran and an intravenous narcotic was also used. They were then positioned prone for posterior fusion and instrumentation. In the prone position a pelvic support and chest cushion were used to minimize intraabdominal pressure.

All of the patients operation were performed by using the Cotrcl-Dubousscct techniques. The maximum available correction was maintained by Cotrcl-Dubousscct instrumentation. The postorior spinal structure over the instrumented area were prepared for bony fusion by excision of the posterior facet joints, removal of the spinous processes and dccorlication of the laminae. Bone used for grafting was obtained from the iliac crest.

Blood loss was measured by weighing the swabs and by suction volume. Intraoperatively, dextrose-saline was infuced (4 ml/kg/h) and blood was given to replace losses. Induced hypotension was employed during whole operation using Sodium Nitropurisside (3 micrograms/kg/min). Intraartcrial blood pressure was measured and maintained at a systolic level of 60 to 70 mniHg. Postopcralively dextrose-saline was given at a rate of 40 ml (Mean 2000 ml/24h providing 60mmol Na/24 h). Blood samples and 24 hour urine collection were taken before (Day 0) and for four consecutive days (Day 1 to 4) after the operation. Daily blood samples were assayed for sodium, potassium, bicarbonate, urea, creatinine, uric acid, creatinine kinase, 24-hour urine excrcation of sodium, potassium, urea and creatinine were measured. In addition, daily specimens of urine were examined for fat droplets using Rcd-0-Stain

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and tested Multistix-Test strips. Results arc cxpcrcssed as mean with standart deviation, and comparison was made with preoperative values using paired Student's t-tests.

RESULTS

Blood pressure was maintained at low levels during the operation in all patients, the mean lowest systolic pressure was 60 mmHg, range 40-1 lOmmHg.

Average blood loss was 300 cc. For compansating this loss an average of 280 cc of blood was used. In spite of induced hypotension we had to use 5 units of blood for 2 patients. No patients had any neurological complications as a result of the operation. Neurologic examinations of the all patients were normal, posto-pcra lively.

All of the patients had their biochemical analyses in normal ranges preoperatively. The results of the blood and urine samples taken on the 1., 2., 3. and 4. postoperative days arc shown in Table 1. We observed that renal function wasn't impaired. Plasma and urine crcalininc levels were normal in all of the patients. Though average values were in the highest levels of normal range, (Average plasma crcatininc level ling/dl, range 0,7-1,2 mg/dl) they fell progressively in following period (Table 1). Clcarcncc of crcatinine were in the same way, first it was high (but in the normal ranges) then it fell progressively.

In the plasma Na and K values we observed a slight fall on the first postoperative day. On the second postoperative day the fall was maximum. On the second postoperative day we observed hypopotassemia and hyponalrcmia in the 24 of the patients (80 %). But

Table 1: Averages of the laboratory findings of the patients on the first, third and fourth postoperative (PO) day.

	Normal Values	PO 1ST DAY	PO 2ND DAY	PO 3RD DAY	PO 4TH DAY
Plasma Creatinine Mg/dl	0,5-1,2	1,1 (0,9-1,2)	1,0 (0,7-1,1)	0,9 (0,6-1,0)	0,6 (0,5-0,8)
Urine Creatinine Mg/dl. Kg/24h	11-26	24 (22-26)	21,1 (18-23)	16 (11-19)	13 (11-17)
Creatinine Clr* Ml/Min/1, 73M2	88-134	114 (121-132)	120 (103-128)	126 (109-132)	130 (129-133)
Bun Mg/dl	7-18	29,1 (16-34)	20 (14-28)	24,4 (20-27)	26,3 (21-28)
Urine Nitrogen Gr/Dl	12-20	33,4 (28-38)	24 (20-31)	28 (22-32)	30 (24-34)
Uric Acid Mg/Dl	3,2-8	5 (4-7)	6,1 (4-8)	6 (4-7)	4,4 (3,2 -6)
Plasma Na Eq/Lt	136-146	130 (121-138)	120 (11-124)	137 (134-139)	140 (136-146)
Urine Na Eq/Lt/24h	40-220	34 (32-38)	28 (25-31)	51 (39-63)	68 (48-89)
Plasma K Eq/Lt	3,5-5,1	3 (2,9-3,6)	2,8 (2,6-3,4)	3,8 (3,6-4,6)	4,6 (4,1-5,1)
Urine K Eq/Lt/24h	25-125	22 (18-24)	18 (14-20)	27 (25-46)	58 (44-91)
Creatinine Kinase IU/Lt	12-80	3021 (436-5025)	3033 (438-5029)	3000 (429-5010)	2800 (430-5000)

on the fourth postoperative day all the patients reached to normal values. Also the urine levels were in correlation with plasma levels.

Plasma urea rose slightly on day 1st, fell on day 2nd and returned to preoperative levels by day 4th this was associated with a progressive increase of urinary urea exereation.

Muscle break down was reflected by a marked elevation of creatinine kinase on day 1st (main 436-5025) which continiued on to Day 4th.

Plasma bicarbonate levels did not alter significantly. Uric acid levels were within the normal limits in all patients. In 4 patients we observed fat droplets in the urine on the first or second postoperative day. (13,3 %)

DISCUSSION

The operative correction of scoliosis or open reduction of the spinal fracture and posterior fusion is one of the most tissue-destructive form of non-ablative surgery now being practised.

Because of the conception that induced hypotension creates an impairment in renal and spinal functions, this method is not a widely accepted method for spinal surgery. But in some reports it is shown that renal and spinal functions arc protected as well. (1,4,5) Our report is in this way too. C-D technique which provides a rigid internal fixation and correction in 3 planes by using multiplex hooks and rods is abviously much more traumatic than the Harrington technique. Trauma on the muscle are shown by the rise on plasma creatinine kinase levels. This rise is ofcourse more than a rise seen in the other orthopaedic operations like osteotomy. The increasing urinary urea reflects the postoperative catabolic state of these patients with negative nitrogen balance.

Several factors arc relevant to the postoperative hyponatremia seen in this study. ln all major operations sodium and water retantion by the kidneys results from increased corlisol levels (LeQuesne, Cochrane and Fieldman-1985) and stimulation of renin and vasopressin release by hypovolemia (Cochrane et al 1981). Additionally dextrose-saline infusion, probably is inaduquate to correct the deficit of total body sodium, and results in dilutional hyponalremia. An increased sodium replacement would seem justifiable, perhaps as plasma rather than in crystalloid form. Similary the development of hypopotassemia would make potassium suplcmcnts appropriate. (6,7)

We observed fat droplets in urine in 4 of the patients (13,3). Two of them showed an impairment of the respiratory function lest performed in the first control one month after the operation. In spite of this we observed a 7,7 % rise in respiratory function of the remaning patients on the first control. In these 2 patients there was a 2,8 % fall in respiratory function. But in the second controls that was held 3 months after the operation these two patients showed were idiopathic thoracal lordoscoliosis. With the derotation performed by using C-D technique progrrcssion of vital capacity is reported by some authors (8,9). With the exception of these two patients our results arc in the same way. This fall in the vital capacity is probably related to fat embolism in pulmoncr circulation.

Spinal cord function may be impaired by either fall in blood pressure or by occlusion of the arterial blood supply during correction of scoliosis (4). In spite of the induced hypotensive anaesthesia we didn't see any neurologic impairment in our patients.

We believe that hyponatrcmia and hypokalcmia seen in some patients on the early postoperative days can be corrected by infusion of the saline and dextrose solution with the potassium until the third postoperative day.

By the direct effect on smooth muscles of artcriols and small venas, sodium nitroprussid provides a marked fall of blood pressure. One of the most important advantages of sodium nitroprussidc is that when the infusion is ceased blood pressure immediately returns to normal levels and so the patient can be awakened for a wake-up test.

There arc a lot of papers reporting that lessening of blood loss is evident with induced hypotensive anaesthesia. Anaesthetic management plays a crucial role in limiting intraoperativc blood loss during corrective surgery for scoliosis. Induced hypotension is an essential part of the anesthetic techniques used in spinal surgery because it reduces intraopcralivc blood loss, the need for blood transfusion and improves operating conditions by providing a bloodless operating field. (10,11,12) Therefore we concluded that during the major spinal surgery, infusion risk is lessened and bloodless operating area provides advantages to surgeon and lessens the risk of infection.

Here in this study in spite of the muscle break down and the risk of fat embolism we didn't sec any impairment of renal function after Cotrcl-Dubousset Instrumentation technique used for correction of the scoliosis or reduction of vertebral fractures and posterior fusion.

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