The Value of Central Venous Pressure Measurement During General Surgery

A Case Report

By

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Summary

An account is given of how continuous venous pressure measurements were of great value when massive haemorrhage occurred during an abdominal procedure. The case shows that the measurement should not be confined only to cardiac bypass surgery.

The main purpose of this account is to emphasize the value of central venous pressure measurement under surgical conditions, where haemorrhage is so massive and rapid that ordinary methods of blood loss assessment are unreliable or time-consuming. Sykes (1963) set out the many factors influencing central venous pressure but still considered the measurement to be of value as an index of circulating volume in certain circumstances.

Case Report

The patient on whom this account is based was a woman of 32 with a considerable previous surgical history, which had included an appendicectomy, a Caesarean section and a cholecystectomy. The last of these operations had been followed by a pulmonary embolus. Obstruction from adhesions following these operations had required more surgery. Recently the patient had been readmitted with intestinal obstruction, when laparotomy had revealed, apart from adhesions, a very large pancreatic cyst. It is the circumstances which accompanied the elective removal of the cyst four weeks later which will be described in detail.

The pre-operative condition was reasonable in view of the recent surgery. There were no abnormalities in the cardiovascular or respiratory systems and the haemoglobin was 13.8 g per cent. Induction of anaesthesia was straightforward, intubation following thiopentone and suxamethonium, and after curarization, the lungs were ventilated with nitrous oxide and oxygen by a Barnet machine. Pethidine was given at intervals to supplement analgesia.

After induction, since no suitable arm vein could be found, a prominent though rather fragile vein on the dorsum of the foot was chosen for an intravenous transfusion, although this ultimately proved inadequate for transfusion requirements.

The first half-hour of operating was uneventful: thereafter as mobilization of the cyst took place, brisk bleeding commenced and the Ringer lactate solution was replaced with blood. After a further half-hour of difficult dissection, the bleeding became extremely heavy and it was found that freeing of adhesions to the cyst had resulted in the superior mesenteric and splenic veins being torn. Moreover, the vessels could not be ligated without threatening the viability of the gut.

Over the space of 2 or 3 minutes, the patient became profoundly shocked although steeply head-down, and after the transfusion of 1 litre of blood, peripheral pulses were impalpable. The pupils, however, remained small. Surgery was discontinued and the house surgeon exposed the median basilic vein, while the anaesthetist inserted a large catheter 5 or 6 inches into the left external jugular vein. The tip of this cannula must have been in the caval or right atrial area; the proximal end was connected by means of a three-way tap to a citrate-containing manometer, the zero of which was levelled with the mid-axillary point.

Over the next 10 minutes, blood was pumped into the three veins together with a total of 25 mg of methyl amphetamine. At the end of this period, the clinical condition was much improved, palpable pulses present, the peripheral circulation quite good, and the blood pressure 110/60 mm Hg. At this stage, the blood loss recorded by swab-weighing together with aspirate was 3 litres. In view of the large amount of blood on the towels and elsewhere, the true loss was probably about 4 litres. Two and a half litres of blood, already prepared, together with 1 litre of dextran and 500 ml of plasma had been given up to this point: the transfusion of this 4 litres of fluid had raised the venous pressure from an unrecordable level to 9 cm H2O.

Because of the improved condition and imminent arrival of a further six bottles of cross-matched blood, it was decided to remove the packs and make a fresh attempt to control the bleeding points.

The next phase lasted for 2 hours, during which time bleeding was continuous and heavy; it was again often necessary to transfuse through all three veins, and despite this, there was a second short period of profound collapse. Four hours after induction, the recorded loss was 8 litres which was obviously a gross underestimate, and though of interest was of little help. The venous pressure was the sole reliable guide, giving moment-to-moment information about the circulatory state; although varying rates of transfusion were required, the aim was always to restore the venous pressure to, or maintain it at 9 or 10 cm H2O. This level always corresponded to a reasonable general condition of the patient who had been returned to a...
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nearly horizontal position, except during the time of the second collapse.

When venous haemorrhage had been successfully dealt with, there was still suspicion of a further bleeding point but because there was so much "sump" blood at the back of the abdomen from earlier bleeding, it was difficult to be certain. On the other hand, the 41-hour ordeal to which the patient had been subjected favoured immediate closure and at this stage venous pressure observation was again invaluable, for despite the transfusion of 300 ml of blood over a period of 5 minutes, the pressure continued to fall. This finding helped to provoke a further search which did in fact reveal a small tear in the splenic artery.

At the conclusion of operation 10.9 litres (22 pints) of fluid had been given; this was composed of 8½ litres of blood, 1½ litres of dextran and 1 litre of plasma. All the blood had been warmed but urgency had not permitted the cross-matching of the last four bottles. Five ml of 10 per cent calcium gluconate were given for each 500 ml of blood and 100 m.equiv of sodium bicarbonate were given empirically to cover the metabolic acidosis, likely to attend massive transfusion of non-fresh blood and the periods of severe hypotension.

During the whole haemorrhagic phase, the minute volume delivered by the ventilator was increased from 8 to 12 l./min, using a minimum of 40 per cent oxygen, which was increased to 100 per cent during the periods of cardiovascular collapse. Central venous blood analysis at the end of operation revealed a surprisingly normal respiratory and metabolic state. The following values were obtained: venous oxygen saturation 68 per cent; standard bicarbonate 24.5 m.equiv/l.; Pa\textsubscript{CO\textsubscript{2}} 47 mm Hg and pH 7.39. The methods used for these estimations were those described by Siggaard Andersen and his co-workers (1960).

The patient awoke promptly at the end of an operation which had lasted 6 hours, and the postoperative course was unremarkable except that there was no jaundice. The day after operation, the haematocrit was 50 and the haemoglobin 15.9 g.

CONCLUSIONS

In retrospect, it was probably unwise to commence the operation without an intravenous catheter that could be used for very rapid transfusion.

Essentially here was a situation in which haemorrhage was at times out of control, outstripping not only replacement but the usual methods of loss assessment. Attention to central venous pressure afforded the only means of assessing circulatory volume. Moreover, by this means it was possible to substantiate the presence of continued bleeding and thus materially to assist in the avoidance of yet a further emergency operation which the patient could scarcely have withstood well.

The emphasis laid on this measurement is not intended to eclipse pulse and blood pressure recording, but it is well known clinically that these two measurements are often unreliable as indices of circulating volume. By contrast it is known that provided the heart is healthy, central venous pressure is the first factor to fall in circulatory deficiency and the last to regain a normal value on full circulatory replacement. It is therefore a most useful measurement, being an indication of circulatory state, easily observed from moment to moment, requiring little in the way of apparatus and no special skill in setting up.

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REFERENCES


LA VALEUR DE LA MESURE DE LA PRESSION VEINEUSE CENTRALE EN CHIRURGIE GENERALE

SOMMAIRE

Compte rendu des mesures continues de la pression veineuse qui s'est révélée de grande valeur en cas d'hémorragie massive au cours d'une opération abdominale. Ce cas montre que ces mesures ne doivent pas seulement être réservées à la chirurgie avec bypass cardiaque.

DER WERT VON MESSUNGEN DES ZENTRALEN VENÖSEN BLUTDRUCKES WAHREND EINES ALLGEMEIN-CHIRURGISCHEN EINGRIFFES

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