When to stop resuscitation - the significance of cuff blood pressure

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SUMMARY

Fifteen consecutive patients who had been resuscitated from cardiac arrest and transferred immediately to an Intensive Care Unit were studied. Measurements of intra-arterial pressure, cardiac output and systemic vascular resistance demonstrate that 'cuff' blood pressure may not always be related to intraarterial pressure or cardiac output and cannot be used for diagnostic, therapeutic, or prognostic purposes.

Following resuscitation, a palpable pulse was present in each of these patients, but did not correlate with adequacy of cardiac output. Too often we hear during a cardiac arrest the question 'Does the patient have an output?', when we should really be asking 'Does the patient have a pulse?'. The palpation of a pulse is a simple and important indication of spontaneous cardiac activity. However cardiac output must be measured and it's adequacy cannot be inferred from this basic clinical measurement.

INTRODUCTION

Blood pressure is related to cardiac output and peripheral resistance ($BP = CO \times PR$). When cardiac output falls, systemic vascular resistance should rise to maintain an intra-arterial pressure. Peripheral pulses may not be felt in these low-flow states with high resistance, and Korotkoff sounds may not be heard. An intraarterial catheter, however, may record a mean arterial pressure close to normal values in these subjects. (Cohn & Luria, 1964; Cohn, 1967)

Resuscitation from cardiac arrest often results in a patient with a palpable pulse, but an absent or inadequate blood pressure when measured by a cuff.

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This may lead to the blind administration of inotropic drugs eg. dopamine, in an attempt to 'produce' a blood pressure. However, maintenance of a high systemic resistance to raise the blood pressure in the presence of a poor flow is an important factor in survival from cardiac arrest and strong alpha-adrenergic agonism producing peripheral vasoconstriction is necessary for successful resuscitation. (Otto *et al.*, 1981 a, b) This vascular response may make conventional blood pressure measurement impossible or, at best, unreliable, in a patient with adequate intraarterial pressure.

We investigated the relationships between pulse, cuff blood pressure, intra-arterial blood pressure, cardiac output, and peripheral resistance in a group of patients immediately after the restoration of a rhythm following cardiac arrest.

PATIENTS AND METHODS

From March 1987 onwards, following cardiac arrest managed in A&E or in a general ward and the restoration of a rhythm, patients were transferred immediately to the Intensive Care Unit (Redmond, 1986). All patients were electively ventilated whether or not respiratory effort was observed. An indwelling arterial catheter was sited in the femoral artery, and a flow-directed, Pulmonary Artery Balloon Catheter was inserted via the right internal jugular vein, the patient's bladder was catheterized. The data presented in this paper represent the initial haemodynamic screen on the first 15 patients looked at in this study. This information was available within an hour of the patient's arrival in the hospital.

Patients who had a rapidly terminated episode of Ventricular Fibrillation with a short period of cardiopulmonary arrest, while being monitored on the Coronary Care Unit, were excluded from the study.

RESULTS

There were 15 patients who fulfilled the criteria for inclusion in the study in the first 12 months. Their haemodynamic parameters immediately after restoration of a rhythm are shown in Table 1.

Five patients had an unrecordable blood pressure in the arm but an adequate mean arterial pressure when measured directly (Table 2). Four of these patients survived.

Conversely, four patients had a cuff blood pressure approaching normal but an inadequate cardiac output — Table 3 (Cardiogenic shock = $CI < 1.8$). Two patients with cuff blood pressures of 50 mmHg are included to demonstrate the lack of correlation between these indices.

The relationship between Cardiac Index and Systemic Vascular Resistance is shown in Figure 1.

Three patients in this study died, and 12 (80%) were discharged to independent existence. No patient was on the ICU for more than a week.

Table 1. Haemodynamic parameters immediately after cardiac arrest

Age	Outcome	Rhythm	Infarct	HR	MAP	CVP	PAW	CI	SVR	Cuff BP
75	D	Asystole	Inf.	144	84	12	19	2.3	1279	120
40	S	VF	Inf.	70	67	4	7	2.5	1071	UR
85	S	VF	Ant.	115	128	10	24	2.3	2245	120
59	S	VF	Ant.	120	86	12	28	1.9	1690	120
NR	S	VF	Ant.	147	98	9	32	1.5	2453	80
72	S	NR	NR	80	68	18	4	1.1	2103	50
69	S	VF	Inf.	91	86	13	4	1.7	2161	50
52	S	VF	Inf.	117	89	18	16	2.2	1319	UR
49	S	VF	Inf.	67	64	26	20	2.1	760	60
67	S	VF	Inf.	82	65	9	2	1.7	1658	UR
72	D	VF	Ant.	76	72	8	20	1.0	2692	90
74	D	VF	Ant.	83	58	13	22	2.7	679	UR
68	S	VF	Inf.	80	62	29	17	0.8	2169	90
59	S	NR	Ant.	127	79	7	19	4.4	661	UR
47	S	VF	Ant.	138	125	3	37	1.9	2635	100

NR = Not recorded

Table 2. Cuff blood pressure versus mean arterial pressure

Cuff B. P.	vs	MAP (mmHg)
UR		67
UR		89
UR		65
UR		58
UR		79

UR = Unrecordable; MAP = Mean arterial pressure

Table 3. Cuff blood pressure versus cardiac index

Cuff B. P.	vs	CI
120		1.9
50		1.1
50		1.7
100		1.9
90		1.0
90		0.8

CI = Cardiac Index = Cardiac output ÷ body surface area

CI < 1.8 ⇒ Cardiogenic shock

Fig. 1. Relationship between cardiac index and systemic vascular resistance

DISCUSSION

The maintenance of a high systemic vascular resistance as cardiac output falls is a major factor in survival from cardiac arrest and may explain why circulating endogenous catecholamine levels are often high at this time. (Little *et al.* 1985). This rise in peripheral resistance may render the relatively crude cuff measurement of blood pressure unreliable. Our findings confirm the work of others that simple sphygmomanometer cuff measurement of blood pressure does not always reflect the true haemodynamic status of critically ill patients. Immediately after cardiac arrest, this method cannot be used to judge accurately the success of the resuscitation attempt, and significant therapeutic decisions should not be based on these measurements. Cuff blood pressure alone may not be of prognostic value.

The presence of a palpable pulse during the management of a cardiac arrest, in the absence of external chest massage, is a sign of spontaneous cardiac activity. However, as all the patients in this series had palpable pulses, there is clearly little correlation between this physical sign and the adequacy of cardiac output. Yet it is convention to feel for a pulse to determine the presence of an 'output'. This convention may lead to a false sense of security. One should continue to palpate for a pulse during cardiac arrest management to identify spontaneous cardiac activity, but relating pulse directly to cardiac output is inappropriate in these circumstances, and often misleading. Meaningful measurements of cardiac output in such patients require invasive monitoring. This can only be performed safely in an Intensive Care Unit. The implications of this are great, as may be the benefits for selected patients.

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