Skin necrosis in a critically ill patient due to a blood pressure cuff

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ABSTRACT
The non-invasive method of blood pressure measurement is regarded as a safe procedure and the reports of any serious complications are rare. We report a unique case of extensive skin necrosis due to an intermittently inflating blood pressure cuff in a 65-year-old critically ill lady following a third time redo mitral valve surgery. A brief review of the literature on complications associated with noninvasive method of measurement of blood pressure is presented along with possible mechanisms of skin injury and ways to avoid it.

KEY WORDS: Skin necrosis, blood pressure cuff

Introduction
Non-invasive blood pressure (NIBP) monitoring is regarded as a safe procedure.[1] Recently there has been a rapid increase in its usage to record ambulatory blood pressure (BP). We report the case of a critically ill patient who developed a significant problem with NIBP.

Case History
A 65-year-old female presented with worsening shortness of breath due to severe rheumatic mitral stenosis. She had a history of two previous closed mitral valvotomies done 35 and 25 years ago. Preoperative investigations confirmed severe mitral stenosis with raised pulmonary artery pressure, impaired left ventricular function and left anterior descending coronary artery stenosis.

At surgery, the heart was densely adherent to the pericardium. The dissection required to free the heart from pericardium resulted in a large raw surface. A mechanical mitral valve replacement with a single coronary artery bypass grafting was undertaken. She was weaned off cardiopulmonary bypass supported by ionotropes and an intraventricular balloon pump (IABP). Hemoostasis was difficult to achieve due to persistent ooze from raw areas. The pericardial cavity was packed with swabs and the chest left open, except the skin.

Continued bleeding, marked hemodynamic instability, hypotension and low cardiac output complicated her postoperative course. Despite IABP and additional ionotropic support with administration of adrenaline 1.66 µg/min, dopamine 4 µg/Kg/min and noradrenaline 4 µg/min, her mean arterial pressure and mean systolic BP were 65 mm Hg (range 50 -70 mm Hg) and 96 mm Hg (range 70-110) respectively. The best hemodynamic parameters after optimization of fluid, ionotropes, IABP and vasoconstrictor were C.I. 2.2 L/min/m², C.O. 3.5 L/min and SVRI 2217 dynes s/cm²/m². Six hours after her arrival in the intensive care unit, she had to be returned to the operating room for cardiac tamponade that resulted from the bleeding raw surfaces. The chest was formally closed the next day when the bleeding had stopped.

An NIBP (oscillometric method) cuff of appropriate size was applied to the arm and set to inflate every 15 minutes. It was continued on the post-operative night alternately on her left and right arms and was changed approximately at four hourly intervals. On the next day, automatic cycling was changed to occasional inflation on manual instruction.

On the third postoperative day, the skin on the anterior aspect of her arms was found to be discolored. This continued to worsen resulting in full thickness skin necrosis of the anterior aspect of both the arms involving up to two-thirds of circumference, two days later [Figure 1]. Additionally, both her great toes, the 4th and 5th toe on right side and 5th toe on left side became gangrenous. The IABP and ionotropes were gradually weaned over several days. A tracheostomy tube was
inserted to assist respiratory weaning. A plastic surgery review was made and a plan was made for a split skin graft to the arm. Fortunately the arm wound healed slowly and she did not require skin grafting. The affected toes needed to be amputated. After 25 days in intensive care and two and half months, of rehabilitation in the ward, she was finally discharged and sent home. She has been under follow up for the past six years and has been doing well.

**Discussion**

Prolonged hypoperfusion due to occlusion of the microcirculation of the skin leads to pressure necrosis, of which bedsores are the best examples. Localized pressure has been reported to be the cause of skin necrosis of other parts of the body such as the bridge of the nose following the use of a continuous positive airway pressure mask for ventilation and penile skin due to a negative pressure device for erectile dysfunction. However skin necrosis due to NIBP has not been described so far in the literature.

In this patient, the NIBP was used to rule out erroneous reading from the arterial line. This was chosen as an alternative to insertion of a new arterial line as it was difficult to cannulate her radial and femoral arteries, which had already been traumatized at earlier attempts to cannulate for IABP monitoring. The NIBP equipment was used as per manufacturer’s standard instructions and the sides alternated as recommended. Low cardiac output and critical hypoperfusion combined with the use of ionotropes and vasoconstrictors explain the development of gangrene of the toes on both sides without any external interruption to the blood flow. In this setting of global hypoperfusion, brief but excessive machine cycling, device malfunction and continuous pressure of a firmly placed cuff, and with the reports of an increased risk of hematoma formation and compartment syndrome with NIBP, NIBP cuffs are also known to be a source of infection. Other reported complications include compressive neuropathy, petechial rash, thrombophlebitis, venous stasis, ecchymoses and phlebitis.

Previous reports have pointed out that excessive machine cycling, device malfunction and continuous pressure of a firmly applied deflated cuff are contributory factors. In the presence of arrhythmia, movement artefacts (muscular straining, shivering, movement disorder) or shock, multiple and prolonged inflations may be needed for one successful reading, greatly increasing the risk of this complication. Suggestions to avoid this problem are to avoid wrapping cuff too tightly and to avoid bony prominences. Anesthetized patients and those at extremes of age need special attention. The sites should be alternated and regularly inspected for any evidence of bruising or petechie. The cuff cycling should be kept to the minimum necessary frequency consistent with satisfactory monitoring. The role of alternative methods of blood pressure measurement such as Finapres remains uncertain, as their reliability and accuracy are not yet established.

We would like to conclude that even innocuous noninvasive clinical monitoring of blood pressure with a NIBP cuff can cause potentially serious skin necrosis in a critically ill patient with compromised hemodynamics. Appropriate precautions should be taken to prevent this complication.

**References**