

The healing of through-knee amputations in relation to skin perfusion pressure

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Abstract

The healing in 20 through-knee amputations was compared with preoperatively measured skin perfusion pressure, determined as the minimal external pressure required to stop the washout of isotopes injected intradermally 10 cm distal to the knee joint. Out of 18 amputations with a skin perfusion pressure of above 20 mmHg only 2 failed to heal, whereas 2 out of 4 cases with skin perfusion pressure below 20 mmHg failed to heal. It is concluded that the through-knee amputation must be considered in cases where the circulation is borderline for healing in below-knee amputation.

Introduction

Skin perfusion pressure (SPP) measured by radioactive isotopes has been used in the determination of level in major amputation since 1972 (Holstein, 1973) and the predictive value as regards the healing in below-knee (BK) and above-knee (AK) amputations has been demonstrated (Holstein et al, 1979 a, b; Kolind-Sørensen and Marqvorsen, 1979; Holstein, 1982). The purpose of this paper is to compare the healing of through-knee (TK) amputations with preoperatively measured SPP.

Patients and methods

During a 7 year period (1.1.1973 to 1.1.1980) 20 TK amputations were carried out after measurement of the local SPP in 20 patients with occlusive arterial disease with gangrene. The arithmetic mean age of the patients was 73 years (range 56-91). Three of the patients had diabetes

mellitus. The surgical technique included bilateral flaps (Kjølbbye, 1970) with a sagittal suture line. Suction drainage was used when necessary and preoperative antibiotics were not used. The postoperative dressing was a loosely applied elastic band. Sutures were removed on the 21st day. The patients were mobilized as soon as possible in a wheelchair or preferably on walking appliances. Prosthetic fitting was made when the stump was mature.

Measurement of the SPP

The principle has recently been described (Holstein, 1980) and will only be summarized. About 0.1 ml of a radioactive tracer—histamine mixture is injected intradermally. The tracer used is either $^{131}\text{I}^-$ -antipyrine (10-20 μCi) or $^{99\text{m}}\text{Tc}$ pertechnetate (50 μCi). The washout is measured with conventional scintillation detector and counting equipment. A semilogarithmic curve is written on a penwriter. By means of a blood pressure cuff placed directly on the depot external pressure is applied to the labelled skin and kept constant. By raising the pressure stepwise the washout decreases and the SPP is defined as the minimal external pressure required to stop the washout. The pressure intervals used are 5 mm Hg. It is most important to immobilize the leg completely during the procedure with sandbags. Since the procedure causes pain analgesics are practically always given (Demerole 35 mg i.v. in repeated doses). The sites of measurements have been standardized: the dorsum of the foot, the anterolateral part of the calf 10 cm distal to the knee joint and the anterolateral part of the thigh 10 cm proximal to the knee joint. In most cases the situation is sufficiently elucidated by one

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measurement, i.e. the standard site 10 cm below the knee. A total mapping out of the limb is rarely indicated.

Results

Table 1 shows the results as regards healing. Below 20 mm Hg 2 stumps out of 4 failed to heal. One stump healed by second intention and one stump healed primarily. Between 20 and 30 mm Hg one stump out of 6 failed to heal and above 30 mm Hg one stump out of 10 failed to heal. The 14 successful stumps with SPP above 20 mm Hg healed by primary intention.

The correlation between wound complications and SPP as evaluated by a rank sum test was almost statistically significant ($P = 0.07$).

Discussion

In this study the healing of TK amputations has been compared to the preoperative SPP as measured 10 cm below the knee joint, i.e. the point usually employed for determination of healing prognosis for BK amputations. SPP values below 20 mmHg at this point means 75 to 90 per cent risk of failure and SPP values between 20 and 30 mm Hg means about 50 per cent risk of failure (Holstein et al, 1979; Holstein, 1982). TK amputations are made a little more proximally, and if no specific complications related to the TK level appear, one would expect a slightly better healing prognosis for this type of amputation as related to the measure point 10 cm below the knee. In fact the healing figures were slightly better with 50 per cent risk of failures below 20 mm Hg and 17 per cent risk of failures between 20 and 30 mm Hg. The TK amputations as well as the BK amputations heal in approximately 90 per cent of the cases in non-ischæmic tissue, i.e. with SPP above 30 mm Hg.

Primary healing took place in all but one of the maintained TK levels. This is in contrast to the BK amputations where previous series demonstrated a high frequency of minor wound complications (Holstein et al, 1979; Holstein, 1982). Although the TK amputation is made with a minimum of soft tissue covering a large bulky triangular hard surface, the stump seems to be more resistant than a BK stump during the healing phase. Moreover rehabilitation as regards walking with a prosthesis is about equal in patients with TK and BK amputations (Steen Jensen et al, 1983). For these reasons the TK

amputation must be considered an alternative to the BK amputation, first of all in cases where the SPP is borderline for healing of a BK stump, i.e. at SPP of 20 to 30 (40) mm Hg. However, the TK amputation should also be considered when the SPP practically excludes healing at BK level, i.e. at SPP below 20 mm Hg; this situation can probably be further evaluated by measurements on the thigh or perhaps at the level of the knee joint.

Table 1. The number of healed TK amputations in relation to the total number and in relation to the skin perfusion pressure (SPP).

	SPP		
	< 20 mmHg	20-30 mmHg	> 30 mmHg
Without diabetes mellitus	1/3	4/5	8/9
With diabetes mellitus	1/1	1/1	1/1
Total	2/4	5/6	9/10

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