

The value of intervention: post-operative application of single-use Negative Pressure Wound Therapy

Introduction

Day 1

Mr B, a male in his mid-twenties in full-time employment as a welder sustained a crush injury to his left leg in a workplace incident. The injury necessitated transport by ambulance to the local hospital where the patient was admitted via the Accident and Emergency department. Investigations and assessments to assess the extent of the injury and inform subsequent management were commenced. A regimen of analgesia was initiated to address the immediate treatment priority of managing the severe pain associated with the injury. An orthopaedic surgical review was arranged to assess the injury and determine the necessary next steps in order to facilitate healing and restoration of function.

Day 2: Initial surgical intervention

Surgical consultation was undertaken the next day by which time the leg was more swollen and painful than it had been upon admission. The diagnosis of compartment syndrome was made and Mr B was taken to theatre where a fasciectomy, debridement and wash-out were performed. In line with standard local practice the wound was packed with povidone iodine-soaked gauze in theatre. Post-operatively the limb was elevated in a Braun frame, the regimen of analgesia was continued and antibiotics were commenced. At this time the management plan was to perform a dressing change within 24-hours, review the wounds which had been created to the medial and lateral aspects of the calf and allow progression to wound closure to occur via secondary intention.

Day 3

The following day the patient was still experiencing severe pain. The dressings were taken down and the limb was re-assessed. Pedal pulses were palpable, the ankle was mobile and knee flexion of 70% could be achieved, however greater than 70% caused severe pain. Conventional dressings were re-applied and a split cast was employed to immobilise the ankle to aid recovery.

Day 5 Surgical debridement

Over the following two days both post-operative wounds failed to improve and the patient's level of pain remained unchanged. Consequently Mr B was returned to theatre where debridement and wash-out of both wounds was performed.

Day 7 Surgical debridement

After a further two days the wounds were still showing no progression toward healing. It was decided that partial closure should be considered and in order to prepare the wounds for this possibility Mr B was again returned to theatre for debridement and wash-out.

Day 10 Surgical debridement

Some three days after this latest surgical intervention the wounds had still failed to progress making partial closure impossible at this time. Mr B was therefore returned once more to theatre where debridement, wash-out and surgical repair to a posterior fibial tendon rupture were performed.

The small unit size meant the PICO device could be fixed in place on the outside of the patient's split-cast, making it minimally intrusive and avoiding any issue of entanglement with the tubing connecting the device and the dressing.

Results

Day 18

The PICO NPWT dressings were left in-situ for two days at which time the wounds were re-assessed. Both wounds showed some evidence of improvement (see Figure 1) and the therapy was proving highly acceptable to the patient, hence PICO was re-applied as previously.



Figure 1: Lateral and medial wounds following two days of NPWT

Day 21

A further wound re-assessment was performed three days later. At this time the wounds showed considerable improvement since the initiation of PICO single-use NPWT with both being reduced in size with a more healthy appearance to the wound bed. The improvements were so substantial that the patient was deemed suitable for discharge with the wound being reviewed on a weekly basis in the outpatients department.

Outpatient management

Following discharge PICO single-use NPWT was continued with the patient returning to the outpatient department for wound re-assessment and NPWT dressing re-application on a weekly basis. The weekly outpatient visits were supplemented with visits by the Wound Care Sister who changed the PICO NPWT dressing as necessary.

Day 28: Outpatient re-assessment

The initial outpatient review took place one week after the patient was discharged, at which point PICO NPWT had been in use for thirteen days. Re-assessment revealed that the improvement in the condition of both wounds that had been achieved since the initiation of PICO NPWT had been maintained (see Figure 2). In both cases the size and depth of the wounds was observed to have reduced during the seven days since discharge. The fact that both the wounds had continued to progress towards healing since discharge was all the more pleasing and remarkable given that at this time the patient reported that he had also returned to work following his discharge.



Figure 2: Lateral and medial wounds one week after discharge following thirteen days of PICO NPWT

The wounds continued to improve and PICO NPWT was discontinued once the wound size and exudate level were appropriate for management with conventional advanced wound management dressings. Subsequent management has successfully maintained progression toward healing and both wounds are now approaching closure.

Discussion

In this case an initial surgical intervention, three subsequent surgical interventions and the use of conventional interactive dressings had failed to achieve any progress toward wound closure and was characterised by a steady deterioration in the condition of the wound. Following assessment by the Wound Care Team an alternative dressing regimen comprising the short-term use of an antimicrobial dressing followed by the application of single-use NPWT was initiated.

The commencement of this new regimen not only arrested the progressive worsening in the condition of the wounds which had occurred over the previous eight days but actually saw the wound improve. This improvement was achieved over a short period of time and was such that the patient was discharged from hospital six days after the Wound Care Team initiated treatment.

In examining this case, one is prompted to question whether the earlier application of single-use NPWT would have been effective in avoiding the surgical interventions which were undertaken in the face of the wounds' failure to improve. It is impossible to determine exactly what would have occurred had single-use NPWT been applied immediately after the initial surgical intervention.

However, if it is assumed that the progress achieved following the application of NPWT immediately post-op would mirror the pattern of improvement seen in this case (when NPWT was applied at a later time point) the theoretical implications of early intervention for time to discharge, time to healing and the associated costs can be determined.

In this way it is possible to estimate the potential value that could have been gained by the early application of an active interventional wound management approach such as NPWT in this case.

A theoretical analysis of the cost implications following early intervention compared with the pattern of care illustrated in this case study is given below.

Cost Analysis

Costs associated with the management approach detailed within the case study were first calculated by applying appropriate unit costs (see Table 1) to the use of resources (see Table 2).

These were compared with the theoretical costs associated with an early intervention approach to managing the wound. In this case it was assumed that following the initial surgical procedure the wound would be reviewed by the Wound Care Team the next day (rather than 12-days post the initial procedure). It was also assumed that as per the case study the initial treatment initiated by the Wound Care Team would be a silver barrier dressing and retention bandage for one day followed by the initiation of NPWT. PICO NPWT would therefore be initiated two days after the initial surgery rather than some 13 days after the initial surgery as in the case study. The final assumption is that the wound would respond to PICO NPWT in the same manner as in the case study, allowing discharge six days after PICO initiation.

The theoretical analysis suggests there would be a marginal reduction in material costs following an early NPWT intervention approach (1%). However the major advantage of early intervention with PICO would be in the other costs, in this instance the avoidance of recurrent episodes of surgical debridement and a reduction in the length of in-patient stay. This results in a dramatic reduction in the overall cost of treatment (55%).

	DESCRIPTION	COST
MATERIAL COSTS	Non-woven absorbent dressing (each)	£0.26 ¹
	Retention bandage (each)	£4.28 ²
	Nanocrystalline silver barrier dressing (each)	£12.86 ³
	PICO single-use NPWT kit (each)	£145.00 ⁴
	Polyester wound contact layer (each)	£1.13 ⁵
	Gauze filler (each)	£1.31 ⁵
	OTHER COSTS	Post-trauma surgery (per procedure)
	Surgical debridement (per procedure)	£1263.00 ⁶
	In-patient stay (per day)	£288.00 ⁶

Table 1: Unit costs

DESCRIPTION	CASE STUDY APPROACH		THEORETICAL EARLY INTERVENTION APPROACH		
	QUANTITY	COST	QUANTITY	COST	
Non-woven absorbent dressing	22	£5.72	0	£0.00	
Retention bandage	1	£4.28	1	£4.28	
Nanocrystalline silver barrier dressing	2	£25.72	2	£25.72	
PICO single-use NPWT kit	4	£580.00	4	£580.00	
Polyester wound contact layer	4	£5.24	4	£5.24	
Gauze filler	4	£4.52	4	£4.52	
MATERIAL COST TOTAL		£625.48		£619.76	Material cost reduction £5.72 (1%)
Post-trauma surgery	1	£2119.00	1	£2119.00	
Surgical debridement	3	£3789.00	0	£0.00	
In-patient stay	21	£6048.00	10	£2880.00	
OTHER COST TOTAL		£11956.00		£4999.00	Other cost reduction £6957.00 (58%)
TOTAL COST		£12581.48		£5618.76	TOTAL COST REDUCTION £6962.72 (55%)

Table 2: Cost Analysis

Conclusion

In this instance the application of single-use NPWT proved highly effective in achieving progress towards healing in two wounds which had previously failed to do so. A theoretical cost analysis illustrates the potential value that an early interventional approach in which NPWT is employed soon after surgery rather than being employed only once the wound has failed to progress.

Method

The wounds had so far failed to progress during the course of the eight days since the initial surgery was performed or following any of the three subsequent surgical interventions. Consequently a referral was made to the Wound Care Team to draw upon their expertise to determine if a different wound management approach could yield any progress toward healing.

Day 14: Specialist assessment

The patient was assessed by the Wound Care Team thirteen days after the initial injury (12 days since the first surgical procedure had been performed). At this point both wound beds comprised exposed tendinous tissue and unhealthy granulation tissue which was failing to advance. Consequently both wounds remained static with no progression being made towards healing via secondary intention. The patient was still experiencing considerable wound-associated pain and the afflicted limb exhibited marked oedema. The static nature of the wound raised suspicions that an elevated bacterial burden was present within the wound bed and perhaps contributing to the failure of the wound to progress. As an immediate measure to address this issue, nanocrystalline silver barrier dressings were applied to both wound beds. A bandage was applied as a means of dressing retention.

Following resolution of the problematic bacterial burden the longer-term goal was to encourage the proliferation of granulation tissue and facilitate progression of the wound to closure via secondary intention. It was thought that Negative Pressure Wound Therapy (NPWT) would therefore be the most suitable intervention since this therapy is effective in fostering the development of granulation tissue so essential to wound progression but which had thus far failed to occur with conventional dressings. In addition NPWT might aid in resolving the persistent oedema that affected the limb and would provide a physical splint to the wound which would hopefully aid healing and help reduce pain associated with movement of the wound edges.

Day 15: NPWT initiated

The wound was re-assessed by the Wound Care Team the following day and the decision was made to initiate NPWT. A single-use NPWT system (PICO[®]) was employed as the small device size coupled with the simplicity of application were seen as advantageous in this case. A non-adherent polyester mesh wound contact layer was applied over the exposed tissues, followed by gauze-filler and the PICO NPWT dressing.

References

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