Technical Note

Risk of heparin lock-related bleeding when using indwelling venous catheter in haemodialysis

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Abstract

Background. The indwelling venous catheter such as Dual-Cath® or Twin-Cath® is widely used in haemodialysis. Although the manufacturer recommends filling the catheter lumen with heparin after the dialysis session to prevent clotting, little is known about the systemic effects of such a procedure.

Methods. Twenty haemodialysis patients with Dual-Cath® were studied. Dialysis anticoagulation was achieved by injecting a bolus of dalteparin. The patient/control ratio of activated partial thromboplastin time (aPTT) was determined at the end of the session immediately before and 10 min after locking with 2 ml of undiluted heparin (10 000 U catheter). We also determined the catheter volume for each patient and measured aPTT immediately before and 10 min after heparin locking with this patient-specific volume. Catheter patency was followed over a 2-week period.

Results. The aPTT values determined at the end of two consecutive dialysis sessions were nearly normal, respectively 1.29 (±0.17) and 1.33 (±0.22), whereas all patients had uncoagulable blood (aPTT > 3.75) 10 min after locking with 2 ml of heparin. When catheter volumes were individually calculated, they were found to be substantially lower than 2.0 ml (1.21 ± 0.12 for the arterial branch and 1.27 ± 0.13 for the venous branch). aPTT was only 2.42 ± 0.73 10 min after locking with the estimated volumes except in one patient (aPTT > 3.75). No catheter clotting was observed despite these smaller locking volumes.

Conclusions. A risk of inducing serious bleeding does indeed exist with Dual-Cath® heparin locking, especially in postoperative patients. This risk can be reduced by measuring catheter length at the time of placement in order to ensure an appropriate lock volume. Sodium citrate, polygeline, or urokinase are possible alternatives to heparin.

Keywords: indwelling venous haemodialysis catheters; heparin locking

Introduction

The indwelling venous catheters Dual-Cath® [1] are widely used in haemodialysis. They are composed of two 40-cm silicone catheters, each with a volume of 1.3 ml. After insertion into the superior vena cava via the internal jugular vein, the catheters are tunneled under the skin of the anterior thorax. They are attached to an external adapter (volume 0.8 ml). At the end of dialysis sessions, heparin is injected into the catheters to prevent clotting, and the catheter is locked. During placement, catheters are often cut according to patient size. The volume of injected heparin should, therefore, vary according to the length of the catheter. A survey involving 15 French haemodialysis centres revealed disparate methods of using the heparin lock. Four centres injected 1.5 ml of undiluted heparin, five injected 2 ml, two injected 2.5 ml and four others injected a volume that was calculated for each patient.

Until July 1999, we injected 2 ml of undiluted heparin (5000 U/ml) into each catheter (a total of 10 000 U/catheter). At that time, we observed that one patient had recurrent profuse epistaxis after dialysis. Two other patients, in whom arterio-venous fistulas had just been created, had prolonged bleeding at their puncture sites the first time the fistulas were used and just after heparin had been injected into the catheters, which were to be subsequently removed. It was suspected that the bleeding was due to the passage of heparin into the circulation.

We decided to evaluate the degree of coagulation induced by this procedure, after which the volumes of individual catheters were measured to determine
whether the injection of an equivalent volume of heparin would minimize the hypocoagulable state.

Patients and methods

Twenty patients dialysed through Dual-Cath® catheters were included in the study. Anticoagulation for the session was performed by injecting a bolus of 2500–5000 U of dalteparin (Fragmine®, Pharmacia-Upjohn) into the arterial line according to the patient’s usual protocol.

During the initial phase of the study, activated partial thromboplastin time (aPTT) (STA-PTT-A® reagent, Diagnostica-STAGO, STA, Stago automate) was determined at the end of the session for two consecutive sessions before locking (the sample being removed from the arterial line), and 10 min after locking with 2 ml of heparin (10 000 IU/catheter) on blood from a peripheral vein. The results were expressed as a ratio, patient control (for values >3.75 the blood was not coagulable). In one hospitalized patient, the aPTT was measured every 30 min for 6 h.

During the second phase, we attempted to determine roughly the catheter volume for each patient in the following manner: the catheter was flushed with 5 ml of normal saline followed by slow aspiration using a 2-ml syringe until blood was visualized at the end of the adapter. The volume of normal saline withdrawn was considered to approximate those of the catheter and the adapter combined.

The third phase consisted of measuring the aPTT before and 10 min after locking with heparin after one session only using the newly determined volumes for each. The frequency of catheter clotting or dysfunction was noted over a 2-week period.

Statistical analysis was performed using Statview® software.

Results

The aPTT values determined at the end of each session (Table 1) were normal or slightly increased without any significant difference ($P<0.001$) between the two consecutive sessions of the first phase 1.29 ($±0.17$) and 1.33 ($±0.22$) (normal values 0.7–1.2), respectively. On the other hand, 10 min after heparin locking, all patients had uncoagulable blood (aPTT >3.75).

Figure 1 shows the aPTT changes measured over a 6-h period in one patient in whom the hypocoagulable state lasted more than 2 h followed by a gradual return to normal after 3 h and 40 min, reflecting the passage into circulation of a considerable amount of heparin.

Rough measurement of each catheter’s volume (Table 2) revealed volumes substantially lower than 2.0 ml (1.21±0.12 for the arterial branch and 1.27±0.13 for the venous branch). Measurement of aPTT 10 min after locking with the newly determined volumes revealed a mean value of 2.42±0.73. Only one patient persisted in having a PTT value >3.75.

Lastly, over a 2-week period, no intra-luminal catheter clotting was observed despite the smaller volumes of heparin in the lock.

Discussion

Heparin locks in this form of vascular access can be a source of problems in everyday practice; however, they are rarely mentioned in the literature [2]. The NKF-DOQI guidelines do not give evidence-based advice or even opinions on how to prevent catheter thrombosis [3]. The manufacturer recommends that...
the catheter lumen be completely filled; however, as catheter volumes vary, the amount injected depends on the discretion of the user. To our knowledge, a serious bleeding complication related to heparin locks has never been reported [4,5]. Nevertheless, in our study, the injection of a standard 2-ml volume (10,000 U/catheter) of heparin resulted in a significant hypocoagulable state in all patients and it was responsible for the bleeding episodes that we observed without initially appreciating their cause. When catheter volumes were measured, values well below 2.0 ml were found, ranging from 1 to 1.5 ml. Thus, the routine practice of injecting 2 ml of heparin into each catheter was tantamount to administering a bolus of 5000–10,000 U (which is the initial dose administered to treat patients with thromboembolism or myocardial infarction [6]). This finding is all the more alarming as it is well known that uraemic patients are already at risk from bleeding [7]. Table 2 shows that the estimated injected volumes do not prevent the passage of heparin into the systemic circulation. Catheter volumes could have been more accurately determined if catheter lengths had been measured prior to placement. Decreasing the heparin concentration would reduce the subsequent circulation of heparin; it could, however, increase the risk of catheter clotting. The optimal dilution remains to be determined.

In conclusion, we believe that the risk of inducing serious bleeding does exist in heparin locking with this type of catheter in which the volume is unknown, and is probably underestimated in everyday practice. Particular attention should be paid to the use of heparin locks in postoperative patients or in those undergoing invasive procedures. Several solutions can be considered: the heparin solution can be diluted; polygeline or sodium citrate can be used as previously recommended [8,9]; and urokinase [10], whose half-life is short, may be of value, although its cost limits routine use. Another solution is to ascertain more accurately catheter volume by measuring catheter length at the time of placement. An appropriate quantity of heparin can then be injected for each patient.

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References

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