

# Stepwise sedation is safe and effective for the insertion of central venous catheters

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## ABSTRACT

**Background:** The introduction of a central venous catheter in haemodialysis patients is an unpleasant procedure for the patient. Intravenous sedation is accepted practice in complicated endoscopic procedures but not often used in haemodialysis patients.

**Methods:** We developed a protocol for the use of stepwise sedation in these patients with the use of midazolam and fentanyl.

**Results:** Stepwise sedation with midazolam and fentanyl was used in 155 procedures. No or minor movements were observed in 94% of 154 procedures. 88% of the 155 procedures were graded as very easy or easy. No or only very slight recall of the procedure were noted in 86% of 133 procedures. Only in 7% of 132 procedures were the patients able to recollect most of the procedure. No, or only a small amount of pain was recollected in 93% of 131 procedures. The most important complication was a slight decrease in oxygen saturation in 23 procedures. In the second part of the study we compared the effects of sedation with midazolam alone versus the combination of midazolam and fentanyl for the introduction of Tesio catheters. Amnesia, ease of procedure and the recollection of pain were equivalent. Oxygen desaturation occurred significantly less often with the use of midazolam alone.

**Conclusion:** We conclude that stepwise sedation is effective and safe in haemodialysis patients and leads to a complete amnesia for the procedure.

## INTRODUCTION

Insertion of central venous catheters is often performed in dialysis patients, mostly for temporary access, but with increasing frequency for permanent vascular access as well.<sup>1,3</sup> Even though the insertion is fraught with many possible complications, such as pneumothorax, arterial puncture and haemorrhage, it is considered to be a relatively safe procedure and can be performed in an outpatient setting.<sup>4</sup> The procedure itself creates some amount of discomfort for the patient. He has to lie flat, mostly in a head-down position, drapes are applied and the procedure may be painful. Furthermore, the patient is not allowed to move, or even scratch his nose. Some procedures take little time but increasingly catheters are tunnelled subcutaneously and this leads to a more complicated and longer procedure.

Intravenous sedation with either midazolam or diazepam is accepted practice in complicated endoscopic procedures, such as colonoscopy or endoscopic retrograde choledochopancreaticography.<sup>5</sup> We could not find references in the literature concerning the role of sedation in dialysis patients. The use of intravenous sedation is not without theoretical dangers in these patients. Firstly many dialysis patients are old and it has been shown that the clearance of midazolam, at least in older men, is slower than in younger men. Furthermore, midazolam and its metabolites are excreted mainly by the kidneys, leading to higher plasma levels in patients with renal insufficiency.<sup>6</sup> Because we had favourable results with intravenous sedation in some patients, we designed the following observational study.

## MATERIALS AND METHODS

All dialysis patients who had to have a central venous catheter inserted in the dialysis department between July 1996 and February 2001 were included. A peripheral venous cannula was inserted if no central venous catheter was present. Oxygen saturation and heart rhythm were monitored during the procedure. From 1 July 1996 to 31 July 1999, fentanyl and midazolam were used for sedation and from 1 August 1999 to 1 February 2001 midazolam alone was used. While talking to the patient, a test dose of midazolam and a dose of fentanyl (50 µg; until 31 July 1999) were given. Old patients with multi-system disease received 1 or 2 mg midazolam; younger patients 3 to 5 mg. Iodine was applied and allowed to dry. During this time the effect of the first dose was observed and if the patient had not yet fallen asleep a second dose of midazolam was given. After the application of local anaesthesia (lignocaine 1%), iodine was applied for the second time and drapes were applied. If necessary a third dose of midazolam was given. Extra amounts of midazolam were given if the patient woke up during the procedure (for instance if the procedure took a long time). Intranasal oxygen was given if the saturation dropped below 85%. Directly after the insertion two items were scored: 1) The movements of the patient during the procedure on a scale from 0 (no movement) to 5 (extreme unrest) and 2) the ease of the insertion on a scale from 1 (very easy) to 5 (very difficult). At the first dialysis session after introduction of the catheter, the patient was asked about recollection of the procedure and the amount of pain experienced during the procedure, both on a scale from 0 to 5. During the procedure the patient was monitored with regard to the following parameters: heart rate, heart rhythm, blood pressure, oxygen saturation. Flumazenil was immediately available if necessary. The first part of our study describes our experiences with stepwise sedation in all patients. In July 1999 the decision was made to omit the fentanyl from the protocol and give only midazolam. We compared our observations between the two time periods to determine whether the administration of fentanyl was necessary. This part of the analysis has been restricted to the introduction of Tesio catheters to obtain a more homogenous picture. All procedures were done by experienced nephrologists or by an experienced junior doctor. The locations for vascular access were chosen by the attending nephrologist. In the beginning of the study some subclavian veins were chosen for short-term access. Later, most catheters were introduced into the internal jugular vein. Femoral veins were chosen if a serious bleeding risk was present (for instance in thrombotic thrombocytopenic purpura) or if an infected catheter was present in the internal jugular vein or had recently been removed.

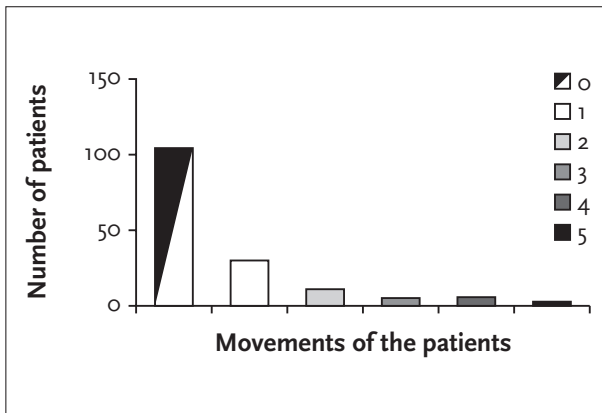
## RESULTS

### All patients

Between July 1996 and February 2001, 155 catheters (Tesio, Medcomp, Harleysville, Pennsylvania 125; double-lumen catheter 29; single lumen 1) were inserted in 98 patients. In 28 patients, more than one catheter was inserted and two patients received five catheters. The average age of the patients was 60.2 years (range 17-93 years). The insertion sites were the right internal jugular vein (64), left internal jugular vein (14), right subclavian vein (26), left subclavian vein (29) and right femoral vein (22). The average cumulative dose of midazolam was 7.2 mg (0-23 mg) and the average dose of fentanyl was 53 µg (0-1500 µg). In 14 patients there was a problem with inserting the catheter into the chosen vein. In twelve of these patients a second vein was cannulated immediately (for instance, failure to cannulate the right internal jugular vein, followed by successful introduction into the right subclavian vein). In two patients the procedure was stopped and a catheter was introduced the next day into a different vein. This was done when a vein on the other side had to be chosen and an X-ray of the thorax was needed to rule out a pneumothorax or haematothorax. In 23 procedures there was a decrease in oxygen saturation below 85% for which the administration of oxygen was necessary. A minor complication occurred in 17 procedures during the insertion: self-terminating ventricular tachycardia (1), arterial puncture (7), extravascular position of the catheter (1), apnoea for which flumazenil was given (1), leakage of the lumen of the catheter (2), and minor bleeding at insertion site (4). The main complications are listed in *table 1*. Movements were scored in 154 of the 155 procedures. No or minor movements (grade 0-2) were noted in 94% of 154 procedures (*figure 1*). Insertion with little difficulty (grade 1-3) was noted in 88% of 152 scored procedures (*figure 2*). No or only very slight recall of the procedure were noted in 86% of 133 procedures. Only in 7% of 132 procedures were the patients able to recollect most of the procedure. No, or only a small amount of pain was recollected in 93% of 131 procedures.

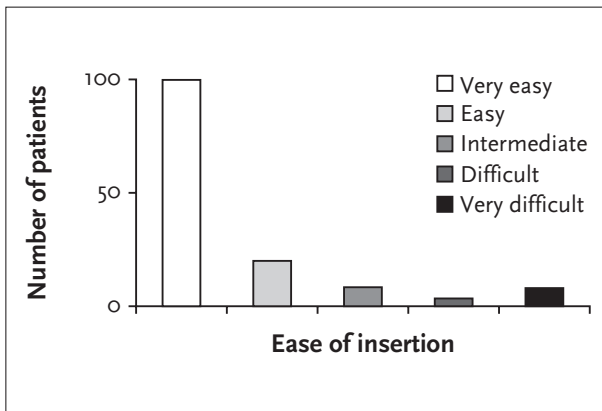
**Table 1**  
*Complications in 155 consecutive catheter insertions*

COMPLICATION	NUMBER
Desaturation (oxygen administration)	23
Flumazenil administration	1
Local haematoma	4 (no blood transfused)
Arterial puncture	7
First time failure to cannulate	14 (12 times immediate cannulation of different vein; 2 catheters introduced the next day)



**Figure 1**  
*Movements of the patients in 154 procedures*

The movements were graded on a scale from 0 (no movement) to 5 (extreme unrest).



**Figure 2**  
*Ease of insertion in 152 patients*

The ease of the procedure was graded on a scale from 1 (very easy) to 5 (very difficult).

### Midazolam versus midazolam and fentanyl in Tesio catheters

Between 1 July 1996 and 31 July 1999, 47 Tesio catheters were inserted; from 1 August 1999 to 1 February 2002, 78 Tesio catheters were inserted. Sedation with midazolam alone proved to lead to equal ease of the procedure and similar amnesia and pain experience. The number of cases of oxygen desaturation differed significantly (*table 2*).

### DISCUSSION

In this observational study we have shown that stepwise sedation is effective in obtaining excellent amnesia and pain relief at catheter insertion in this group of patients. It is unfortunate that not all procedures were scored. Especially the recall of the procedure and the recollection of pain was not always scored, since this was done the next day by the nurse who was responsible for the haemodialysis session. However we feel that enough patients were scored to draw some conclusions. The most important point in our study is that the sedation was titrated in every patient in a stepwise fashion. The first dose was administered before the application of iodine and subsequent doses were given after observation of the effects of every dose. Every step in the preparation before the actual insertion, such as the drying of the iodine, the administration of lignocaine and the positioning of the drapes, takes several minutes so that there is enough time to observe the level of sedation before the actual catheter insertion. The major complication was a drop in oxygen saturation, which resolved without further sequelae after the administration of oxygen. Flumazenil was given only once. The fentanyl was probably an important reason for these desaturations. In the second part of the study, we demonstrated clearly that the number of oxygen

**Table 2**  
*Comparison of sedation with either midazolam alone or the combination of midazolam and fentanyl in the insertion of Tesio catheters (125 procedures)*

MEDICATION	MIDAZOLAM (N=47)	COMBINATION (N=78)	P VALUE
Midazolam (mg)	7.7	7.9	p=n.s.
Fentanyl (µg)	0	86.9	
Desaturation (<85%)	1	18	p=0.0014
Complication	3	13	p=0.02
No movement	42 (46)	70 (78)	p=1.0
Easy insertion	39 (45)	69 (78)	p=0.78
No recall	27 (33)	64 (70)	p=0.19
No pain after procedure	27 (32)	55 (70)	p=0.59

The number between brackets refers to the number of patients scored.

desaturations decreased significantly in the patients who received midazolam alone. So, it can be concluded that stepwise sedation can be performed safely in patients with renal insufficiency. Furthermore, sedation with midazolam alone is sufficient to achieve adequate results. Since almost all patients remained perfectly still during the procedure, we feel that this protocol leads to an easier introduction of the catheter. This, however, has not been tested. And lastly, we would like to stress that all insertions were done under close observation of the patient and monitoring of oxygen saturation, heart rate and rhythm.<sup>7</sup>

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