
ORIGINAL ARTICLE

Sharp Versus Blunt Needle: A Comparative Study of Penetration of Internal Structures and Bleeding in Dogs

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■ Abstract:

Background and Objectives: Complications associated with interventional pain procedures have raised questions regarding the relative safety of sharp vs. blunt needles. It has been speculated that the incidence of hemorrhage, intraneural and/or intravascular injections may be reduced by the use of blunt needles. In this study we compared penetration and bleeding associated with sharp vs. blunt needle punctures.

Methods: Attempts were made to insert blunt and sharp needles (18-, 20-, 22-, and 25-gauge) directly or percutaneously into kidney, liver, renal artery, intestine or spinal nerve/nerve root of anesthetized dogs. Penetration and bleeding were ascertained by direct vision through a surgical wound.

Results: All attempts to directly puncture the kidney and liver with sharp needles were successful. All but one attempt to puncture a spinal nerve/nerve root with 20-, 22-, and 25-gauge sharp needles were successful but half or less attempts to puncture the intestines were successful. All attempts to puncture the renal artery with sharp needles were successful. Blunt needles never punctured the renal artery, spinal nerve/nerve root and intestines and rarely penetrated the

kidney (22- and 25-gauge one time each). All attempts to puncture the liver with blunt needles were successful. Bleeding scores for kidney punctures were generally higher for larger sharp needles than for smaller ones. Bleeding scores for blunt needle punctures of the liver were generally smaller than for sharp needle puncture.

Conclusion: Blunt needles are less likely than sharp ones to enter vital structures and/or produce hemorrhage. Thus, blunt needles may be preferable to sharp ones for performing interventional pain procedures. ■

Key Words: needle, sharp vs. blunt

INTRODUCTION

Akins et al¹ demonstrated that 18g blunt needles may be less likely than sharp ones to unintentionally enter blood vessels and produce bleeding. Surgeons use blunt tipped devices to avoid inadvertent penetration of arteries or adjacent vital structures.² Complications resulting from interventional pain procedures have raised the issue of the safety of blunt vs. sharp needles for doing these procedures.³ The complications include paresis, paralysis and/or death associated with segmental root, facet joint and transforaminal injections. Evidence indicates that these complications are caused by blood vessel impalement with subsequent intravascular injection and/or hemorrhage. Furman and colleagues^{4,5} reported that the rate of intravascular injection was 21.3% for

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S1 transforaminal epidural steroid injection attempts, 8.1% for injections at the lumbar level and 19.4% for cervical transforaminal injections. The incidence of intravascular injection during caudal epidural steroid injection attempts was reported to be 9.2%.⁶

The objectives of the investigation reported here were to compare blunt and sharp needles of various sizes with respect to penetration of bowel, blood vessels, spinal nerves and organs (liver, kidney, and renal artery) and bleeding associated with penetration.

METHODS

After Institutional Animal Care and Use Committee (IACUC) approval, studies were performed on 10 random source dogs. Needles used in this study (18-, 20-, 22-, 25-gauge, blunt and sharp (B bevel); see Figure 1) were obtained from Epimed International (Johnstown, NY). Dogs were anesthetized by intravenous injection of thiopental followed by tracheal intubation. Anesthesia was maintained by allowing the animal to spontaneously breathe halothane in oxygen.

There were three parts to the study. In part one, needles were advanced into the abdomen via a surgical wound. In part two, needles were inserted percutaneously and in part three, needles were advanced through a lumbar spine laminotomy. Speed of needle advancement and force applied to needles during insertion attempts was subjectively gauged to equal or exceed what an experienced interventional pain physician would use. Needles were advanced with the shaft perpendicular to the target site. Puncture attempts were stopped when the needle entered the target by 2+ mm

or produced indentation of a target site by 2+ mm without puncture. Penetration was scored as + (penetration) or - (not penetrated). Bleeding following needle insertion and subsequent withdrawal was assessed using the scoring system shown in Table 1. A grid pattern was used to determine sites for needle insertion attempt. Space between sites was 5 mm or more; insertions were not attempted in areas visibly affected by preceding puncture attempts.

A laparotomy was performed on eight of the dogs to access bowel, liver, kidney and/or renal artery. In four dogs (Part 1), needle punctures of the kidney and liver were attempted via the surgical wound under direct vision, 12 attempts for each organ. Puncture was attempted with three different needles of each gauge, blunt and sharp. The order in which needles were inserted was randomized by drawing slips of paper with preprinted needle type and size on them from a container.

In two other dogs, attempts were made to puncture the small intestines via a surgical wound. The order in which needles were used in the 12 attempts to puncture the intestines was randomized.

In the same two dogs attempts were made to puncture the renal artery via a surgical wound. Attempts to puncture the renal artery were made first with blunt needles, one of each size progressing from the smallest gauge (25-gauge) to the largest. During preliminary evaluation, puncture of the artery with a sharp 18-gauge needle produced profuse bleeding that obliterated the visual field. Thus during the study we planned to proceed with testing a sharp needle of each size from the smallest to largest. However, the first attempt to puncture the artery with a 25-gauge sharp needle was successful and caused severe bleeding; therefore one further attempt was made to puncture the artery in each dog with either a 22-gauge sharp needle or 18-gauge sharp needle. Attempts were scored as 0 (deflected) or 1 (entered).

Percutaneous punctures (Part 2) of the kidney and liver were attempted in 2 dogs to simulate usual clinical practice. The intra-abdominal needle path of travel

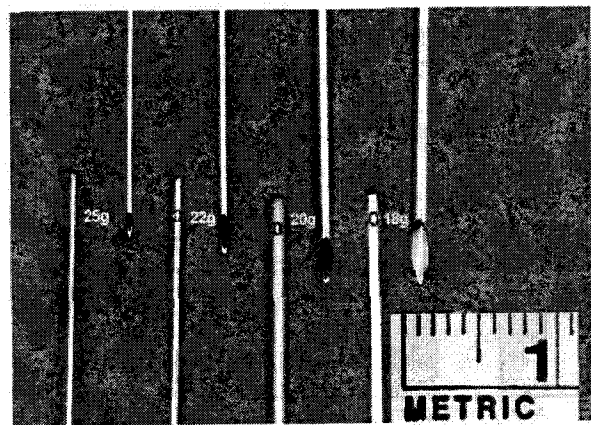


Figure 1. Photograph of the B bevel needles (upper row) and blunt needles (lower row) used for the study. Needle sizes from left to right are 25, 22, 20 and 18g.

Table 1. Scale for Bleeding Score

Score	
0	No bleeding
1	Subcapsular bleeding without capsule distension
2	Extra capsular bleeding with or without distension
3	Pulsating or squirting extra capsular bleeding

was observed through a surgical wound. Puncture was attempted with three different needles of each gauge, blunt and sharp in random order. The order was randomized by using the technique described above.

In two dogs (Part 3) a lumbar laminectomy was performed to visualize spinal nerve roots. Then attempts were made to penetrate the spinal nerve or nerve root starting with the smallest needle size and proceeding to the largest. The blunt needle and then the sharp needle of each size were tested.

Data Analysis: Each observation represents the consensus of the person who inserted the needles (JEH) and two other observers (TL, BJ). Sample size was based on a similar experimental design used in a previous study.¹ Results were clear and did not require statistical analysis to reach conclusions.

RESULTS

Direct Puncture: Liver and Kidney

All attempts to directly puncture the kidney and liver were successful with all 4 sizes of sharp needles (see

Figure 2). All but 2 attempts to puncture the kidney with blunt needles failed (see Figure 2, 3a). One of 12 attempts with a 22-gauge and with a 25-gauge blunt needle was successful (see Figure 2, 3b). All attempts to puncture the liver with blunt needles were successful (see Figure 2).

The majority of bleeding scores for kidney punctures were 3 (pulsating or squirting extra capsular bleeding) for 18-gauge (8/12) and 20-gauge (7/12) needles (see Figure 2). The majority of scores were 2 (extra capsular bleeding with or without distension for 22-gauge (10/12) and 25-gauge (7/12) needles.

The majority of bleeding scores for puncture of the liver with 18-gauge (8/12), 20-gauge (7/12), and 22-gauge (7/12) blunt needles were (0) no bleeding (see Figure 4a), but half of the scores with blunt 25-gauge needles were 2 (see Figure 2; see above).

Bleeding scores for puncture of the liver were generally higher for the 2 largest size sharp needles as compared to the score for the 2 smallest sizes (see Figure 4b). Bleeding scores for liver puncture with 25-gauge

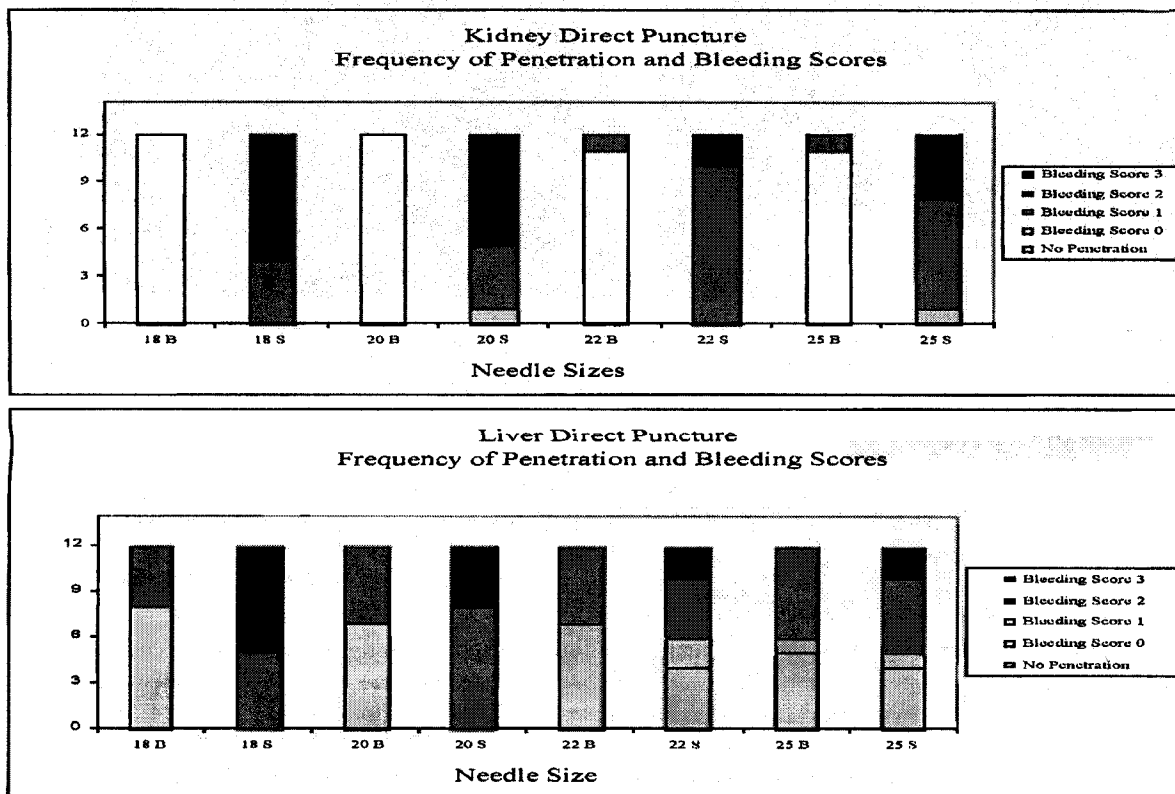


Figure 2. Frequency of direct penetration and bleeding scores for blunt and sharp needle penetration of the kidney and liver.



Figure 3A. Photograph of failed attempt to directly puncture the kidney with a 22g blunt needle. Note the denting of the kidney capsule by the needle.



Figure 3B. Photograph taken following a successful direct penetration of the kidney with a 25g sharp needle. The puncture produced a pulsating and squirting extra capsular bleeding.



Figure 4A. Photograph of the liver following puncture with a 20g blunt needle. Note the absence of any bleeding.



Figure 4B. Photograph of the liver following puncture of the liver with a 20g sharp needle. The puncture produced a pulsating and squirting extra capsular bleeding.

blunt needles were closer to the scores for 22- and 25-gauge sharp needles than to scores for other size blunt and sharp needles.

Percutaneous Puncture: Kidney, Liver and Intestines

None of the attempts to puncture the kidney or intestine with percutaneously directed blunt needles were successful (see Table 2). Conversely, all attempts to puncture the kidney with percutaneously placed sharp needles as well as all attempts to puncture the liver with blunt and sharp needles were successful. Different sizes sharp needles punctured the intestine up to 50% of the

time with no clear trend for a correlation between needle size and frequency of puncture.

Direct Puncture: Renal Artery and Spinal Nerve/Nerve Roots

All attempts to directly puncture the renal artery with sharp needles were successful. All attempts with blunt needles were unsuccessful (see Table 3). Blunt needles did not penetrate the spinal nerve/nerve roots (18-gauge needles were not tested). Almost all puncture attempts with 20-, 22-, and 25-gauge sharp needles were successful in penetrating the spinal nerve/nerve