Randomized Comparison of VasoSeal and AngioSeal Closure Devices in Patients Undergoing Coronary Angiography and Angioplasty

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AngioSeal (AS) and VasoSeal (VS) are collagen-based arterial closure devices utilized to achieve earlier hemostasis and ambulation in diagnostic and interventional percutaneous procedures. To our knowledge, there has been no randomized studies comparing these two devices as approved for use in the United States. One hundred fifty-seven patients were randomized to receive either the 8 Fr AS (n = 79) or VS (n = 78) closure device. Data on 95 patients who had coronary angiography (49 AS, 46 VS) and 55 patients who underwent angioplasty (28 AS, 27 VS) were completed. Heparin was not administered during the coronary angiogram procedure. The activated clotting time was kept at approximately 300 sec during angioplasty. Patients on coumadin or GP IIb/IIIa platelet inhibitors were not included in this study. The time unit interval to achieve hemostasis in this study was based on the time the AS tension spring was left over the common femoral artery following collagen deployment as per the manufacturer's instructions (20 min). Time to hemostasis, time to ambulation, and major and minor complications were prospectively recorded. Two-tailed t-test and chi-square analysis were performed on continuous and dichotomous variables, respectively. For the angiogram-only subgroup, time (min) to hemostasis (20.51 ± 4.36 vs. 18.59 ± 11.77; P = 0.30) and ambulation (145.71 ± 60.37; P = 0.075) were not statistically different for the AS and VS, respectively. Similarly, for the angioplasty subgroup, time (min) to hemostasis (24.23 ± 2.27; P = 0.077) and ambulation (607.32 ± 200.37; P = 0.12) were not statistically different for both AS and VS, respectively. Furthermore, there were no statistical differences in deployment failure, major, minor, or total complication rates between the two devices. In the absence of GP IIb/IIIa inhibitors, VS and the 8 Fr AS devices have statistically similar time to hemostasis and ambulation as well as device failures and complication rates following coronary angiography and angioplasty. Cathet Cardiovasc Intervent 2002;55:421-425. © 2002 Wiley-Liss, Inc.

Key words: closure device; AngioSeal; VasoSeal; cardiac catheterization; coronary intervention

INTRODUCTION

Percutaneous coronary procedures have greatly increased in frequency over the past decade, in part due to advances in revascularization techniques. Historically, arterial access has necessitated prolonged periods of bed rest following sheath removal. Arterial closure devices have recently become widely utilized to allow early ambulation and to shorten patients’ hospital stay.

VasoSeal (VS; Datascope) and AngioSeal (AS; Daig) are collagen-based vascular hemostasis devices approved in the United States for use at the femoral arterial puncture site in diagnostic and interventional procedures us-

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ing an 8 Fr or smaller procedural sheath utilizes an absorbable intravascular polymer anchor and a collagen sponge connected by an absorbable positioning suture [1]. VS is totally extravascular, delivering purified bovine collagen into the tissue tract created by the removal of a sheath device [2]. Both devices are effective in reducing the time to hemostasis and ambulation following both coronary angiography and intervention [1-6]. To our knowledge, there has been no randomized comparison of the AS and VS devices. This trial is a single-center, randomized study comparing the time to hemostasis, time to ambulation, device failure, and minor and major complications between the two devices in both angiographic and interventional procedures.

MATERIALS AND METHODS

This study was conducted at Genesis Medical Center from May 1999 to May 2000. Patients undergoing diagnostic cardiac catheterization or percutaneous interventional procedures were included in the study if they did not meet any of the following exclusion criteria: arteriotomy larger than 8 Fr; any suspicion that the introducer has been placed through the superficial femoral artery and the profunda femoris or at the bifurcation of these two vessels; the presence of significant vascular disease as judged by the cardiologist; uncontrolled hypertension at the time of deployment of the device (SBP > 140 or DBP > 90); allergy to beef product, collagen, or polylactic or polylactic acid polymers; emergency cases; therapeutic thrombolysis; GP IIb/IIIa inhibitors or warfarin; vascular graft puncture; bleeding disorder; pregnant or lactating females; previous AS or VS placed within 6 weeks in the same common femoral artery; preexisting autoimmune diseases; morbid obesity (> 300 pounds); hematoma prior to the AS or VS placement; younger than 18 or older than 80 years of age; and needle depth indicator outside the range indicated on the needle depth measurement card for the VS device.

A total of 157 patients were enrolled in the study (79 AS, 78 VS). Time to hemostasis and to ambulation were recorded on 150 patients (data were incomplete on seven patients). Complications were recorded on 156 patients. Two-tailed t-test and chi-square analysis (with Fisher's exact test) were performed to determine statistical differences between continuous and dichotomous variables, respectively.

RESULTS

Clinical Characteristics

Table I shows the different clinical characteristics between the AS and VS groups. There were no statistically significant differences between the two groups.

angiogram subgroup; 49 and 46 patients were randomized to the AS and VS, respectively. Time to hemostasis was 20.51 ± 4.36 min for the AS and 18.59 ± 11.57 min for

Definition of Primary Endpoints

The primary outcomes of this study were time to hemostasis, time to ambulation, and complication rates until discharge and at 1-month follow-up (major and minor). Time to hemostasis was measured in 20-min increments. Twenty minutes of light manual pressure or tension spring was applied after VS or AS deployment, respectively. Increments of 20 min are added until hemostasis is achieved. Time to ambulation was measured in 90-min and 360-min increments for both angiogram and interventional procedures, respectively. Increments of 90 and 360 min for angiography and interventional procedures were added respectively until successful ambulation was achieved. Successful ambulation was defined as walking for 5 min or 100 feet without bleeding complications. A major complication was defined as one of the following: the occurrence of a pseudoaneurysm, arterio-venous fistula, thrombosis of the common femoral artery, retroperitoneal bleed, infection, bleeding from the puncture site requiring transfusion, or death. Routine duplex ultrasound was not performed to the puncture site unless there was a clinical suspicion of a pseudoaneurysm or a fistula. A minor complication was defined as a localized allergic reaction, a hematoma not requiring transfusion, or a continuous mild oozing at the puncture site. Failure to deliver the collagen to the puncture site was recorded as deployment failure. No distinction between operator or device failure was made. For the first 51 patients enrolled (22 VS, 29 AS), the ankle brachial index (ABI) was measured and compared before and after the procedure.

Statistical Analysis

Two-tailed t-test and chi-square analysis (with Fisher’s exact test) were performed to determine statistical differences between continuous and dichotomous variables, respectively.

follow-up data were also obtained to record late complications.

Angiogram Subgroup

Ninety-five patients were enrolled in the coronary angiogram subgroup; 49 and 46 patients were randomized to the AS and VS, respectively. Time to hemostasis was 20.51 ± 4.36 min for the AS and 18.59 ± 11.57 min for
Table 1: Baseline Clinical Characteristics

<table>
<thead>
<tr>
<th></th>
<th>AngioSeal (n = 79)</th>
<th>VasoSeal (n = 78)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60 ± 11.4</td>
<td>60- 10.9</td>
<td>0.76</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>46.5</td>
<td>53.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Weight (pounds)</td>
<td>202.56 ± 43.50</td>
<td>192.44 ± 38.27</td>
<td>0.21</td>
</tr>
<tr>
<td>History of diabetes (%)</td>
<td>29.1</td>
<td>21.8</td>
<td>0.36</td>
</tr>
<tr>
<td>History of hypertension (%)</td>
<td>45.6</td>
<td>30.8</td>
<td>0.07</td>
</tr>
<tr>
<td>History of myocardial infarction (%)</td>
<td>26.6</td>
<td>23.1</td>
<td>0.71</td>
</tr>
<tr>
<td>Activated clotting time at time of sheath removal (see)'</td>
<td>281.65 ± 43.22</td>
<td>278.77 ± 42.34</td>
<td>0.91</td>
</tr>
</tbody>
</table>

For the angioplasty subgroup only.

VS (P = 0.30). Time to ambulation was 145.71 ± 124 min for AS and 109.89 ± 60.37 min for VS (P = 0.08). There was only one major complication in the VS group (pseudoaneurysm requiring surgical repair). Chi-square analysis indicated that there was no statistically significant difference between the two devices for major complications (P = 0.30). There were 2/49 (4.1%) minor complications in AS group and 4/46 (8.7%) in the VS group (P = 0.36). Total complications (major and minor) were not statistically different between the two devices (4.1% AS vs. 10.9% VS; P = 0.21).

Angioplasty Subgroup

Fifty-five patients were enrolled in the coronary angioplasty subgroup; 28 and 27 patients were randomized to the AS and VS, respectively. Time to hemostasis was 24.23 -1 12.70 min for the AS and 19.57 ± 2.27 min for VS (P = 0.08). Time to ambulation was 607.32 ± 344.22 min for AS and 486.48 ± 200.37 min for VS (P = 0.12). There were no major complications seen with either device. There were 7/28 (25%) minor complications in AS group and 5/27 (18.5%) in the VS group (P = 0.56). Total complications (major and minor) were not statistically different between the two devices (25% AS vs. 18.5% VS; P = 0.56).

ABI and Device Failure

The first 51 patients enrolled in the study (AS = 29, VS = 22) had their ABIs measured before and after the angiographic procedure (angiogram or angioplasty). For the AS patients, the ABI preprocedure was 0.99 ± 0.16 and after the procedure was 1.02 ± 0.21 (P = 0.39). For the VS patients, the ABI preprocedure was 1.05 ± 0.12 and that after the procedure was 1.03 ± 0.18 (P = 0.69). When the mean difference between pre- and postprocedure ABI was compared for AS and VS patients combined, no statistical difference was seen (P = 0.64). Deployment failure occurred in 6/78 (7.7%) for the AS group and in 4/77 (5.2%) for the VS group (P = 0.75). We did not differentiate between deployment failure due to device failure and operator failure.

One-Month Follow-Up Data

Data on 118 patients (75.2%) were available at 1-month follow-up (62 AS, 56 VS). There were two minor complications in the AS group and no complications in the VS group (P = NS).

DISCUSSION

Every year in the United States, there are over 1 million diagnostic and interventional percutaneous coronary procedures performed. Prior to vascular closure devices, prolonged bed rest was required to prevent vascular access site complications. Several vascular closure devices have gained market approval in the past few years. Compared to the historical control of manual pressure, these devices provide shorter time to hemostasis and earlier time to ambulation with no statistical difference in major and minor complications. To our knowledge, there have not been any prospective randomized comparison trials between collagen-based vascular closure devices. In this study, we have collected prospective, randomized data comparing the outcomes between the VS and AS closure devices.

Time to Hemostasis and Ambulation

In this study, we have shown that the time to hemostasis and time to ambulation are not significantly different between the AS and VS devices. We defined the incremental time interval of 20 min as the time to achieve hemostasis for both VS and AS. This time interval was chosen because it is the recommended duration for the tension spring to be left in place over the common femoral artery in the manufacturer's package insert of the 8 Fr AS device at the time the study was conducted [7]. To avoid potential bias, we chose the same manual pressure time interval over the common femoral artery after deployment of the VS. In previously published studies of the AS device, time to hemostasis did not take into account the time the tension spring was left over the common femoral artery [1,4], potentially yielding a mis-
leadingly low time to hemostasis. We suggest that the AS tension spring left for approximately 20 min over the common femoral artery should be included toward hemostasis time since it involves a mechanical pressure over the deployed collagen similar to the manual pressure utilized with the VS. The time to ambulation was also similar in both devices and was considerably shorter than historic controls utilizing manual pressure [1-6].

Major Complications

A low rate of major complications was also reported in both the AS and VS groups. There was only one pseudoaneurysm requiring surgical repair recorded in a VS patient after diagnostic angiography. The incidence of major complications in the VS population was therefore 1.4%, which is within the range of published data [8-12]. Major complications for VS ranged from 0.3% to 3% in different studies and did increase in patients undergoing complex interventions. In this randomized study, and when comparing all AS and VS patients, no statistical difference in major complications was seen between the two devices. This is in contrast to nonrandomized reported data that showed conflicting results. AS had a higher rate of major complications than VS in the study of Shlake [13]. On the other hand, VS had a higher rate of major complications than AS in the study of Silber [14]. These studies, however, were based on nonrandomized retrospective analysis and therefore device or patient selection bias cannot be excluded. Given that the number of major complications is very small for both AS and VS, a much larger randomized study would be needed to detect any significant small differences between the two devices. Our study is underpowered to detect such a small difference in major complication rates between AS and VS.

Minor Complications

The incidence of minor complications was 9/79 (11.4%) and 9/77 (11.7%) in the AS and VS groups, respectively. This was also statistically not different between the two devices (P = 0.95). These percentages are within those reported for minor complications in the literature ranging from 4% to 23% [3,5,14]. The wide range of variability of minor complications reported is probably due to differences in definitions between trials, such as the threshold of reporting a groin ooze or a very small hematoma. Using the same definition for both AS and VS, we found no differences between the two devices in our study.

ABIs and Device Deployment Failure

Deployment failure and change in pre- and post-ABI were also similar between the AS and VS devices. Deployment failure has been reported in up to 4.4% of AS [3] and 2% in the VS [2]. In our study, deployment failure was reported at 7.7% and 5.2% in the AS and VS groups, respectively (P = 0.75). We did not distinguish between deployment failures due to operator vs. device failure.

Study Limitations

This study was performed on low-risk patients and excluded those with GP IIb/IIIa inhibitors, coumadin, or those who had received thrombolytic therapy. In addition, patients with uncontrolled hypertension were excluded, as were the elderly and the obese. Whether the results of this study can be extrapolated to these subgroups is uncertain and deserves further clinical trials. Also, the relatively small population in this study makes it underpowered to detect very small differences between these two devices.

The 8 Fr AS and VS devices behave similarly in this prospective randomized study of low-risk patients undergoing routine percutaneous vascular procedures. To our knowledge, this is the first study that compared these two devices in a prospective, randomized design. Since this study was performed, the second-generation VS ES and the 6 Fr AS devices were released on the market. It is difficult to appreciate whether these modifications will truly result in a superior collagen closure device. Additional randomized studies using the new-generation devices and comparing their performance in a high-risk population are encouraged.

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REFERENCES


