Evaluation of in vitro performance of suction drains

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Objective—To assess the in vitro performance of suction drains.

Sample Population—11 drainage systems (3 rigid drains and 8 compressible drains [2 grenade type, 5 concertina type, and 1 pancake type]).

Procedures—A pressure transducer was connected to the patient end of each drainage system. Serial pressure measurements were obtained during incremental addition and removal of air into the reservoir of each system, followed by incremental addition of water. The volume of air removed to restore the initial suction was recorded. Maximum filling volume was compared with the stated reservoir volume. For compressible drains, the suction generated following 3 compression methods was compared.

Results—The initial suction generated by the drainage systems ranged from –633.4 ± 14.7 mm Hg to –90.1 ± 19.5 mm Hg. Rigid drains had greater initial suction than compressible drains. For all compressible drains, compression with 2 hands, rather than 1, produced greater suction, apart from the pancake-type (200-mL reservoir) drains for which the reverse occurred. For grenade-type drains, rolling the reservoir from apex to base generated greater suction than 1-hand compression. Maximum filling volume was lower than stated for the concertina-type drains with 50-mL, 25-mL, and 400-mL reservoirs and the rigid-type drain with a 200-mL reservoir. As increments of air or water were added, compressible drains lost suction rapidly up to a fill of 20% to 30% and then more gradually. Rigid drains lost suction more slowly.

Conclusions and Clinical Relevance—Drainage systems varied widely in their initial suction and rate of loss of suction during filling. (*Am J Vet Res* 2009;70:283–289)

A suction drain is a closed-tube drain used to evacuate fluid from a wound or cavity into an attached reservoir following a differential pressure gradient. Suction drains are routinely used in clinical veterinary practice. A wide range of systems are available with different methods of operation.[1] These can be broadly divided into systems with compressible reservoirs, which require evacuation of air by compression to create suction, and systems with rigid reservoirs, which provide suction by prior evacuation of air. There is little information available regarding the functional characteristics of drainage systems, including the initial suction pressures generated, how this changes as the reservoir fills, and how this varies among systems.

The suction pressure generated by suction drains will impact on drain system function. Excessive suction pressure may increase the volume and duration of fluid drainage,[2] and inadequate suction may result in ineffective drainage. Starling's law of transvascular fluid exchange[3,4] states that the balance between hydrostatic and oncotic pressure gradients in the intravascular and interstitial space determines fluid flow between these compartments. Therefore, as the suction pressure increases, so will the amount of fluid that is produced in the wound above that which would develop following surgery or trauma alone in an undrained wound.[5] In fact, experimental systems generating suctions between 50 and 200 mm Hg are used to produce effusion fluid for sample collection from the SC space.[6,7] Because the duration for which a drain remains in place is often dictated by the volume of fluid accumulating in the reservoir,[8] an increased volume of fluid collection may result in the drain remaining in place for longer, which may also dictate an extended hospitalization period.[2] Results of studies[9–11] in the human medical literature also indicate that excessive pressure can cause tissue damage.

The use of invasive devices, including suction drains, is associated with an increased rate of hospital acquired

Abbreviations

G100	Grenade-type 100-mL drain
G400	Grenade-type 400-mL drain
CA20	Concertina-type brand A 20-mL drain
CA50	Concertina-type brand A 50-L drain
CB25	Concertina-type brand B 25-L drain
CB400	Concertina-type brand B 400-mL drain
CC120	Concertina-type brand C 120-mL drain
P200	Pancake-type 200-mL drain
RA200	Rigid-type brand A 200-mL drain
RA400	Rigid-type brand A 400-mL drain
RB400	Rigid-type brand B 400-mL drain

Received September 26, 2007.
Accepted May 15, 2008.

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Presented in abstract form at the American College of Veterinary Surgeons Congress, Washington, DC, 2006.

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infection and surgical site infection in humans, and this is becoming an increasingly apparent problem in veterinary patients.[12] It is recognized that the presence of foreign material within a wound reduces the number of microorganisms required for infection by 10,000 fold.[13] An increased rate of wound infection or inflammation in association with the use of surgical drains has been documented in a prospective study[14] of surgical site infection in dogs and cats. The use of active suction drains reduces surgical site infection, compared with the use of open passive drains[15]; the constant negative pressure generated by the system minimizes the potential for retrograde flow of bacteria and fluid.[16] If suction is lost as the closed system fills, this protective effect is lost and the active removal of wound fluid will cease. An understanding of the functional characteristics of different systems will provide information to guide their use and design, allowing selection of appropriate suction drains for use in clinical cases. An improved understanding of the effects of drain use on fluid production in the wound may be used to optimize the duration of drain use, which may have an impact on duration of hospitalization, patient morbidity, and risk of hospital-acquired infection.

The clinical assessment of drain efficacy and decisions made regarding time of drain removal are largely based on the volume of fluid accumulating in the reservoir. It is therefore important that the function of the drainage system used is predictable and consistent. The drainage system should maintain suction to complete filling of the reservoir therefore allowing the clinician to accurately assess ongoing fluid accumulation in the reservoir as representative of ongoing fluid production in the wound. While the drain reservoir is not full, the clinician may assume that the drain remains functional, although in fact, there is no ongoing drainage. In this circumstance, fluid may continue to accumulate in the wound. There would also be the potential for retrograde movement of fluid in the drain tubing, leading to an increased risk of postoperative wound infection. This potential risk underscores the need for maintaining a negative pressure gradient and the need for aseptic technique when emptying the drain reservoir. An ideal drainage system should maintain suction pressure until complete filling of the reservoir and exert adequate but not excessive suction, therefore promoting fluid drainage but not inciting increased fluid production or causing tissue damage.

The aim of the study reported here was to assess the in vitro functional characteristics of commercially available active suction drainage systems used by specialist veterinary surgeons working in the United Kingdom. Objectives included determination of maximum initial suction generated by the drainage systems and how this may be affected by variation in operator use, determination of pressure-volume relationships during filling of the reservoir with water or air, and assessment of the maximum volume of water aspirated by use of the drainage systems set at the maximum initial suction. The initial suction generated by the drainage systems and their pressure-volume relationships during filling were hypothesized to vary widely among systems.

Materials and Methods

Drainage systems—A telephone poll of specialist veterinary surgeons working within the United Kingdom was performed to determine the make and brand of drains used in clinical veterinary practice. Eleven commercially available drainage systems were in routine use.[a–k] Samples of each of the drainage systems were obtained as prepared for clinical use. Each drainage system included a drain reservoir and drain tube with a fenestrated tip. Drainage systems were broadly classified as rigid drains (RA200,[i] RA400,[j] and RB400[k]) or compressible drains. Compressible drains included those with grenade-type reservoirs (G100[a] and G400[b]), concertina-type reservoirs (CA20,[c] CA5O,[d] CB25,[e] CB400,[f] and CC120[g]), and pancake-type reservoirs (P200[h]).

Drainage systems were assembled routinely with the drain tube supplied; when a choice of drain sizes was available, the tube in the middle of the range was selected. To create a single end opening at the patient end, the drain tube was cut immediately distal to the first fenestration and connected to a piezo-resistive differential pressure transducer[l] by use of an adaptor and 3-way stopcock.[m] An appropriate adaptor was selected for each drain tube to achieve an air-tight connection with the Luer lock of the 3-way stopcock. For larger drain tubes, the standard Luer-lock adaptor[n] was used. When this was not appropriate, an IV catheter[o] (14 to 18 gauge) was cut 5 mm from the hub and used as a push-fit adaptor (**Appendix**). The 3-way stopcock allowed a portal for addition or removal of incremental volumes of air or addition of water. The differential pressure transducer was connected to a volt meter[p] and received a constant power supply at 10 V.[q] The volt meter readings in millivolts were converted to millime-

Table 1—Mean ± SD subatmospheric pressure (suction) generated with manually compressible reservoirs by use of different methods of compression.

Drain type	Reservoir (mL)	1 hand (mm Hg)	2 hands (mm Hg)	Against tabletop or rolling (mm Hg)
G100	100	84.2 ± 7.7[a,b]	110.2 ± 16.4[a,c]	170.7 ± 11.0[b,c]
G400	400	79.3 ± 9.0[a,b]	119.2 ± 15.5[a]	132.1 ± 18.2[b]
CA20	20	231.5 ± 13.0[a,b]	251.7 ± 9.2[a]	249.0 ± 9.6[b]
CA50	50	218.4 ± 9.3[a,b]	244.8 ± 7.4[a,c]	238.0 ± 4.2[b,c]
CB25	25	178.0 ± 39.7[a]	199.8 ± 3.7[a,b]	166.6 ± 2.8[b]
CB400	400	64.5 ± 4.2[a,b]	108.6 ± 5.4[a,c]	97.2 ± 3.9[b,c]
CC120	120	113.6 ± 4.7[a,b]	145.9 ± 14.3[a]	138.0 ± 9.0[b]
P200	200	65.1 ± 7.2[a,b]	82.7 ± 12.3[a,c]	111.2 ± 7.9[b,c]

[a–c]Within each row, values with the same superscript letters are significantly ($P < 0.05$) different.

ters of mercury according to the calibration of the manufacturer. Readings were corrected before each measurement for pressure within the tubing system. An air-tight seal between the drainage system, adaptor, and pressure transducer was confirmed prior to the study. This was achieved by determining consistent readings at the initial suction pressure and 12 hours later, with the drainage systems undisturbed. The use of a differential pressure transducer corrected for variations in atmospheric pressure. The term suction is used synonymously with subatmospheric pressure.

Effect of methods of compression on maximum initial suction—For compressible drains, the initial suction generated was recorded following various techniques of compression. For all compressible drains, pressure measurements were recorded for compression with 1 hand or compression with 2 hands. For concertina-type and pancake-type reservoirs, compression against a rigid surface was also assessed. For grenade-type reservoirs (ie, G100 and G400), compression by rolling from apex to base was assessed. Ten repetitions of each technique were performed by a single investigator (ZJH).

Maximum initial suction—For rigid drains, the maximum initial suction was measured upon activation of the commercially supplied system; the rigid drains are supplied pre-evacuated by the manufacturer. A mean of 3 readings from 3 identical systems was calculated. For compressible drains, a mean value for all the techniques already described for the determination of the effect of methods of compression on maximum initial suction was recorded as the maximum initial suction.

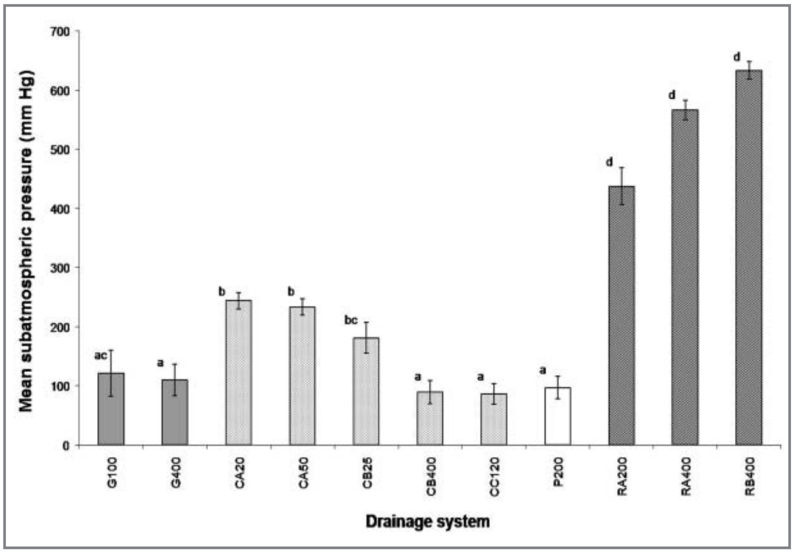

Figure 1—Mean ± SD subatmospheric pressure (suction) within the various drainage systems at initial activation. $^{a-c}$Different letters indicate significantly ($P < 0.05$) different pressures.

Pressure-volume relationships—Pressure-volume relationships were assessed during 3 phases. Pressure measurements were made at initial drain activation and during addition of incremental aliquots of air. Each aliquot was 10% of the total stated volume of the reservoir, and aliquots were added to reach the total stated capacity of the drain reservoir (phase 1). Incremental aliquots of air were then removed until the drainage system was reset at the initial pressure (phase 2), and pressure within the drainage system was recorded at each step. The volume of air that was removed to reset the drainage system at the initial pressure was recorded. Incremental aliquots of water, representing 10% of the stated volume of the reservoir, were then added to the drainage system to reach the total stated capacity of the drain reservoir (phase 3). For rigid drains, the volume of air that needed to be removed to reset the pressure indicator was recorded. Experiments were completed in triplicate by a single investigator (ZJH) for each drainage system; a new system was used each time.

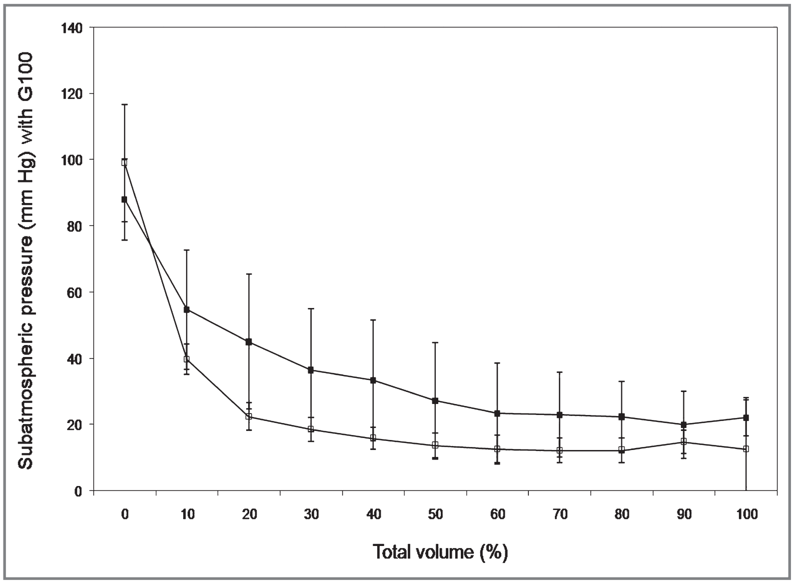

Figure 2—Mean ± SD subatmospheric pressure (suction) within the G100 drainage system during filling with incremental volumes (10% of total stated volume) of air (white symbols) or water (black symbols). Graph is representative of data from grenade-type compressible drainage systems (ie, G100 and G400).

Maximum volume of water aspirated—All drainage systems were set at their maximum initial suction, and the single end opening of the patient end of the drain was placed in a water bath positioned on a tabletop at the same level as the drain reservoir. The end of the drain tube remained submerged in the water bath for 1 hour. The volume of water aspirated into the drainage reservoir was recorded. This was repeated in triplicate for every drainage system.

Statistical analysis—Data are presented as mean ± SD. Differences between continuous variables were analyzed by use of a *t* test and a 1-way ANOVA, with a Tukey post hoc test.[r] Values of $P < 0.05$ were considered significant.

Results

Effect of methods of compression on maximum initial suction—For all compressible drains, compression with 2 hands produced a significantly ($P < 0.001$) greater suction than compression with 1 hand. For the grenade-type drains (ie, G100 and G400), rolling the reservoir from apex to base generated a significantly ($P < 0.001$) greater suction than 1-hand compression for both reservoir sizes and a significantly ($P < 0.001$) greater suction than 2-hand compression for the 100-mL reservoir but not the 400-mL reservoir ($P = 0.061$). For the concertina-type drains, compression against the tabletop resulted in significantly ($P = 0.043$ to < 0.001) less suction than compression with 2 hands for the CA50, CB25, and CB400; made no difference for the CA20 and CC120 ($P = 0.091$ to 0.581); and resulted in a significantly ($P < 0.001$) greater suction for the P200 (**Table 1**).

Maximum initial suction—All rigid drains had a significantly greater initial suction than all compressible drains. All rigid drains of different types and volumes had significantly different initial suction from each other. No significant difference was found in the suction pressure generated by the CA20, CA50, and CB25 systems, and these systems generated a significantly greater suction pressure than the other concertina-type drains (CC120 and CB400). No difference was found in the initial suction pressure generated by the 2 grenade-type drains (G100 and G499; **Figure 1**).

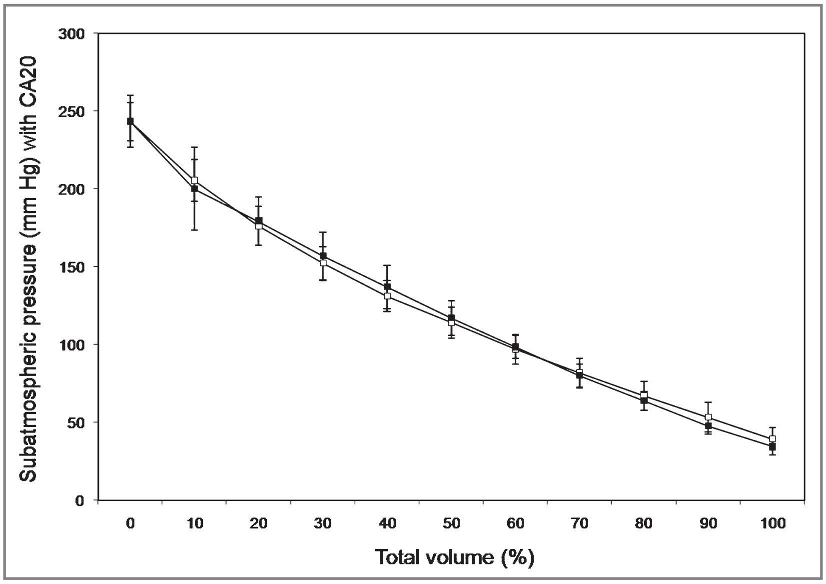

Figure 3—Mean ± SD subatmospheric pressure (suction) within the CA20 drainage system during filling with incremental volumes (10% of total stated volume) of air (white symbols) or water (black symbols). Graph is representative of data from concertina-type and pancake-type compressible drainage systems (ie, CA20, CA50, CB25, CB400, CC120, and P200).

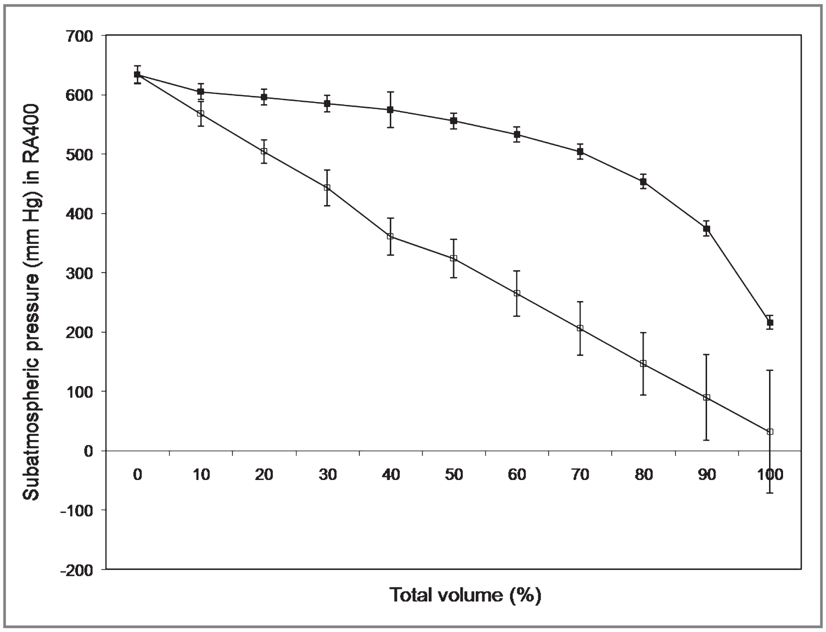

Figure 4—Mean ± SD subatmospheric pressure (suction) within the RA400 drainage system during filling with incremental volumes (10% of total stated volume) of air (white symbols) or water (black symbols). Graph is representative of data from rigid drainage systems (ie, RA200, RA400, and RB400).

Pressure-volume relationships—Pressure-volume relationships during filling varied among different types, brands, and sizes of drainage systems. Grenade-type compressible drainage systems (ie, G100 and G400) had a higher rate of initial suction loss, followed by maintenance of a consistent low amount of suction throughout filling (**Figure 2**). Pancake-type and concertina-type compressible drains had a loss of suction proportional to the amount of reservoir filling in a linear fashion (**Figure 3**). Rigid drains maintained a high amount of suction, compared with the initial suction pressure throughout filling (**Figure 4**). A distinct difference in the pattern of suction loss was observed when comparing the functional characteristics of the different system types (**Figure 5**). When each drainage system was infused with air (10% of the stated capacity of the reservoir), the remaining suction pressure was significantly less than the initial suction pressure. When this test was repeated with water (again, a volume representing 10% of the stated capacity), only the RA200 and RA400 had values that were not significantly less than their initial pressure. When 50% of the stated capacity was filled with air or water, all drains had significantly less suction than the maximum initial suction. The suction pressure maintained by the drainage system at 50% fill with water was significantly greater than the suction pressure maintained by the system at 50% fill with air for the CA20 ($P = 0.021$), RA400 ($P = 0.003$), and RB400 ($P = 0.001$).

Suction was not maintained when the reservoir was filled to 90% of the stated volume with air or water for the CA50, CB25, CB400, and RA200 and when the reservoir was filled to 100% of the stated volume for the CC120 and RA400 (**Table 2**). Compressible drains lost suction rapidly at 20% to 30% fill and then more gradually. The change in pressure was similar when filling with air or water. Rigid drains lost suction more slowly, and greater suction was maintained when filling with water, compared with air.

The mean volume of air that was removed to return each drainage system to the initial subatmospheric pressure varied (Table 2). For all drainage systems, the volume of air that had to be removed from the reservoir to restore the original subatmospheric pressure exceeded the maximum stated volume of the reservoir. For the compressible drains, the volume of air removed ranged from 98% to 140% (expressed as a percentage of the stated maximum volume of the reservoir). For the rigid drains, the volume of air that was removed ranged between 160% and 330% of the stated maximum volume of the reservoir. For the rigid drains, the volume of air required to reset the pressure indicator was 72.8%, 57.5%, and 58.6% for the RA200, RA400, and RB400, respectively.

Maximum volume of water aspirated—The volume of water aspirated by the drainage system was significantly lower than the stated volume for the CA50 ($P = 0.036$), CB25 ($P = 0.020$), CB400 ($P < 0.001$), and RA200 ($P = 0.005$; **Figure 6**).

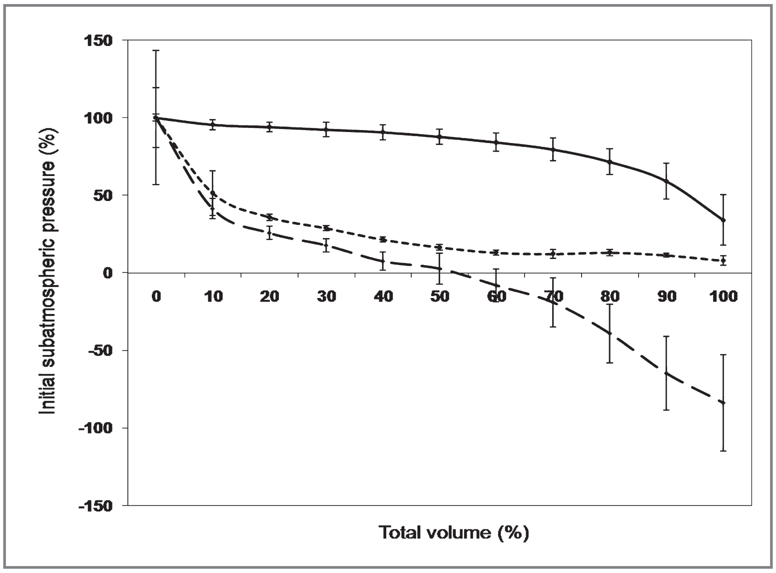

Figure 5—Percentage change in mean ± SD subatmospheric pressure (suction) during filling with water for 3 types of drainage systems with a stated maximum volume of 400 mL (solid line represents RB400, dotted line represents G400, and dashed line represents CB400).

Discussion

Examination of the in vitro performance of the active suction drains allows a rational basis for their clinical use to be established and will guide adjustment in system design. On the basis of this study, grenade-type compressible suction drains appear to perform in a safe, predictable, and consistent manner and operate with a lower amount of suction that, while promoting ongoing drainage from the wound, will have a minimal effect upon fluid production in the wound. The in vitro performance of the grenade-type drainage systems conforms to our proposed criteria for an ideal suction drainage system. Further in vivo studies are required to verify these assumptions.

Results of the study reported here support the hypothesis that the initial pressure generated by suction drains varies widely for different types, brands, and reservoir size of drainage system. There was a wide range of initial pressures generated by different systems, with a clear distinction between the high-pressure rigid drainage systems and the low-pressure compressible

Table 2—Mean ± SD (median) subatmospheric pressure (suction) within the various drainage systems at initial activation and maximum filling volumes of drainage systems.

				Volume of air removed in milliliters (%SMV)	
Drain type	Subatmospheric pressure at initial activation (mm Hg)	Maximum filling volume in milliliters (%)	Fill volume when suction lost (% SMV)	To return to initial pressure	To reset indicator
G100	121.7 ± 38.7^{a,c}	105.0 ± 5.29 (105)	Not lost	110 ± 0 (110)	NA
G400	110.2 ± 26.9^{a}	398.3 ± 12.6 (99.6)	Not lost	406.7 ± 23 (102)	NA
CA20	244.1 ± 13.8^{b}	28.7 ± 4.9 (143)	Not lost	28 ± 2 (140)	NA
CA50	233.7 ± 13.4^{b}	42.0 ± 2.7* (84)	90% air (80% water)	58.3 ± 3 (117)	NA
CB25	181.4 ± 26.3^{b,c}	21.0 ± 1.0* (84)	90% air (90% water)	29.2 ± 1.4 (117)	NA
CB400	90.1 ± 19.5^{a}	243.3 ± 1.9* (61)	60% air (60% water)	393.3 ± 23.1 (98)	NA
CC120	86.5 ± 17.1^{a}	110.7 ± 9.2 (92)	Not lost	132 ± 0 (110)	NA
P200	97.3 ± 18.9^{a}	177.0 ± 43.6 (89)	Not lost	220 ± 11.5 (110)	NA
RA200	437.6 ± 31.2	153.3 ± 5.8* (77)	70% air (80% water)	320 ± 40 (160)	180 ± 53 (72.8)
RA400	566.3 ± 16.6	390.0 ± 17.3 (98)	Not lost	906.6 ± 23.1 (227)	320 ± 40 (57.5)
RB400	633.4 ± 14.9	406.6 ± 11.6 (102)	Not lost	1320 ± 138.6 (330)	386 ± 83 (58.6)

*Significant ($P < 0.05$) difference between actual filling volume and stated volume of the reservoir.
%SMV = Percentage of stated maximum volume. NA = Not applicable.
$^{a–c}$ Within the column, values with the same superscript letters are not significantly ($P < 0.05$) different.

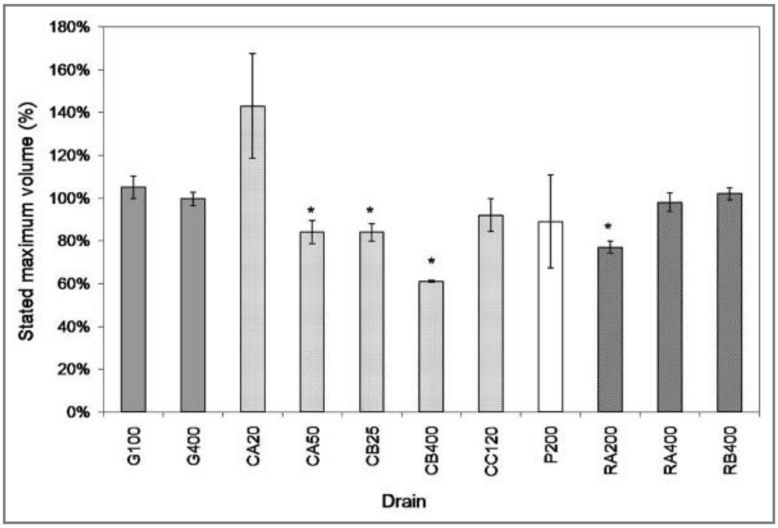

Figure 6—Mean ± SD volume of water aspirated by each drainage system as a percentage of the stated maximum volume for each drainage system. *Significantly ($P < 0.05$) different from the stated maximum.

drainage systems. For the compressible drainage systems, the variability of initial suction generated was further compounded by the outcome of different methods of compression. When comparing the initial suction of drainage systems of the same brand but with a different reservoir size, there was no significant difference in suction generated by the concertina-type drains of brand A and grenade-type drains. For all other systems examined, a different reservoir size resulted in significantly different suction pressure; there was no consistent relationship between change of reservoir size and relative increase or decrease in suction. The selection of drainage system type, reservoir size, and the mode of operation used for compressible drainage systems results in a wide variation of suction exerted within the wound. Rigid drainage systems assessed in this study generated between 430 mm Hg and 630 mm Hg of subatmospheric pressure at initial activation, and a high amount of suction was maintained during filling of the reservoir. This amount of suction in the wound is likely to promote further fluid production,[3,4,6,7] which does not conform to our proposed characteristics of an ideal suction drain.

Pressure-volume relationships were determined for all systems and revealed the different functional characteristics. All drains had a decline in suction pressure as the reservoir was filled, and the rate of loss of pressure was more rapid with compressible reservoirs than rigid drainage systems. A number of drains, including those in the compressible and rigid drain groups (CA50, CB25, CB400, and RA200), did not maintain suction at filling volumes significantly below the stated maximum on the reservoir. Both grenade-type reservoir, 2 concertina-type reservoir (CA20 and CC120), and the pancake-type reservoir (P200) drainage systems and 2 of the rigid drainage systems (RA400 and RB400) maintained suction pressure throughout filling of the reservoir. Pressure-volume graphs revealed the differing patterns of loss of suction. Rigid drains maintained a high amount of suction throughout filling. Pancake-type and concertina-type compressible drains had a loss of suction proportional to the amount of reservoir filling in a linear fashion. Grenade-type compressible drains had a higher rate of initial suction loss, followed by maintenance of a consistent low amount of suction throughout filling. The pattern observed with the grenade-type compressible drains seems ideal to accommodate the rate of fluid production anticipated from a wound, with a higher rate of fluid production following initial tissue trauma, which then decreases.

The volume of air removed from each system to return to the initial suction pressure was determined after equilibration with atmospheric pressure. This information is of relevance in a clinical setting if attempting to recharge the suction pressure in a drainage system. It is of note that, as a percentage of initial maximum stated capacity, the rigid evacuated reservoirs required removal of a relatively greater volume of air than the compressible reservoirs. The pressure indicator of all rigid drains was reset following removal of only a fraction of the volume of air removed to regain the initial subatmospheric pressure. The pressure indicator can therefore only be a considered a crude indicator of the amount of subatmospheric pressure within a system and the likely clinical efficacy of that system.

This study has a number of limitations. Water was used to simulate the wound fluid in this study, and other fluids were not assessed. Results obtained may have varied if a fluid of greater viscosity with particulate matter was used, and the use of water may not truly reflect how the systems behave during clinical use. All of the drainage systems were used with the drainage tube supplied commercially, and variations in drain size and length were not assessed. However, the relationship between drain length, luminal diameter, and pressure differential between the 2 ends of a cylindric tube can be determined with the Poiseuille-Hagen equation for laminar flow.[17] The study assessed the pressure generated within the drainage system and not the pressure generated by each drainage system within a wound. The variation in the tip of each drain tube is likely to have a substantial effect on the subatmospheric pressure exerted in the wound; this was not examined in this study. Future examination of the in vitro performance of these active suction drains will allow a rational basis for their clinical use to be established and will guide adjustment in system design.

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a. Jackson Pratt 100 mL, Cardinal Health, Swindon, England.
b. Jackson Pratt 400 mL, Cardinal Health, Swindon, England.
c. Mini Redon 20 mL, Primed, Halberstadt Medizintechnik, Halberstadt, Germany.
d. Mini Redon 50 mL, Primed, Halberstadt Medizintechnik, Halberstadt, Germany.
e. B Vak mini wound drainage system, 25 mL, Biçakcilar, Istanbul, Turkey.
f. B Vak wound drainage system 400 mL, Biçakcilar, Istanbul, Turkey.
g. Vygon 120 mL, Vygon, Ecouen, France.
h. Wound Evac 200 mL, Microtec Medical, Staffordshire, England.

i. Privac 200 mL, Primed, Halberstadt Medizintechnik, Halberstadt, Germany.
j. Privac 400 mL, Primed, Halberstadt Medizintechnik, Halberstadt, Germany.
k. Braun Redovac 400 mL, B Braun, Sheffield, England.
l. Part No. 235 5790, RS components, Corby, Northants, England.
m. Smiths Medical, Kirchseeon, Germany.
n. Little Herbert, SurgiVet, Waukesha, Wis.
o. Jelco IV catheter, Medex Medical, Haslingdon, England.
p. Fluke 25 multimeter, RS components, Corby, Northants, England.
q. Manson EP-613, 0 to 30 V, 2.5 A DC Power Supply, Manson Engineering Industrial Limited, Hong Kong, People's Republic of China.
r. StatView for Windows, version 5.01, SAS Institute Inc, Cary, NC.

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Appendix

Adaptors used for connection of each drain tube to the Luer-lock of the 3-way stopcock.

Drain type	Reservoir size (mL)	Drain size (mm)	Adaptor
G100	100	4.0	Luer-lock adaptor[n]
G400	400	4.0	Luer-lock adaptor[n]
CA20	20	2.0	18-gauge catheter[o]
CA50	50	2.0	18-gauge catheter[o]
CB25	25	2.4	16-gauge catheter[o]
CB400	400	3.0	14-gauge catheter[o]
CC120	120	2.0	18-gauge catheter[o]
P200	200	2.4	16-gauge catheter[o]
RA200	200	4.0	Luer-lock adaptor[n]
RA400	400	4.0	Luer-lock adaptor[n]
RB400	400	6.0	Luer-lock adaptor[n]