Engorgement Annotated Bibliography
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REFERENCE	Content	LEVEL OF EVIDENCE
	MANAGEMENT STRATEGIES FOR ENGORGEMENT IN LACTATING WOMEN OR BOTH LACTATING AND NON-LACTATING WOMEN	
Snowden HM, Renfrew MJ, Woolridge MW. Treatments for breast engorgement during lactation. Cochrane Database Syst Rev. 2001;(2):CD000046	Systematic review of randomized and 'quasi-randomized' controlled trials that assessed effectiveness of treatments for breast engorgement in providing symptomatic relief. 8 trials of 424 women included. 3 studies used cabbage leaves or extract without overall benefit. Oxytocin and cold packs were without benefit. Ultrasound was also no better than placebo. An anti-inflammatory agent (Danzen) and bromelain/trypsin complex were found to be superior to placebo in improving symptoms.	II-3
Nikodem VC, Danzinger D, Gebka N, Gulmezoglu AM, hofmeyr GJ. Do cabbage leaves prevent breast engorgement? A randomized, controlled study. Birth. 1993;20(2):61-4	Randomized controlled trial of 120 women enrolled 72 hours postpartum and assigned to either routine care (60) or to the use of cold cabbage leaves applied after the next 4 consecutive feeding for approximately 20 minutes each or they reached body temperature. Mean number of applications in the treatment group was 3. A similar number of women from each group regarded their breasts as engorged before the first application (32: treatment vs 29: control). There was no statistically significant difference in the women's perception of engorgement noted. There was a slight increase in duration of breastfeeding as assessed at 6 week postpartum survey in the treatment group (36 d: treatment vs. 30 d: control, P=0.04).	I
Storr G. Prevention of nipple tenderness and breast engorgement in the postpartal period. JOGNN 1988 May/June 203-209	37 volunteer healthy primigravida women with uncomplicated singleton pregnancies were recruited into the study and served as their own controls.. Prenatal nipple conditioning was instructed to the volunteers including: 1) nipple rolling twice daily for 30 seconds 2) gently rubbing nipples with a terry towel twice daily for 15 seconds. Breast massage was also instructed to this group and was to be performed 4-5 times after feeds. Nipple preparation was begun at 34 weeks. Massage was initiated in the postpartal period and continued for 4 days. 25 of the women completed the study. The nipple conditioning and breast massage were performed on one breast and the other breast was used as control. Only one participant noted no difference in nipple tenderness. The cumulative tenderness ratings for the other 24 participants noted less overall pain on the experimental side ($p = 0.001$). Seven women performing massage noted no difference in engorgement between breasts. Fourteen women performing massage reported less overall engorgement on the experimental side ($p = 0.004$).	III
Kee WH, Tan SL, Lee V, Salmon YM. The treatment of breast engorgement with	70 symptomatic women who complained of engorgement were randomized to Danzen 10mg 3 times daily or placebo 3 times daily for 3 days. All other drugs were withheld during the	I

Serrapeptase (Danzen): a randomized double-blind controlled study. Singapore Med J. 1989 Feb;30(1):48-54	treatment period. An independent observer assessed symptoms based on a 4 point scale beginning prior to therapy and daily during therapy. An improvement rating was then assigned using a 5 point scale, (1 marked improvement – 5 worsening symptoms). Thirty-five patients were included in each group. Only 4 patients in the Danzen group and 8 in the placebo group breastfed their infants during the study. Three patients in the Danzen group and 5 in the placebo group used massage and pumping during treatment. The improvement ratings revealed marked improvement in 22.9% of the women in the Danzen group as compared to 2.9% in the placebo group. 85.7% in the Danzen group reported either marked or moderate improvement compared to 60% in the placebo group. These differences were statistically significant with $P < 0.05$.	
Roberts KL, Reiter M, Schuster D. A comparison of chilled and room temperature cabbage leaves in treating breast engorgement. J Hum Lact 1995 Sep; 11(3): 191-4	28 exclusively or almost exclusively breastfeeding women were recruited into the study when they noted engorgement. Pain was measured pre-treatment and post-treatment. Treatment consisted of chilled green cabbage leaves to one breast and room temperature cabbage leaves to the other for a 2 hour period. A hole was cut in the cabbage leaves for the nipple. Discomfort was rated with a questionnaire. Engorgement began on day 2 in 36% and day 3 in 36% of the mothers. 70% stated they had difficulty feeding the baby related to the engorgement. Mean pre-treatment pain rating was 5.4 using the Bourbonnais pain ruler. Post-treatment mean pain rating was 3.3 for chilled cabbage leaves and 3.4 for room temperature leaves. This represented a 37-38% reduction in pain rating which was statistically significant ($p = 0.001$) from pre-treatment. There was no statistically significant difference between treatment groups.	II-2
Cotterman KJ. Reverse pressure softening: a simple tool to prepare areola for easier latching during engorgement. J Hum Lact. 2004 May;20(2):227-37	Description of reverse pressure softening. Review speculates as to potential etiology, physiology and predisposing factors leading to engorgement such as intravenous fluid administration, use of oxytocin during labor and the use of breastpumps. Basic principles for reverse pressure softening are described and 4 different methods for application are mentioned. Three therapeutic effects of the technique are listed as: 1) stimulation of milk ejection reflex 2) reduction of tension in the walls of the lactiferous sinuses 3) shifting the edema.	III
Roberts KL, A comparison of chilled cabbage leaves and chilled gelpaks in reducing breast engorgement. J Hum Lact. 1995 Mar;11(1):17-20	34 exclusively or almost exclusively breastfeeding women (20 primipara and 14 multipara) with breast engorgement were enrolled. Chilled cabbage leaves with a hole for the nipple were applied to one breast while breast shaped gelpaks were applied to the other excluding the nipple. A self administered questionnaire was given before and after treatment and measurement of pain was assessed using a visual analogue scale. Gelpaks and cabbage leaves were renewed “ad lib, usually every 2 to 4 hours”for up to 8 hours. Engorgement occurred between 2 and 6 days postpartum	II-2

	with 50% occurring on day 3. Mean onset of engorgement was 3.6 days in primipara and 2.8 days in multiparous women. Prior to treatment, the mean pain rating using the Bourbonnais pain ruler was 5.9. The post treatment mean rating for cabbage leaves was 4.1 and 3.7 for gelpaks.There was no statistically significant difference between treatment groups with both representing a statistically significant reduction in pain from pre-treatment levels ($p = 0.0001$). Cabbage leaves reduced pain by 1.8 points (30%) and gelpaks reduced pain by 2.2 points (39%). Sixty-eight % reported relief within 1-2 hours.	
Roberts KL, Reiter M, Schuster D. Effects of cabbage leaf extract on breast engorgement. J Hum Lact. 1998 Sep;14(3):231-6	Double blind placebo controlled trial for the treatment of breast engorgement in 39 lactating women. The treatment group received a cream containing cabbage leaf extract while 18 received a placebo cream. Symptoms were evaluated using 4 methods both prior to and after 2 hours of treatment. These were: 1) The Hill and Humenick Breast Engorgement Scale (a 6 point scale) 2) The Bourbonnais pain scale (a visual analogue scale from 0-10) 3) The Roberts Durometer (a device measuring resistance of tissue to the compression of a spring designed to detect tension of hardness) 4) Maternal chest circumference. 54% of mothers reported difficulty in feeding the baby due to engorgement. There was no statistically significant difference in any of the parameters measured by treatment group. The mean decrease in pain after treatment as measured by the Bourbonnais pain scale was 0.8 points.	II-1
Evans K, Evans R, Simmer K. Effect of the method of breast feeding on breast engorgement, mastitis and infantile colic. Acta Paediatr. 1995 Aug;84(8):849-52	An opportunity sample of breastfeeding women were assigned to either the experimental group (n=150) or the control group (n=152). The experimental group was asked to empty one breast at each feeding alternating which breast was offered first while the control group was instructed to offer both breasts at each feed. Mothers were seem daily for the first 8 days and infant were weighed on day 3,5 and 8. Questionnaires were administered to evaluate symptoms. There was significantly less breast engorgement in the experimental group (61.4%) than in the control group(74%) $p<0.02$. There was no difference in infant weight or the incidence of mastitis between groups. There was also less colic in infants followed to 6 months in the experimental compared to the control group (12% verses 23%, $p<0.02$). Overall, 49% of mothers were still nursing at 6 months.	II-1
Newton M, Newton N. Postpartum engorgement of the breast. Am J Obstet Gynecol. 1951 Mar;61(3):664-7	An observational study of 47 post-partum women using clinical estimations of breast engorgement on average 67 hours after delivery (range 38-100 hours). The clinical estimation of breast engorgement was made by an experienced observer, chest circumference just above the nipple was then measured while the patient was lying flat. The amount of milk in the breast was then estimated by allowing infant feeding for 20 – 30 minutes using test weights, followed by electric breast pumping for 5 minutes,	III

	followed by injection of 0.3 cc of pitocin with subsequent additional pumping for 5 minutes beginning one minute after the pitocin injection. The total amount of milk in the breast was then estimated by combining these measurements. Engorgement was scaled with 0 representing no engorgement and 4+ representing breast which were "very hard, lumpy and tense". The results were as follows: 9 measures with an engorgement score of 0 had an increase in chest circumference of 0.4cm, 60 measures of 1+ had in increase of 2.2cm, 29 measures of 2+ had an increase of 3.1cm, 13 measures of 3+ had an increase of 4.2cm, and the 8 measures of 4+ engorgement had an increase of 4.6cm. Similarly the average amount of milk increased with the level of engorgement from 5gms with an engorgement rating of 0 to 110gms with a rating of 3+. A single measure was performed in a woman with 4+ engorgement and it was diminished at 36gms. The authors speculate that this may have been due to the fact that her more severe symptoms limited breast pumping. They also found that in 65% of patients more than an additional 25% of the milk volume occurred after the administration of pitocin though they describe the breasts at that time to appear "almost dry". The authors speculate that breast engorgement begins with retention of milk and that the features of vascular and lymphatic stasis may occur secondarily	
Ingelman-Sundberg A. Early puerperal breast engorgement. Acta Obstet Gynecol Scand. 1953;32(4):399-402	A blinded study of treatment of symptomatic breast engorgement in 40 postpartum nursing women enrolled between 2 and 4 days after delivery. Symptomatic women were treated with either 2.5IU of oxytocin daily until the breasts were soft or a saline placebo injection. The amounts of milk was recorded and no differences were noted between groups.	II-2
Ryan GM Jr, Brown DA. Intranasal syntocinon and postpartum breast engorgement. Obstet Gynecol. 1962 Nov;20:582-4	A randomized double blind trial of nasal syntocinon compared to placebo on postpartum breast engorgement. A nasal spray containing either 40 IU/cc of syntocinon or placebo was given to use at 20 minute intervals after delivery if the women noted breast discomfort. The estimated spray from the inhaler delivered 800 mU. The initial group of 50 treated patients were to use the inhaler one spray per nostril. The second group of 30 treated patients used it 2 sprays per nostril. The placebo group included 88 patients. One-third of patients did not experience symptoms to warrant treatment. Engorgement typically began on day 3, increased in severity over the next 12 hours, lasted 48 hours and then subsided. The degree of engorgement (rated on a scale of 0 to 4+) was not correlated with discomfort. There was no difference in symptom relief between those patients treated with syntocinon and those receiving placebo.	I
Thornton DR Jr. Oxytocin nasal spray in the treatment of breast	A study of oxytocin nasal spray 40 IU/cc used in 7 breastfeeding and 78 non-nursing mothers for postpartum breast engorgement.	III

engorgement. Obstet Gynecol. 1961 Dec;18:701-3	The patients were instructed to use the spray one dose per nostril as needed to relieve breast engorgement. Most using the medication 2-3 times daily for 2-3 days starting post-partum day one. The breastfeeding mothers were instructed to use the medication for pain which remained after nursing. The authors report that the "effect obtained in all 7 was excellent" and this treatment "removed the need for supplemental nursings". Ice was also used for comfort but pain medications were note needed. The authors also report that "total relief" of breast engorgement occurred in 61 of 78 non-nursing mothers but go on to describe the use of ice and testosterone in some women.	
Tyson JE, Perez A, Zanartu J. Human lactational response to oral thyrotropin releasing hormone. J Clin Endocrinol Metab. 1976 Oct;43(4):760-8	Three study groups were evaluated to study response to thyrotropin releasing hormone (TRH). The first study evaluated 6 nursing women between 5 and 35 days postpartum given 5mg of TRH compared to 5 receiving placebo. Blood was evaluated in the first 3 hours after dosing. Mean prolactin levels were found to increase by 46.3 ng/ml 60 minutes after TRH administration. The second study evaluated 60 "fully" nursing women given 5mg TRH or placebo daily for 30 days beginning on day 29 post-partum. Blood and milk samples were collected weekly though half of the mothers were dropped from the study due to changes in nursing. No differences in milk production were noted in this group of fully breastfeeding women as assessed by infant weight. The 3rd study group consisted of 13 women with "lactational insufficiency" who were partially nursing between postpartum day 13 and 71. Four were treated with 5mg and 9 with 20mgs twice daily for 5 days. Blood and milk levels were collected. Basal plasma prolactin levels were increased on days 2 and 3 of TRH administration. Women in this group treated with TRH reported an increase in breast engorgement, milk let down and were able to fully breastfeed.	III
Rosier W. Cool Cabbage Compresses. Breastfeed Rev. 1988;12:28	Case report of the use of cabbage leaves for the successful treatment of engorgement. The article summarizes 9 "interesting case" treated with the application of cabbage leaves from 30 cases that the lactation consultant had supervised. Two of these cases involved the suppression of lactation while the remaining cases were for management of engorgement symptoms in nursing mothers. The authors describes using cleaned, cold (preferably refrigerated) cabbage leaves applied to the breasts and changing them every two hours or when limp. Other measures were used simultaneously to support breastfeeding in the nursing mothers.	III
	MANAGEMENT STRATEGIES FOR SUPPRESSION OF LACTATION AND MANAGEMENT OF ENGORGEMENT IN NON-LACTATING WOMEN	

Reisfield DR, Paret FL. Value of a diuretic in suppressing breast engorgement. J Med Soc N J. 1966;63(10):458-61	Prospective double blinded study of hydroclorothiazide verses placebo in 100 consecutive postpartum women who did not plan on nursing. 90 women (44 treated and 46 placebo) completed study. 28 treated HCTZ women had 55 days with milk. 38 placebo patients had 65 days with milk. No statistically significant difference in milk production. Both groups reported PPD #4 as most painful. Women in the HCTZ group did report fewer total days of pain (37 treatment vs 55 placebo), fewer days requiring analgesics (25 HCTZ vs 40 placebo) and fewer days requiring ice packs (17 HCTZ vs 35 placebo). The later measurement was statistically sign. at P= 0.05	II-1
Brooten DA, Brown LP, Hollingsworth AO, Tanis JL, Donlen J. A comparison of four treatments to prevent and control breast pain and engorgement in nonnursing mothers. Nurs Res. 1983;32(4):225-9	Prospective observational study of 68 women delivered vaginally. Group assignment was random with the exception of the group given bromocriptine which was assigned by physician. Group 1 received Bromocriptine 2.5 mgs BID x 14 days. Group II received a tight fitting bra. Group III had fluids limited to 1500ml/m^2/day. Group IV received a compression binder. Chest circumference, pain, breast leakage and breast tension were measured. There was no stat. sign difference in chest circumference from day 1-5. Fewer women in the bromocriptine group experienced breast leakage than the other 3 treatment groups ($P<0.01$). There was also less pain in the bromocriptine group compared to the bra group ($P<0.05$). Irrespective of treatment group, the highest incidence of pain was between day 3 and 5.	III
Wong S, Stepp-Gilbert E. Lactation suppression: nonpharmaceutical verses pharmaceutical method. JOGNN 1985 July/August 302-310	Population study of postpartum non breastfeeding mothers. 36 treated with bromocriptine suppressive therapy and 17 treated with non pharmaceutical therapy consisting of 1) tight bra/binder within 6 hours after delivery for 5 days after delivery. 2) Ice packs over axillary breast tissue 15-20 minutes 4 times daily for 5 days. 3) No warm water to breasts while showering. 4) No stimulation of nipple or massage for one week. Engorgement in the drug group peaked on day 9, while the non-pharmaceutical group's engorgement peaked on day 4. Similarily, discomfort peaked on day 9 for the drug group and day 4 for the non pharmaceutical group.	II-1
Piya-Anant M, Worapitaksanond S, Sittichai K, Saechua P, Nomral A. The combined oral contraceptive pill verses bromocriptine to suppress lactation in puerperium: a randomized double blind study. J Med Assoc Thai. 2004 Jun;87(6):670-3	Randomized double blind study in 230 HIV positive mothers after normal term delivery, 116 received combined pills (100 micrograms twice daily for 5 days) and 114 received brompcriptine. Therapy was initiated within 12 hours after delivery. Breast engorgement occurred in 33 (28.5%) of women treated with combined pills and in 29 (25.4%) treated with bromoctiptine. All engorgement was reported as mild with the exception of one patient in the bromocriptine group (0.9%) who experienced fever and required analgesics. No side effects were noted from the drug therapy.	I
Swift K, Janke J. Breast	60 non-breastfeeding post-partum women were randomly assigned	II-2

binding…is it all that it's wrapped up to be? J Obstet Gynecol Neonatal Nurs. 2003 May-Jun;32(3):332-9	to either breast-binding (n=30) or the use of a support bra (n=30) for the first 10 days after delivery. They then completed questionnaires involving breast engorgement, tenderness, leakage and the use of other pain relief measures. Analysis revealed no significant difference between groups for engorgement. Those women using breast binders experienced more breast tenderness and leakage and were more likely to use other pain relief measures ($p < 0.05$). Engorgement peaked in both groups on day 4 and leaking and tenderness peaked on days 3 and 4.	
Fioretti P, Nasi A, Medda F, De Murtas M, Melis GB, Caminiti F. Inhibitory effect of prostaglandin F2alpha (PgF2alpha) on puerperal lactation. Acta Eur Fertil. 1977 Sep;8(3):265-71	20 women with a medical indication for lactation suppression were treated on post-partum day #4 with 10mg of PgF1alpha in a saline infusion. Blood was collected for prolactin testing prior to infusion and every 4 hours for 24 hours then daily for 6 days. Milk secretion and engorgement were classified on a scale of 0-3 with 0 being absent and 3 being high. These were assessed prior to infusion and after 4, 12 and 24 hours and then daily thereafter. Plasma prolactin levels decreased immediately after infusion, "these levels were up to almost basal levels after 16 to 20 hours". Treatment of two patients during post-partum day #2 did not prevent lactation on the 4^{th} day.	III
Spitz AM, Lee NC, Peterson HB. Treatment for lactation suppression: little progress in one hundred years. Am J Obstet Gynecol. 1998 Dec; 179(6 Pt 1):1485-90.	A review attempting to characterize engorgement symptoms in non-breastfeeding women and data review of the efficacy of various agents to suppress lactation. Medline, Popline and the Cochrane database were used to identify articles. Selection criteria included a randomized trial design, a placebo group with at least 45 women and data on lactation symptoms. Fifteen studies met criteria. Results included a peak in the symptoms of breast pain, leakage and engorgement at days 3-5. Up to $2/3^{rd}$ of women experienced moderate or severe engorgement and pain. Analgesics were used by 22-47%.	III (review)
Almeida OD, Kitay DZ. Lactation suppression and puerperal fever. Am J Obstet Gynecol. 1986 Apr;154(4):940-1	Prospective randomized double-blinded placebo controlled study comparing bromocriptine (n=45) to placebo(n=47) in 75 non breastfeeding puerperal women. Fever was defined as $\geq$100.0. Ten women (13.3%) were considered to have fever associated with breast engorgment. 4 of 10 febrile patients were treated with parlodel while the remaining 6 received placebo. No fevers occurred in those women receiving parlodel < 18 hours after delivery.	II-2
Booker DE, Pahl IR. Control of postpartum breast engorgement with oral contraceptives. Am J Obstet Gynecol. 1967 Aug 15;98(8):1099-101	Observational study in 100 non-nursing women using 2mg norethindrone and 0.1mg mestranol once daily for 20 days post-partum beginning 2 hours after delivery. Breast symptoms were evaluated daily for 5 days and then intermittently through 6 weeks post-partum. The highest number of women experienced engorgement on day 4 with 18 women reporting slight symptoms and 9 reporting moderately severe engorgement. No women reported experiencing very severe engorgement throughout the	III

	study period. Overall 54% of treated patients reported experiencing no breast symptoms throughout the study period.	
Markin KE, Wolst MD Jr. A comparative controlled study of hormones used in the prevention of postpartum breast engorgement and lactation. Am J Obstet Gynecol. 1960 Jul:80:128-37	680 non-nursing mothers were assigned to 9 different groups (either active or placebo medications). 194 failed to complete the study. Complete data were analyzed for 486 patients (268 treated with endocrine medication and 218 treated with placebo. The treatment groups were as follows: diethylstilbestrol (52), dienesterol plus methyl-testerone (58), conjugated estrogens equine plus methyl-testerone (49), testerone propionate plus diethylstilbestrol (67), testerone enanthate plus estradiol valerate (42) (Deladumone). The only hormonal regiem with a "net effectiveness" greater than placebo ($p < 0.001$) was testerone enanthate plus estradiol valerate. All endocrine agents provided some symptom control during the 5 days after delivery, however most failed to prevent delayed engorgement.	II-2
Duckman S, Hubbard JF. The role of fluids in relieving breast engorgement without the use of hormones. Am J Obstet Gynecol. 1950 Jul;60(1):200-4	278 non-breastfeeding women were assigned to one of 3 groups. Group F (N=139) received "forced fluids" from 2,500 to 5,000cc per day. Group R (N=89) received restricted fluids of < 1,500cc per day. The control group (N=50) received 1,500 to 2,500 cc per day. Engorgement was rated from the least description of "soft", to "filling", "full", "hard" to the most extreme of "hard, red and tender". The control group experienced the most frequent and extreme symptoms on days 3 and 4. The objective findings were similar in all three groups. The number of women requiring medication for pain relief was similar across groups at 42 – 43% with between 1.62 to 1.95 doses per patient needed. (The pain medication used in the study was 0.032gm of codeine with 0.65 gm of aspirin.)	III
Peters F, Del Pozo E, Conti A, Breckwoldt M. Inhibition of lactation by a long-acting bromocriptine. Obstet Gynecol. 1986 Jan;67(1):82-5	A dose response study of bromocriptine IM injections given to 122 postpartum women at doses of 20, 30, 40 and 50mgs after delivery. Breast engorgement, lactation and prolactin levels were measured during the next 22 days. Twelve breastfeeding women served as controls. The 50mg dosage (N=30) was reported to be 97% effective in suppression or prevention of lactation with a fall in plasma prolactin level from a basal level of 90ng/mL to an average of 13ng/mL from day 4 to 22. Women treated with 20 and 30mg had mixed results. Nine of these women experienced a fall in prolactin levels which remained below 25 ng/mL. Milk volumes measured in 4 of these women fell from an average of 360mL/day to 25mL/day or less by the 4^{th} post-partum day. Eleven women experienced only a brief fall in prolactin or no effect and the women continued to make an "average" milk volume. They describe one patient from the 20mg group who had a transient fall in prolactin (from 90 to 16 ng/mL) but then subsequently experienced breast engorgement followed by resumption of lactation and increase of prolactin above 25ng/mL. The authors	III

	speculate that a continued suppression of prolactin to levels < 25ng/mL is a "threshold" for persistent inhibition of lactation.	
Shrivastav P, George K, Balasubramaniam N, Jasper MP, Thomas M, Kanagasabhapathy AS. Suppression of puerperal lactation using jasmine flowers. Aust N Z J Obstet Gynaecol. 1988 Feb;28(1):68-71	Sixty women who delivered at 30 weeks or more and required lactation suppression due to either stillbirth or neonatal death were randomly divided into two groups. Group I was treated with 2.5 mg of bromocriptine every 8 hours for 5 days. Group II was treated with 50cm of stringed jasmine flowers kept in place over the breasts with loosely applied surgical adhesive. Flowers were replaced every 24 hours for 5 days. A lactation score was given based on both a milk production score and an engorgement score. Milk production was rated on a 4 point scale (0 – absent, 3 – abundant spontaneous secretion). Engorgement was rated on a 4 point scale (0 – none, 3 – severe pain, analgesics required). Prolactin levels were measured. Treatment was considered unsuccessful if after 72 hours the lactation score was 4 or higher. The lactation scores and analgesic use were similar in both groups. The fall in serum prolactin levels was significantly greater in the group treated with bromocriptine and jasmine flowers. Serum prolactin levels were not found to correlate with lactation scores.	II-2
	CHARACTERIZATION OF ENGORGEMENT & OTHER	
West CP, McNeilly AS. Hormonal profiles in lactating and non-lactating women immediately after delivery and their relationship to breast engorgement. BJOG. 1979;(86):501-6	Observational study of hormonal levels in the first 7 days postpartum in lactating(17) and non-lactating (25) mothers. Six non-lactating women experienced engorgement. Progesterone, estradiol, estrone, human placental lactogen and prolactin were measured on enrollment, within an hour of completion of the third stage of labor and daily for 6 days. There was no difference in any hormonal levels in those women who experienced engorgement compared to the other non-lactating women.	II-2
Humenick SS, Hill PD, Anderson MA. Breast engorgement: patterns and selected outcomes. J Hum Lact. 1994 Jun;10(2):87-93	Observational study following 114 breastfeeding women 14 days after birth and rating their symptoms of engorgement twice daily using a visual display. Mothers used a 6 point scale: 1=soft, no change, 2= slight change, 3= firm, non-tender, 4=firm, beginning tenderness, 5=firm, tender, 6=very firm and very tender. Four different patterns of engorgement were noted. Most (N=46) women experienced bell-shaped symptoms. Eighteen women experienced bimodal or multimodal symptoms. Twenty-three women experienced "intense" engorgement which peaked and continued for a longer period of time than other mothers. Twenty-seven experienced minimal engorgement with milder symptoms. The feeding frequency and duration was similar across groups during the first week. There was also no statistically significant	III

	difference between groups in the incidence of perceived insufficient milk supply by 20 weeks of lactation.	
Hill PD, Humenick SS. The occurrence of breast engorgement. J Hum Lact. 1994 Jun;10(2):79-86	Observational study evaluating engorgement over the first 14 postpartum days in 114 mothers using a visual display. Mothers used a 6 point scale: 1=soft, no change, 2= slight change, 3= firm, non-tender, 4=firm, beginning tenderness, 5=firm, tender, 6=very firm and very tender. The highest levels of engorgement were noted 5 days postpartum with 72% of women noting some tenderness. Ten percent of mothers experienced peak engorgement between day 9 and 14. The multiparous women delivering vaginally (N=31) noted more engorgement than the 56 first time mothers though there was no noted difference in the timing of peak engorgement. Their engorgement also appeared to resolve more rapidly than first time mothers. The nine women undergoing a second cesarean birth also noted more engorgement compared to 18 breastfeeding mothers undergoing a first cesarean birth. The time of peak engorgement was also earlier for second cesarean mothers.	III
Moon JL, Humenick SS. Breast engorgement: contributing variables and variables amenable to nursing intervention. JOGNN 1988 July/August: 309-15	54 women completed the study evaluating their subjective breast changes every 6 hours during the 78 hours after delivery. Thirty-nine women had vaginal births while 15 had cesarean delivery. Twenty-three were primiparous and 31 were multiparous. Thirty-five women experienced some breast changes within 78 hours. The number of hours until initial breastfeeding negatively correlated with the self-rated level of engorgement at 48 and 54 hours, especially in primiparous women. The number of feeding also correlated with engorgement at 48 and 54 hours. The cumulative number of minutes the infant breastfed by 48 hours negatively correlated with engorgement at 54 hours. Women undergoing cesarean showed engorgement later than those delivered vaginally.	III
Glover R. The engorgement enigma. Breastfeeding Review 1998; 6(2):31-34	Review of the endocrine and autocrine factors involved with the pathophysiology of engorgement. Application of knowledge to the prevention and management of engorgement stressing the importance of efficient, thorough and frequent milk removal. Discussion of assessing engorgement, identifying causes and management.	III (review)
Brzozowski D, Niessen M, Evans B, Hurst L. Breast-feeding after inferior pedicle reduction mammaplasty. Plast Reconstr Surg. 2000 Feb; 105(2):530-4	Breastfeeding practices were studies in a series of post-partum women who had undergone a prior reduction mammaplasty using the inferior pedicle technique. 78 women patients from their series had children. 15 (19.2%) exclusively breastfed for 2 weeks post-partum, 8 (10.3%) breastfed with supplementation, 14 (17.9%) were unsuccessful and 41 (52.6%) did not attempt breastfeeding. Of the 41 patients who did not attempt breastfeeding, 31 patients experienced post-partum breast engorgement and lactation.	III

Lurie S, Rotmensch N, Glezerman M. Breast engorgement and galactorrhea during magnesium sulfate treatment for preterm labor. Am J Perinatol. 2002 Jul;19(5):239-40	Case report of breast engorgement and galactorrhea occurring during tocolysis at 30 weeks gestation using magnesium sulfate. Symptoms began on day 4 of magnesium therapy. Prolactin level at that time was 83.6 ng/ml. Tocolytic therapy was changed to nifedipine and these symptoms disappeared.	III
Shalve J, Frankel Y, Eshkol A, Serr DM. Breast engorgement and galacotrrhea after preventing premature contractions with ritodrine. Gynecol Obstet Invest. 1984;17(4):190-3	An observational study of 11 women undergoing tocolytic therapy with ritodrine was performed evaluating hormonal levels of prolactin, progesterone, estradiol and estriol. Prolactin levels were measured prior to administration of the ritodrine and at 4, 12, 24, 36, 48 and 60 hours after initiation of therapy. Progesterone was measured at baseline and 24 or 36 hours after therapy. Estradiol was measured prior to treatment and at 24 hours. Six women also had a 24 hours urine collection for estriol excretion done during the 6 days of therapy. Nine of the eleven women complained of breast engorgement within 12 to 50 hours of initiation of the ritodrine while 6 experienced galactorrhea. Prolactin levels measured before and after ritodrine were not statistically different. Only one women had a significantly higher prolactin level after therapy. There was also no statistically significant difference in pre and post treatment levels of progesterone. Estradiol levels were unchanged in 4 women but fell in 6. There was a wide variation in these levels. Estriol levels increased in 2 women, was unchanged in 3 and fell in one. Overall there were no predictable differences in hormonal levels following ritodrine treatment which could explain the engorgement.	III
Hardwick-Smith S, Mastrobattista JM, Nader S. Breast engorgement and lactation associated with thyroid-releasing hormone administration. Obstet Gynecol. 1998 Oct;92(4 Pt 2):717	A case report of a women undergoing tocolysis with magnesium sulfate. Beta-methasone and thyroid releasing hormone (400µg every 8 hours x 4 doses) were used in an attempt to enhance fetal lung maturity. Thirty-Six hours after administration of the last TRH dose the patient complained of breast engorgement. A prolactin level drawn at the time of her symptoms was 55.4mg/ml (normal for pregnancy) and her symptoms resolved in 96 hours. The authors speculated that the transient increase of prolactin associated with TRH administration in addition to the TRH induced release of oxytocin may have been responsible for this patient experiencing engorgement during her tocolytic therapy.	III
Martin RH, Oakey RE. The role of antenatal oestrogen in post-partum human lactogenesis: evidence from oestrogen-deficient pregnancies. Clin Endocrinol. 1982 Oct;17(4):403-8	The authors describe hormone levels and initiation of lactation in 5 women with severe ante-partum estrogen deficiency (as measured by urinary oestrogen excretion of < 20 µmol/day). Four of these women had placental steroid sulphatase deficiency and one was related to an unknown cause. Levels of prolactin, α-lactalbumin, oestradiol and progesterone in plasma were measured during the first 10 days post-partum. Despite attempts to breastfeed, the prolactin levels were low and were similar to those of normal	III

	bottle feeding women. The mean concentration of α-lactalbumin of oestrogen deficient women on day 4 was 420µg/l and was significantly less then either normal bottle feeding (1246 µg/l) or breastfeeding (1100 µg/l) mothers. Three of the 5 women attempted to breastfeed but were unsuccessful. A review of 9 other cases of women with placental steroid sulfatase deficiency showed that 6 of the women were unsuccessful in establishing lactation and the remaining 3 who chose to bottle feed did not experience engorgement. The authors speculate that adequate antenatal oestrogen levels are required for adequate prolactin secretion and for successful lactogenesis in response to prolactin.	
Simkin P, Intermittent brachial plexus neuropathy secondary to breast engorgement. Birth 1988 Jun;15(2):102-3	A case report of a 30yo pateitn who experienced numbness, tingling and weakness of bilateral upper extremities starting approximately 3 days after delivery. Her symptoms were noted to improve temporarily after feedings and were not related to position. Her symptoms improved after two weeks time as her engorgement subsided.	III
Neifert M, DeMarzo S, Seacat J, young D, Leff M, Orleans M. The influence of breast surgery, breast appearance, and pregnancy-induced breast changes on lactation sufficiency as measured by infant weight gain. Birth 1990 Mar;17(1):31-8	A prospective study of factors associated with onset of lacation in 319 primiparous women and infant weight and maternal engorgement in the first 2 weeks post-partum. Women who reported only minimal breast enlargement when their milk came in were more likely to have insufficient milk supply ($P < 0.001$) as defined by infant weight gain of < 28.5 g/d between 2 consecutive visits. In women with sufficient milk as defined by this study, 51.7% experienced moderate engorgement (1 cup size) and 25.1% experienced marked engorgement (> 1 cup size), while only 23.2% noticed less than 1 cup size increase in their breasts. In women with insufficient milk supply however, 33.3% noted moderate engorgement, 27.1% noted marked engorgement and 39.6% noted < 1 cup size increase.	II-3
Neifert MR, Seacat JM, Jobe WE. Lactation failure due to insufficient glandular development of the breast. Pediatrics. 1985 Nov;76(5):823-8	Case report describing features of 3 women with lactation failure believed to be due to insufficient glandular tissue. Two of these women described failure of post-partum breast engorgement. These women also underwent diaphanography (light scanning) and were noted to have increased through transmission of light. This finding was suggested by the author's to be consistent with the clinical impression of insufficient glandular tissue. Serum prolactin levels were elevated in all three women.	III
Brook OR, Guralnik l, Keidar Z, Gaitini DE, Engel A. Ptifalls of the lactating breast on computed tomography. J Comput Assist Tomogr. 2004 Sep-Oct;28(5):647-9	Case report of computed tomography (CT) findings in three post-partum women with breast engorgement. The three women were 4 weeks, 6 and 8 months postpartum at the time of CT. All women had reported recent interruption or discontinuation of breastfeeding due to their other health concerns. Two of the three women reported symptoms of engorgement. Authors noted that findings on CT included enlargement with "cord" and "mass-like hypoattenuation".	III

Mass S. Breast Pain: Engorgement, Nipple Pain and Mastitis. Clin Obstet Gynecol. 2004 Sep;47(3):676-82	Review article regarding engorgement. Discusses the physiology relating to breast engorgement. Defines pathologic engorgement and delineates causes, management and treatment strategies.	III
Thomsen AC, Espersen T, Maigaard S. Course and treatment of milk stasis, noninfectious inflammation of the brest, and infectious mastitis in nursing women. Am J Obstet Gynecol. 1984;149:492-495	213 women with symptomatic breast inflammation were studied. Symptoms included swelling, redness, heat, and decreased milk secretion. Milk samples were collected and evaluated for bacteria and leukocyte count. Cases were then classified according to bacterial counts; milk stasis was defined as $<10^6$ leukocytes and $<10^3$ bacteria per milliliter of milk. Non-infectious inflammation was defined as $>10^6$ leukocytes and $<10^3$ bacteria per ml and infectious mastitis was defined as $>10^6$ leukocytes and $>10^6$ bacteria per ml. 63 women with milk stasis received no treatment while 63 women received treatment with emptying of the breast. The mean duration of symptoms was 2.3 days without treatment and 2.1 day with treatment. "Poor" lactation occurred in 6 patients without treatment and 4 patients with treatment while the remaining participants in both groups had "normal lactation". Noninfectious inflammation was treated with no therapy in 24 cases and with breast emptying in the remaining 24 cases. The mean duration of symptoms without treatment in this group was 7.9 days while the treated group was symptomatic for 3.2 days. "poor" outcome occurred in 19 women in the untreated group while only one women treated with breast emptying had this result.	II-2